Courses and Degrees
1964-65

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UNIVERSITY CALENDAR

1964

Autumn Quarter

Sept. 28–29 Monday–Tuesday Registration
Sept. 30 Wednesday Instruction begins
Oct. 2 Friday Conferring of degrees
Oct. 4 Sunday Matriculation Sunday
Oct. 20 Tuesday Last day for registration
Oct. 27 Tuesday Last day for filing advanced degree applications:
A.M., M.S., Engineer for April conferral; Ph. D.
for June

Nov. 3 Tuesday Last day for filing Ph.D. Plan A dissertations
Nov. 26–29 Thursday–Sunday Thanksgiving Recess
Dec. 1 Tuesday Last day for filing A.B. and B.S. applications
Dec. 14 Monday Last day for filing theses and Plan B dissertations
Dec. 14–18 Monday–Friday End-quarter examinations

1965

Winter Quarter

Jan. 4 Monday Registration
Jan. 5 Tuesday Instruction begins
Jan. 8 Friday Conferring of degrees
Jan. 15 Friday Last day for filing Fellowship and Graduate Scholar-
ship applications
Jan. 25 Monday Last day for registration
Feb. 1 Monday Last day for filing A.B. and B.S. applications for
April and June conferral
Feb. 1 Monday Last day for filing advanced degree applications:
A.M., M.S., Engineer for June conferral; Ph.D.
(Plan B) for October
Feb. 8 Monday Last day for filing Ph.D. Plan A dissertations
Feb. 22 Monday Washington’s Birthday (Holiday)
Mar. 9 Tuesday Founders’ Day
Mar. 15 Monday Last day for filing theses and Plan B dissertations
Mar. 15–19 Monday–Friday End-quarter examinations

Spring Quarter

Mar. 29 Monday Registration
Mar. 30 Tuesday Instruction begins
Apr. 2 Friday Conferring of degrees
Apr. 19 Monday Last day for registration
Apr. 19 Monday Last day for filing Ph.D. Plan A dissertations
Apr. 26 Monday Last day for filing advanced degree applications:
A.M., M.S., Engineer for October conferral; Ph.D.
for January
May 1 Saturday Last day for filing Undergraduate Scholarship appli-
cations, matriculated undergraduates
June 3 Thursday Last day for filing theses and Plan B dissertations
June 4–9 Friday–Wednesday End-quarter examinations
June 12 Saturday Senior Class Day
June 13 Sunday Baccalaureate Sunday
June 13 Sunday Commencement

Summer Quarter

June 21 Monday Registration
June 22 Tuesday Instruction begins
July 5 Monday Holiday for Independence Day
Aug. 13–14 Friday–Saturday Eight-week term examinations
Aug. 14 Saturday Eight-week term closes
Aug. 31 Tuesday Quarter closes
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This section describes requirements for degrees which apply to all students at Stanford University. Special departmental or school requirements are described in the section on the school or department itself.

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

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

GENERAL STUDIES PROGRAM

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

The General Studies Program, inaugurated at Stanford in 1956, is directed toward satisfying these aims and is the product of intensive study. They combine to create a better society and a more rewarding individual pattern for living. The General Studies Program is spread over the entire four years of undergraduate work, permitting flexibility in planning individual programs of study. A student may spend much of the first two years in fulfilling General Studies requirements, or he may begin specialization early and carry both his major and General Studies courses for four years.

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

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

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

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

A. BASIC REQUIREMENTS FOR ALL STUDENTS

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

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

B. AREA REQUIREMENTS FOR ALL STUDENTS

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

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

   * Only courses listed in the General Studies Bulletin may be used in fulfillment of this requirement.
2. Social Sciences—Two 5-unit General Studies courses selected from the following:
   a) Anthropology 1
   b) Communication 1
   c) Economics 1
   d) Geography 1
   e) Political Science 1
   f) Psychology 1
   g) Sociology 1

3. Natural Sciences—Students who have not taken biology in high school will take Biology 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 (or 4)
   c) Physical Sciences 1, 2, 3
   d) Physics 21, 23, 29; 51, 52, 53, 54, 55, 56
   e) Geology 1, 2
   f) Mathematics 10, 11, 21, 22, 23; 41, 42, 43; 52, 53; 62, 63
   g) Philosophy 3 (Logic)
   h) Statistics 50
   i) Psychology 60
   j) Anatomy 114
   k) Physiology 90, 91
   l) Physical Sciences 50, 100
3. **Senior Colloquia**—Two colloquia of 2 units each, as listed in the *Time Schedule*, under “Senior Colloquia.” No more than two may be taken for credit. The following A.B. candidates are exempt from the Senior Colloquia requirement:

a) Students taking their senior year of undergraduate study as their first year in the School of Law and School of Medicine.
b) Students enrolled in 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, Engineering, or Nursing, or Departments of Chemistry, Mathematics, Physical Sciences, Physics, Physiology, or Statistics receive the degree of Bachelor of Science; candidates who fulfill these requirements in other schools or departments receive the degree of Bachelor of Arts.

Forty-five units constitute a normal year’s work. The degree is conferred whenever the requirements are met, provided the candidate has spent three quarters in resident study and completed at least 45 units (including the last 15) in this University. In special cases, students who have obtained at least 135 units in resident work,
DEGREES

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

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

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

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

ADVANCED DEGREES

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

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

Each student should consult his major department and examine its section in this Bulletin regarding specific departmental requirements for advanced degrees. All applications or petitions to the University Committee on the Graduate Division must be submitted to the major department for approval before being filed with the Graduate Study Secretary. Communications should be addressed to the Graduate Study Secretary, Registrar's Office, Stanford University, Stanford, California.

Candidacy for A.M., M.S., Engineer, and Ph.D. degrees must be approved by the University Committee on the Graduate Division. Candidacy is valid for five years from date of such approval and may be renewed by the submission and approval of a new application.

Bachelor of Architecture

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

Master of Arts or Master of Science

Upon recommendation to the Academic Council by the faculty of the major department and the University Committee on the Graduate Division, the degree of Master of Arts (A.M.) or Master of Science (M.S.) is conferred on candidates who have satisfactorily completed at least one academic year (three quarters) of work as a graduate student at this University, presented an acceptable thesis (unless this requirement is waived), and fulfilled such other requirements as may be prescribed by the
DEGREES

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.

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 completed the required curriculum in medicine. (Full information concerning requirements for the M.D. degree will be found in the School of Medicine Bulletin.)

Doctor of Philosophy

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

A minimum of three years (nine quarters) of graduate registration satisfactorily completed is required of each candidate. The minimum 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 completed at least two years of acceptable work elsewhere as a graduate.

**Admission to Candidacy**—When a student has completed the major department’s required preliminary procedures, and has completed the reading requirement in at least one foreign language, the major department may certify him to the University Committee on the Graduate Division for admission to candidacy. If the student’s program includes a minor, certification by the minor department is also required. If the student offers no minor, his application must show at least three units of work taken (or to be taken) as a graduate under each of four or more Stanford faculty members. Application for admission to candidacy is made on Form G34, which must be filed with the Graduate Study Secretary not later than the fourth week of the final three quarters of candidacy. Candidacy, when approved by the University Committee, is valid for five years and may be renewed by the submission and approval of a new application.

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

**University Oral Examination**—When a candidate has been admitted to candidacy, and has shown special ability in his field of study and proved his capacity for independent investigation to the satisfaction of the schools or departments concerned, he may arrange through the Graduate Study Secretary for the University oral examination. This examination shall not exceed three hours in length. It shall not be held during the first two weeks in any quarter or after the last day of instruction in any quarter. The request for an oral examination must be submitted to the Graduate Study Secretary on Form G21 at least three weeks prior to the date proposed for the examination. The purpose of the examination is to test the candidate’s command of his fields of study and to confirm his fitness for scholarly pursuits. The examining committee shall be composed of (1) the Dean of the Graduate Division or his delegate, presiding, (2) four or more faculty members appointed by the Dean of the Graduate Division from the major and minor departments, (3) any additional representatives selected by the major and minor departments and the Dean of the Graduate Division, and (4) any members of the Academic Council who may attend. On the favorable vote of three-fourths or more of the examining committee (including the presiding chairman), the candidate shall be certified as having passed the examination.

Five members present and voting, including 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. Dissertation research and preparation may proceed under Plan A or Plan B, described in the following para-
graphs. A dissertation will automatically be under Plan A unless the candidate petitions for Plan B, using Form G59 for that purpose.

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

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

After its final acceptance, the dissertation shall be microfilmed and bound at the direction of the Graduate Study Secretary. A negative microfilm copy of the dissertation shall be kept on file by University Microfilms (in Ann Arbor, Michigan), from whom positive microfilm copies may be ordered. When bound, the original copy will be sent to the author, the first two carbon copies to the Stanford University Library, and the third carbon copy to the major department.

Directions regarding the form of the dissertation, title and signature pages, and the abstract may be obtained from the Graduate Study Secretary. The abstract (600 words or fewer in length) shall be published in Dissertation Abstracts by University Microfilms. The candidate shall be charged a $40 fee to cover the cost of microfilming the dissertation, binding four copies of the dissertation, and publishing the abstract. This fee is payable at the Cashier's office on or before the last day of instruction in the final quarter of candidacy.
COURSES of INSTRUCTION

1964-65

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 1965 will be eight weeks in length, except in certain schools which will offer ten-week courses.

This announcement includes, for the Summer Session of 1965, 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 1965.

GRADUATE SCHOOL OF BUSINESS

Dean: Ernest Comings Arbuckle

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

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

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

The School of Business also offers a Doctoral Program leading to the Ph.D. degree for individuals interested in preparing themselves for college teaching and/or research. Doctoral applicants should write to Professor Oscar N. Serbein, Director, Doctoral Program, Graduate School of Business, Stanford University, for separate bulletins and application forms.
The School of Earth Sciences includes the Departments of Geology, Geophysics, Mineral Engineering, and Petroleum Engineering.

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

**UNDERGRADUATE PROGRAM**

**Faculty Adviser**—A student may enter the School of Earth Sciences when he selects one of the Earth Sciences fields for his major program. Upon entering the School, a student should report to the head of his department, who will designate a member of the faculty to act as his adviser. The adviser will aid the student in the selection of courses and will serve as consultant during his scholastic career. The adviser's approval of the study plan must be obtained before registration is completed at the beginning of each quarter.

**Requirements**—Specific requirements for the Bachelor of Science degree are listed below for each department. As a general requirement for the School, a student's mean grade in required courses in each of the fields of mathematics, chemistry, physics, and earth sciences must be C or better.

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

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

**GRADUATE PROGRAM**

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

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

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

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

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

GEOLOGY

Emeritus: Eliot Blackwelder (Professor)

Executive Head: Arthur D. Howard

Professors: Robert Ross Compton, William Robert Evitt, Joseph J. Graham, Arthur David Howard, M. King Hubbert (Geology and Geophysics), Colin Osborne Hutton (Mineralogy), Konrad Bates Krauskopf (Geochemistry), Siemon William Muller, Benjamin Markham Page, Charles Frederick Park, Jr. Consulting: Harold W. Hoots, Adolph Knopf

Associate Professors: Stanley Nelson Davis, William R. Dickinson (on leave 1964-65), John W. Harbaugh, Myra Keen (on leave 1964-65)

Assistant Professor: Paul H. Reitan (Mineralogy)


PROGRAMS OF STUDY

Bachelor of Science

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

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

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

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

Total: 62

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 70. Introduction to Geochemistry</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>At least 5 additional units in geology</td>
<td>Any</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geophysics 190. General Geophysics</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56. Elementary Physics</td>
<td>WSA</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Mathematics 21, 22. Calculus</td>
<td>Any</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Mathematics 23, or Statistics 50 or 110</td>
<td>Any</td>
<td>3-5</td>
<td></td>
</tr>
<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</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 70, 170. Geochemistry</td>
<td>AW</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Geology 179. Physics of Underground Fluids</td>
<td>W</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 116. 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 123, Optical
Mineralogy; Geology 160, Elementary Stratigraphy; Geology 182, Geology of Petroleum; Geology 183, Ore Deposits; Geology 184, Engineering Geology; Geology 185, Hydrogeology.

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

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

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

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

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

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

c) Geology 150 a, b, c and 6 units of Geology 155.

d) At least 13 units of advanced course work in geology or related fields.

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

Master of Science

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

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

1. Be registered in the graduate school for at least three quarters.

2. Complete 45 units, at least 6 of which must be independent work on a research problem. Certain courses such as Geology 225 and Geology 383 may be taken to satisfy all or part of the research requirement. Units from School of Earth Sciences courses with grades of D will not be counted toward the required 45 units of work, and the average of all grades must be a B or better.
3. Make up deficiencies in previous training. Previous training should be approximately equivalent to one of the three curricula leading to the B.S. degree in Geology at Stanford. Not more than 10 units of such work may be counted as part of the minimum total of 45 units. Geology 123 and 124 (or equivalents) and one course in economic geology must be taken, if these courses or equivalents have not previously been completed.

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

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

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

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

These courses must be junior, senior, or graduate courses (courses numbered 100 or higher) with the following exceptions: 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 200, 300, and 400 series ordinarily are not open to undergradu-
ates. Courses in the summer quarter are offered for a ten-week period unless other-
wise 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, (Compton), 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, (———), MWF 8; lab., field trips by arrangement
- spring, (———), MWF 9; lab., field trips by arrangement

#### 103. Geologic Problems

Supervised reading, written reports thereon.

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

#### 105. Structural Geology

Folds, faults, other structural features in outer part of the earth. Prerequisites: I and 51.

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

#### 107. Geologic Field Techniques

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

- 3 units, spring, (Rich), by arrangement

#### 108. Field Geology I

First half of summer (mid-June to mid-July) will be spent in an area consisting mainly of sedimentary rocks, generally in one of the California coast ranges. Geology will be plotted on topographic maps and aerial photographs. A report, prepared at Stanford during the latter half of August, will include a complete stratigraphic and structural description of the entire area covered by the class. (For second half of summer field work, see 109.) (Open to women students if two or more women register.) Prerequisites: 1, 2, 25, 51, 105, 107.

- 8 units, summer (first half), (Compton)

#### 109. Field Geology II

Second half of field season (mid-July to mid-August) will be spent in Nevada or eastern California, in an area of metamorphic and igneous rocks. (Open to women students if two or more women register.) Prerequisite: 108.

- 7 units, summer (second half), (Compton)

#### 116. Physical Oceanography

Prerequisites: Mathematics 22, Chemistry 3.

- 4 units, spring, (Harbaugh, Krauskopf, Saur, Thompson), MTWTh 8
133. Principles of Geomorphology—Land forms; processes which create, modify them. Prerequisite: 1. Recommended: 2, 51, 70.
4 units, autumn, (Howard), MW F 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), MW F 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

5 units, spring, (Hubbert), MTWThF 11

3 units, autumn, (Harbaugh), by arrangement

205. Research in Computer Applications in Geology—Guidance in development of methods for treating student's individual research data. Review of literature of statistical methods and of computer applications in geology. One seminar-type meeting per week.
1 to 5 units, winter, (Harbaugh), by arrangement

210. Geology of California.
3 units, spring, (Muller), TTh 11, F 1:15-4:05

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), MW F 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, spring, (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 11; seminar W 4:00-5:30

337. Seminar in Geomorphology.
2 units, winter, (Howard), by arrangement

361. Permafrost (Geocryology)—Engineering problems in permanently frozen ground. Open to graduate students, others by permission of instructor.
2 units, winter, (Muller), W 1:15-3:05

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. Approximately 100 of the more common rock-forming and ore-forming minerals. Introduction to the chemistry of silicates and mineral associations. Prerequisites: 1 and/or Chemistry 1 (either may be taken concurrently).

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

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

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

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

3 units, autumn, (Krauskopf), MWF 8

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

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

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

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

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

4 units, spring, (Reitan), MWF 11; seminar by arrangement

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

3 units, spring, (Harbaugh), TTh 10; one lab., field trips by arrangement

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

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

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

4 units, spring, (Dickinson), M 1:15-4:05; two labs. by arrangement, to be given in 1965-66

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: 124, and permission of instructor.

5 units, spring, (Hutton), Th 10; lab. TTh 1:15-4:05 and two labs. by arrangement

224. Advanced Petrology—Advanced topics of igneous and metamorphic petrology. Prerequisites: 105 and 124.

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

270. Geochemistry of Ore Solutions—Prerequisites: 170 and 183.

2 units, spring, (Krauskopf), by arrangement
407. Seminar in Geochemistry.  
2 units, spring, (Krauskopf), by arrangement  
Spectrographic Analysis—See Mineral Engineering 205.

### Paleontology and Stratigraphy

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Semester</th>
<th>Instructor(s)</th>
<th>Time(s)</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Curatorial Methods in Paleontology</td>
<td>1</td>
<td>spring</td>
<td>(Keen)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Elementary Paleontology—Prerequisite: 2.</td>
<td>5</td>
<td>autumn</td>
<td>(Muller)</td>
<td>MWF 10; lab. W 2:15-5:05</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>Systematic Invertebrate Paleontology—Mollusca, Echinodermata, Coelenterata.</td>
<td>5</td>
<td>winter</td>
<td>(Keen)</td>
<td>MWF 9; lab. W 2:15-5:05 and two labs. by arrangement, to be given in 1965-66</td>
<td>112.</td>
</tr>
<tr>
<td>114</td>
<td>Systematic Invertebrate Paleontology—Brachiopods, Graptolites, Trilobites.</td>
<td>4</td>
<td>autumn</td>
<td>(Evitt)</td>
<td>TTh 9; two labs by arrangement</td>
<td>112.</td>
</tr>
<tr>
<td>115</td>
<td>Biological Oceanography</td>
<td>4</td>
<td>autumn</td>
<td>(Keen)</td>
<td>MTWTh 9, to be given in 1965-66</td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>Introduction to Micropaleontology—Principles, techniques of preparation, classification of various fossil plants and animals. Two lectures and two laboratory periods per week. Prerequisite: 113 or equivalent.</td>
<td>5</td>
<td>autumn</td>
<td>(Graham)</td>
<td>lab. lec. and lab. by arrangement</td>
<td>113.</td>
</tr>
<tr>
<td>160</td>
<td>Elementary Stratigraphy—Classification of stratigraphic units, facies, unconformities, and principles of correlation. Prerequisite: 105. Recommended: 112.</td>
<td>3</td>
<td>winter</td>
<td>(Muller)</td>
<td>TTh 10; lab. M 1:15-4:05</td>
<td></td>
</tr>
<tr>
<td>218</td>
<td>Research in Micropaleontology—Prerequisite: 118.</td>
<td>5</td>
<td>spring</td>
<td>(Graham)</td>
<td>MTWTh 10; lab. by arrangement</td>
<td>118.</td>
</tr>
<tr>
<td>316</td>
<td>Palynology I—Introduction to study of microfossils smaller than 200 microns.</td>
<td>5</td>
<td>winter</td>
<td>(Evitt)</td>
<td>by arrangement</td>
<td>315.</td>
</tr>
<tr>
<td>317</td>
<td>Palynology II—Continuation of 316.</td>
<td>5</td>
<td>spring</td>
<td>(Evitt)</td>
<td>by arrangement</td>
<td>316.</td>
</tr>
<tr>
<td>367</td>
<td>Seminar in Paleontology and Stratigraphy—Limited enrollment by approval of instructors. Normally for second-, third-year graduates.</td>
<td>2</td>
<td>each quarter</td>
<td>(Staff)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>182</td>
<td>Geology of Petroleum—Principles of occurrence, origin, and accumulation of petroleum. Laboratory consists of directed individual work in subsurface exploration in California's Sacramento Valley. Use of digital computer in analysis of subsurface data. Two and a half-day field trip to Ventura Basin.</td>
<td>4</td>
<td>winter</td>
<td>(Harbaugh)</td>
<td>MWF 11</td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>Ore Deposits—Principles of occurrence, processes of deposition, structure of ores. Prerequisites: 51 and 105.</td>
<td>5</td>
<td>autumn</td>
<td>(Park)</td>
<td>MTWTh 10; lab. field trips by arrangement</td>
<td>182.</td>
</tr>
<tr>
<td>184</td>
<td>Engineering Geology—Application of geology to engineering practice in construction of dams, highways, foundations, etc. Prerequisite: 1. Recommended: 25, 51, and 105.</td>
<td>3</td>
<td>autumn</td>
<td>(Davis)</td>
<td>TTh 8; lab. by arrangement</td>
<td>183.</td>
</tr>
<tr>
<td>185</td>
<td>Hydrogeology—Chemical composition, movement, utilization of underground water. Prerequisites: 1, Physics 21 or 51, and Mathematics 22. Recommended: 2, 105.</td>
<td>5</td>
<td>winter</td>
<td>(Davis)</td>
<td>MWF 8; seminar M 2:15-4:05; lab. W or Th 1:15-4:05</td>
<td>185.</td>
</tr>
</tbody>
</table>

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

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

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


1 unit, autumn, (Harbaugh), by arrangement

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

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

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

2 units, autumn, (Park), by arrangement

487. Seminar in Hydrogeology.

2 units, autumn, (Davis), by arrangement

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

GEOPHYSICS

Executive Head: Joshua Lawrence Soske

Professors: Joshua Lawrence Soske, George Albert Thompson. Visiting: Seiya Uyeda

Assistant Professor: To be announced

Research Associates (by courtesy): Allan V. Cox, Richard R. Doell

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>Chemistry 1, 2, 3. General Chemistry</td>
<td>AWS</td>
<td>13</td>
<td></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 70. 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 116, 123, 124, 170, 179; Physics 120, 121, 122 and Mathematics 45, 46, 132.

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

**Master of Science**

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

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

1. Be registered in the graduate school for at least three quarters.
2. Complete 45 units with at least a B average. At least 6 of these units must be independent work on a research problem.
3. Make up deficiencies in previous training. Not more than 10 units of such work may be counted as part of the minimum total of 45 units.
4. Demonstrate by examination his ability to read geologic literature in a foreign language. The examination must be passed no later than the date of filing for the Master of Science degree.

**Doctor of Philosophy**

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

Requirements for the Degree—A minimum of three years (nine quarters) of graduate study must be satisfactorily completed. At least one of these years, ordinarily the
last, must be spent as a registered student at Stanford. The candidate must demonstr-

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.


t 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, (——), 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

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

250a. 3 units, autumn, (Uyeda), MWF 10

250b. 3 units, winter, (Uyeda), MWF 11


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

292. Gravity Measurements—Origin and geologic interpretation of gravity anom-

alies: methods of analysis applicable to gravity measurements. Prerequisites: 191, Geology 105, Mathematics 23, and Physics 55.

3 units, spring, (Thompson), 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

301. Problems in Geophysics.

Each quarter, (Staff), by arrangement

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

5 units, winter, (Thompson), MWF 9; lab., and 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

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>Engr. 11</td>
<td>Engineering Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Engr. 12</td>
<td>Engineering Mechanics</td>
<td>4</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 .................................................. 126
# MINERAL ENGINEERING

## 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. 183</td>
<td>Ore Deposits</td>
<td>5</td>
</tr>
<tr>
<td>Engr. 9</td>
<td>Engineering Drawing</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 114</td>
<td>Elementary Problems in Mining Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 115</td>
<td>Mine Exploration</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 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>C.S. 136</td>
<td>Use of Automatic Digital Computers</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133</td>
<td>Industrial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>54</strong></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>Chem. 171, 173, 175</td>
<td>Physical Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>Engr. 50</td>
<td>Introductory Science of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Math. 24</td>
<td>Analytical Geometry and Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 130b</td>
<td>Transport Phenomena</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 121</td>
<td>Solid State Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 122</td>
<td>Solid State Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 127</td>
<td>Crystallography and X-Ray Analysis, or Geol. 123</td>
<td>Optical Mineralogy, or Min.E. 205. Spectrochemical Analysis</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>Mathematics, Statistics or Computer Science (See Note 3)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>54-55</strong></td>
</tr>
</tbody>
</table>

## 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>Price Theory and Policy</td>
<td>5</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133</td>
<td>Industrial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>Lang. 1, 2, 3</td>
<td>Modern European Language</td>
<td>12</td>
</tr>
<tr>
<td>Phil. 3</td>
<td>Introduction to Logic</td>
<td>5</td>
</tr>
<tr>
<td>Pol.Sci. 1</td>
<td>Major Issues of American Public Policy</td>
<td>5</td>
</tr>
<tr>
<td>and Group A or B below:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A (Mining)
Geol. 51. Elementary Petrology .................................................. 5
Geol. 105. Structural Geology .......................................................... 5
Geol. 183. Ore Deposits ................................................................. 5
Electives ....................................................................................... 8
Total ......................................................................................... 56

B (Chemical and Extractive Metallurgy)
Chem. 171, 173. Physical Chemistry .................................................. 6
Min.E. 107. High Temperature Laboratory, or Min.E.190. Physical Chem-
istry of Metal Refining, and Min.E. 216. Mineral Processing Seminar
(Engineering) .............................................................................. 6-7
Electives ....................................................................................... 9
Total ......................................................................................... 54-55

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. 70 and 170</td>
<td>Geochemistry</td>
<td>6</td>
</tr>
<tr>
<td>Stat. 116</td>
<td>Theory of Probability</td>
<td>4</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. 123</td>
<td>Materials Science Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 124, 125</td>
<td>Structural Control in Materials</td>
<td>7</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 24 and Physics 110 and 111. Mathematics 130 is recommended with these.

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

*Note 3*—Statistics 110, Computer Science 136, or a Mathematic elective will satisfy this requirement.

**GRADUATE PROGRAMS OF STUDY**

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

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

Candidates for the degree of Doctor of Philosophy in Mineral Engineering are normally those preparing for careers in education or basic research. Department programs at this level are very flexible but place emphasis on advanced study in the basic sciences and on creative research.

Graduate students must maintain a B average in the School of Earth Sciences and equivalent status in other schools.

Master of Science

Specific requirements

1. Complete 45 units, at least six of which must be independent work on a research program; be registered in the graduate school for at least three quarters.

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

Courses Required for the Master's Degree

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.E. 215</td>
<td>Mineral Economics</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 300a or b.</td>
<td>Advanced Work</td>
<td>6</td>
</tr>
</tbody>
</table>

Mining Option

I.E. 133a or Business 210-11. Industrial or Management Accounting .............. 6
Min.E. 230. Mining Seminar ......................................................... 4
Min.E. 231. Mining Seminar ......................................................... 4
Min.E. 232. Mining Seminar ......................................................... 4
Electives .................................................................................. 18

Mineral Processing Option

Min.E. 203. Advanced Solid Separations: Principles ................................. 4
Min.E. 216. Mineral Processing Seminar (Engineering) .............................. 2
Min.E. 217. Mineral Processing Seminar (Research) .................................. 2
Min.E. 223. Equilibria and Kinetics in High Temperature Reactions, or
Min.E. 226. Corrosion and Electrometallurgy ........................................ 3
Min.E. 225. Surfaces and Interfaces, or Min.E. 227. Equilibria and Kinetics
in Aqueous Systems ........................................................................ 3
Electives .................................................................................. 22

Chemical and Extractive Metallurgy Option

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

Bus. 200-01. Business Economics ........................................ 6
Bus. 210-11. Management Accounting .............................. 6
Bus. 271. Employment Relationships ................................. 3
Mineral Engineering Electives ........................................... 6
Electives ........................................................................... 8

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>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 a or b.</td>
<td>Advanced Work (Thesis)</td>
<td>10</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

* In addition to requirements for Master's degree.

Doctor of Philosophy

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

Prior to applying for admission to candidacy the student must (1) demonstrate mastery of his option and related subjects by passing a written qualifying examination usually taken during the first year of residence, and (2) within one year after passing the written examination, demonstrate a high level of proficiency in his option by passing a Departmental oral examination, and (3) should he elect as his option Mineral Processing or 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 various processes used in 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 171 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: 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

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

4 units, winter, (Just), by arrangement

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

2 units, winter, (Just), by arrangement

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, even numbered years, (Staff), by arrangement

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, odd numbered years, (Staff), by arrangement

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, and the vacuum refining of steels and 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. Prerequisites: 103 or equivalent. Chemistry 175, Geology 25, and Engineering 50 recommended.

4 units, autumn, (Parks), MWF 11; one recitation section by arrangement
205. Spectrochemical Analysis—Fundamentals of spectrochemical analysis and its application to study of rocks and minerals. Enrollment limited to 6. Prerequisite: consent of instructor required.
5 units, autumn, (Reitan), MW 9; lab. MW 1:15-4:05 and one lab. 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 123 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.
3 units, spring, (Just), by arrangement

216. Mineral Processing Seminar (Engineering)—Lectures, guest speakers, and student seminars on Mineral Processing topics, emphasizing engineering and economic aspects. Open to undergraduates by permission. May be repeated with credit. Prerequisite: 103. In addition Speech 20 recommended.
1 to 2 units, winter, (Parks), by arrangement

217. Mineral Processing Seminar (Research)—Weekly meetings for critical review of current literature and research. Occasional guest speakers. Open to undergraduates by permission. May be repeated with credit.
1 to 2 units, spring, summer, (Parks), by arrangement

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

3 units, summer, (Parlee), by arrangement, to be given in even numbered years

224. Physical Chemistry of Metals Seminar—Lectures, student seminars, guest speakers on topics in the physical chemistry of metals. Can be repeated with credit.
1 to 3 units, summer, (Parlee), by arrangement, to be given in odd numbered years

225. Surfaces and Interfaces—A general study of solid-gas and solid-electrolyte interfaces. Applications in froth flotation of 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, to be given in alternation with 227 in odd numbered years

226. Corrosion and Electrometallurgy—Electrochemical principles with applications to corrosion, electrolytic processes and energy conversion cells. (Same as Mat.Sci. 226.) Prerequisite: Chemistry 173.
3 units, winter, (Shepard), MWF 9

227. Equilibria and Kinetics in Aqueous Systems—Review and development of concepts useful in predicting probability, extent and rate of heterogeneous reactions involving one aqueous phase. Applications in hydrometallurgy or other topics chosen by the student. Prerequisites: either Chemistry 173 and Materials Science 122 or Chemistry 173 and Geology 70.
3 units, spring, (Parks), three lecs. by arrangement, to be given in alternation with 225 in even numbered years
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, to be given in even numbered years

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, to be given in odd numbered years

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

300a or b. Advanced Work in Mining or Metallurgical Engineering—Individual work on a research problem in mining, mineral processing, or chemical and extractive metallurgy. Register in 300a for directed projects. Register in 300b for independent research such as Ph.D. dissertation work.
Each quarter, (Staff), by arrangement

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

PETROLEUM ENGINEERING

Emeritus: Frederick George Tickell (Professor)

Executive Head: Frank G. Miller
Professors: Sullivan S. Marsden, Jr., Frank G. Miller
Assistant Professor: To be announced
Visiting Lecturer: Thomas D. Mueller
Research Associates (by courtesy): Thomas D. Mueller, 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</td>
<td>Analytical Geometry and Calculus</td>
<td>18</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>Stat. 110</td>
<td>Statistics for Engineering and Science</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 31</td>
<td>Elementary Engineering Thermodynamics</td>
<td>5</td>
</tr>
<tr>
<td>Chem. 171</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 20</td>
<td>Elementary Surveying</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>
</tr>
<tr>
<td>Engr. 15</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 21</td>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 41</td>
<td>Circuits, Electronics, and Electromechanics</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 1</td>
<td>Physical Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 2</td>
<td>Historical Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 25</td>
<td>Elementary Mineralogy and Crystallography</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 105</td>
<td>Structural Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 157</td>
<td>Sedimentary Petrology</td>
<td>3</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</td>
<td>Formation Evaluation</td>
<td>8</td>
</tr>
<tr>
<td>Pet.E. 151a</td>
<td>Petroleum Reservoir Fluids</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 151b</td>
<td>Fluid Behavior in Reservoir Rocks</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 152</td>
<td>Development and Production Technology</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 153</td>
<td>Development and Production Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>Pet.E. 160</td>
<td>Report on Oil Field Training</td>
<td>1</td>
</tr>
<tr>
<td>Social Sciences.*</td>
<td>(General Studies Requirement)</td>
<td>10</td>
</tr>
<tr>
<td>Group Activity</td>
<td>(General Studies Requirement)</td>
<td>(6)</td>
</tr>
<tr>
<td>Humanities</td>
<td>(General Studies Requirement)</td>
<td>8</td>
</tr>
<tr>
<td>Restricted Electives</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

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

Graduate Degrees

The petroleum industry is increasingly interested in engaging petroleum engineers having advanced training. A balanced Master's degree curriculum covering both professional engineering and research requires a minimum of five years of college study. The demand for men with this background exceeds the supply. As a result, there are many attractive employment opportunities.

The degree of Engineer in Petroleum Engineering (Management Option) requires two years of graduate study, combining engineering and business administration. This program is conducted in cooperation with the Graduate School of Business.
The degree of Doctor of Philosophy is awarded primarily on the basis of accomplishments in research. A minimum of three years of graduate work is required for the degree.

**Master of Science**

The objective is to prepare the student for professional work in petroleum engineering through the completion of fundamental courses, both in the major field and in related sciences, and by obtaining a start on independent work and specialization. The candidate must fulfill the following requirements:

1. Be registered in the graduate school for at least three quarters.
2. Complete 45 units with at least a B average. At least 6 of these units must be independent work on a research problem. Units from courses with grades of D will not be counted toward the required 45 units of work, and the average of all grades must be a B or better.
3. Make up deficiencies in previous training. Not more than 10 units of such work may be counted as part of the minimum total of 45 units.
4. Demonstrate his knowledge of basic principles and research methods in his general field of study by preparing a report, ordinarily a term paper written for 6 units of research, to be submitted to at least two faculty members.

**Courses Required for the Master's Degree**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pet.E. 270a.</td>
<td>Elements of Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270b.</td>
<td>Applications of Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270c.</td>
<td>Applications of Oil Reservoir Engineering</td>
<td>3</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.

3 units, autumn, (Marsden), T 1:15; lab. TTh 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


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


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


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


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

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

3 units, 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, alternate years, to be given in 1964-65

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

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

Emeriti: Warren D. Allen, A. John Bartky, W. H. Cowley, Maud Merrill James, Lucien B. Kinney, Maud L. Knapp, 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

Acting Instructors: N. R. Dodl, J. Mudra

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

Members of the faculties of other divisions of the University giving courses or cooperating in the offerings of the School of Education are John D. Black, Richard F. Carter, Howard Dallmar, William Paul Fehring, Charles E. Finger, James Gaughran, Joseph R. Higgins, Conrad Jarvis, Payton Jordan, Raymond E. Lunny, Jr., Virginia Puich, John Ralston, and Clifford F. Weigle.

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

GRADUATE DEGREES

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

Students working toward graduate degrees should follow the suggestions outlined under each degree. Students applying for the Master's, Educational Specialist, or Doctor's degree will present a preliminary program of study which represents the work to be completed in earning the degree. They will also consult their advisers with regard to organizing their graduate programs within the limits described in this Bulletin.

Students who are candidates for the degree of Master of Arts or Doctor of Philosophy should consult also the University's general requirements described in the section "Degrees" in this Bulletin.

Field of Concentration for Advanced Degrees—Candidates for advanced degrees in education should plan to specialize in the field of their professional interest, preparing for some line of professional activity and at the same time securing mastery of an organized body of knowledge. The choice should be made in light of the professional objective of the student. The program of study for the various fields of concentration is somewhat flexible, allowing a student, in consultation with his adviser, to emphasize certain aspects of the work, depending on his special interests and his professional objective. Each candidate will select a faculty adviser to assist him in planning his program of study and in projecting research plans for his dissertation. Other members of the faculty of the School of Education may also be consulted with regard to the particular field chosen by the student. Each program as finally approved will designate one area of special interest as a major field of concentration.

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

General School Administration
Elementary School Education
Secondary School Education
Higher Education
Junior College
Guidance
Philosophy and/or History of Education
Overseas and/or Comparative Education
Psychological Foundations of Education
Social Foundations of Education
Health Education
General Curriculum
Child Development
Educational Research

Teacher Education, or Secondary Education, or Special Curriculum, with concentrations in any of the following:

- Art
- Health
- Journalism
- Language Arts or English
- Mathematics
- Modern European Languages
- Music
- Physical Education for Men
- Science
- Social Studies
- Speech
Candidates who select one of the fields of concentration indented above should identify their field as in the following examples:

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

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

A preliminary interview for all advanced degree candidates is required. Application forms may be obtained at the office of the School of Education.

**Master of Arts**

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

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

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

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

1. A minimum of 45 units of graduate study is required. At least 36 units must be completed at Stanford. Two-thirds of the program must be in the School of Education. In no case will the degree be granted unless the student has been registered at Stanford University for three full quarters, or the equivalent, after the conferring of the Bachelor's degree. Evaluation of residence is based on tuition payments. One full-time quarter (a minimum of 12 units) is required. The remainder of the work may be carried on a part-time basis.

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

3. Satisfaction of all requirements for the degree within 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.

1. **Research type**—A thesis is required. Recommended for future doctoral candidates, research workers, and college teachers of education.

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

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

**Master of Arts in Teaching**

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

1. The applicant must have completed a Bachelor's degree with an acceptable grade point average to qualify him for graduate study. The department of the major teaching field determines the adequacy of this preparation. The School of Education determines the adequacy of the candidate's background in professional education. 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 offers work for 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 offers work for the supervision and administration credentials described below. Information about current advisers, programs of study, and application procedures should be obtained from the Credential Secretary in the School of Education on or shortly after registration day in the first quarter of residence.

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

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

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; or
   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, or
   b) Completion of a program of study, including a minimum of 36 quarter units of professional education, designated by the Committee on Credentials as appropriate to the area in which the applicant expects to serve. The program shall be approved by the adviser in the School of Education and filed with the Credential Secretary.

Teaching Credentials

The Stanford School of Education offers work for 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 requirement at Stanford. Such a waiver does not imply granting of credit. Course work must be substituted for exemptions in order to have the required number of education units.

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

A brief summary of these credentials follows.

Teaching Credential (Secondary)

Candidates working toward the Standard Teaching Credential with an emphasis on Secondary School Teaching can also complete requirements for a Master of Arts degree in Education. Consult Master of Arts secretary, Room e43 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 Education Program 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.

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 19, 1964
   b) Saturday, January 23, 1965
   c) Saturday, March 13, 1965

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).

*b) 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 e43.

*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 PROGRAM

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter</th>
<th>Units</th>
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<tbody>
<tr>
<td>Ed. 211a, b.</td>
<td>Academic Courses</td>
<td>Any</td>
<td>12-19</td>
</tr>
<tr>
<td>Ed. 211c.</td>
<td>Psychological Foundations</td>
<td>Su A</td>
<td>6</td>
</tr>
<tr>
<td>Ed. 260 Series</td>
<td>Social Foundations</td>
<td>W</td>
<td>3</td>
</tr>
<tr>
<td>a.</td>
<td>Curriculum and Instruction in Major Teaching Field</td>
<td>Summer</td>
<td>3</td>
</tr>
<tr>
<td>b, c.</td>
<td>Curriculum and Instruction in Major Teaching Field</td>
<td>AW</td>
<td>2</td>
</tr>
<tr>
<td>d.</td>
<td>Curriculum and Instruction in Major Teaching Field</td>
<td>S</td>
<td>1</td>
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</tbody>
</table>
Ed. 240
240a. Secondary Education ......................... Summer 3
240b. c. Secondary Education ......................... AW 2
240d. Secondary Education ......................... S 1

Ed. 246
246a. Instruction Laboratory ......................... Summer 3
246b. Internship ........................................ A 3
246c. Internship ........................................ W 4
246d. Internship ........................................ S 4

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

7. A battery of 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 working toward 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, Room e43.
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 offers work toward the Standard Designated Services Credential with a Specialization in Pupil Personnel Services which provides authorizations in counseling and in school psychology. For further information concerning this credential write to the Coordinator for the Designated Services Credential Program in the School of Education.

COURSES IN OTHER DIVISIONS OF THE UNIVERSITY

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

COURSES IN EDUCATION

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

The various courses are distributed as follows:

Foundations of Education (Digits 00-19), i.e., 218, Health Foundations of Education
Administration (Digits 20–29), i.e., 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. Child Psychology—(Enroll in Psychology 111.)
116. Development in Middle Childhood—Development of the child from six to twelve. Research readings, observations, development of case study materials. Pre-requisite: Psychology 111 or equivalent.
4 units, winter, (P. Sears), MWF 9 and one 3-hour block by arrangement

119. Adolescent Development—(Enroll in Psychology 119.)
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

180. Art in the Elementary Schools—Basic concepts and practice in art education for elementary school teachers.
3 units, winter, (———), F 10–12, lab. T 2:15–4:05; or F 10–12, lab. Th 2:15–4:05

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), TWF 4:15

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), MTWTTh 1:15 and by arrangement

201. History of Education in the United States—Detailed study of American educational history in its cultural setting. Education 200 will provide a helpful background but is not a prerequisite.
3 units, summer, (———)

204. Philosophy of Education—Philosophical issues in epistemology, value theory, metaphysics of significance to educational policy, practice. No previous study of philosophy assumed.
4 units, winter, (Fischer), MTWTTh 9
summer, (Fischer), MTWTThF 2:15

206. Comparative Education—Comparative study of education in several nations, cultural areas.
4 units, summer, (———), MTWTThF 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, Fischer), 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, (Gage), MTWTh 11
summer, (McDonald), 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, (Olkin), MW 12:30-2:00
4 units, summer, (———), MTWThF 9

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

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

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

3 units, autumn, (Byrd), MWF 9
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, Strand), 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 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 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, (James, Shaftel, Sowards), 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, (Boyan, 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, (P. Sears), alternate years, to be given in 1965-66

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, (Bush), 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, (Boyan), 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, (Boyan), 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), MTWTh 8

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.

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

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

8 units, autumn, (Begle, Iverson), MTWTh 2:15–4:05

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

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

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

2 to 4 units, winter, spring, (Sowards), by arrangement

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

6 units, autumn, (Sowards, Staff), F 10–12 and by arrangement

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

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

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

3 units, summer, (———), MTWTh 4:15

246b, c, d. **Internship**—Field experience in local secondary schools. Taken during each quarter of internship. Prerequisite: 246a.

246b. 3 units, autumn, (Staff), by arrangement
246c. 4 units, winter, (Staff), by arrangement
246d. 4 units, spring, (Staff), by arrangement

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

6 units, autumn, spring, (Mayhew), by arrangement

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
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, (Krumboltz), MTWThF 1:15

**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, (Grommon), T 4:15-6:05
261d. 1 unit, spring, (——), T 4:15

**262a, b, c, d. Curriculum and Instruction in Secondary School English**—Evaluation of conflicting views of programs of language arts; study of research and recommendations for teaching of composition, critical thinking, semantics, grammar, usage, punctuation, spelling; study of recommendations for teaching of reading and of the various types of literature.

262a. 3 units, 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

**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

**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

**265a, b, c, d. Curriculum and Instruction in Secondary School Music**—Theory and practice of vocal and instrumental instruction. (Same as Music 291a, 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

**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, Ruff), T 4:15-6:05
266c. 1 unit, winter, (Ruff), T 4:15-6:05
266d. 1 unit, spring, (Ruff), T 4:15

267a, b, c, d. Curriculum and Instruction in Secondary School Science—Introduction to objectives of secondary science teaching; selection and organization of teaching units; laboratory and demonstration techniques; tests, evaluation. Emphasis upon instructional materials, community resources for science teaching. 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

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

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

283. Spanish Applied Linguistics—(Same as Spanish 190). 2 units, autumn, (Politzer), TTh 3:15

285. Curriculum and Instruction in Secondary School Journalistic Writing. 4 units, any quarter, (Weigle), by arrangement

287. German Applied Linguistics—(Same as German 190). 2 units, autumn, (Politzer), TTh 11

288. Methods of Teaching French—(Same as French 288). 3 units, winter, (Politzer), M 4:15-6:05 and by arrangement

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

291. Methods of Teaching German—(Same as German 200). 4 units, spring, (Lohnes), MTh 4:15-6:05

292. Methods of Teaching Spanish—(Same as Spanish 200). 3 units, winter, (Morgan), MWF 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), W 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, (Fischer), MTWTh 11
   summer, (Fischer), MTWThF 10

307. Social Psychology of Higher Education—Analysis of the behavior and development of college students and of the college as a social organization.
   2 units, 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, planning for future. (Enroll in Graduate Special 308.)

310. Education in American Society—Analysis of education in American society as applied to problems of educational leadership. Assumed that class members have had teaching experience or equivalent. For Ed.S., Ed.D., and Ph.D. candidates.
   4 units, winter, (Quillen), MTWTh 10
   summer, (Quillen), MTWThF 10

312. Occupational Trends—Current nature of American labor force; occupational structure; intended for vocational counselors, advanced students of educational sociology. Prerequisite: 210 or 310.
   3 units, 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, (——), MTWThF 11

315. Cultural Transmission—Education in cross-cultural perspective: transmission of values; transmission of covert culture, implicit cultural assumptions; adolescent education; case studies of teachers in American schools. For advanced graduate students in education, anthropology, other behavioral sciences.
   3 units, autumn, (Spindler), M 7–10 p.m.
   4 units, summer, (——), MTWThF 9

316. Advanced Educational Psychology II—Principles of learning and motivation relevant to the study of classroom behavior. Prerequisite: 314.
   3 units, autumn, spring, (McDonald), MWF 8

318. Advanced Educational Psychology III—Application of theories, concepts, research techniques of social psychology to the educational process. Prerequisite: 314.
   3 units, winter, (Gage), MWF 3:15
   4 units, summer, (McDonald), MTWTh 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 adminis-
trative relationships in education. Prerequisite: 220 or equivalent, or consent of instructor.

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

322a, b, c. Seminar in Secondary School Administration and Supervision—Designed primarily for students in the Administrator-Internship Program in Secondary Education. Critical analysis of problems of the secondary school principalship observed in internship assignments as related to function of the secondary school; its curriculum; appraisal of teaching and learning; pupil characteristics; patterns of organization of personnel and resources.

322a. 4 units, autumn, (Boyan), W 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.

4 units, summer, (Boyce), 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

326b. Public School Accounting—Designed to familiarize school administrators with techniques of fund accounting as applied to public school operations; emphasis upon applications consistent with requirements in California.

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

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

3 units, spring, (James), Th 7-10 p.m.


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

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

4 units, winter, (---), 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.

2 units, autumn, winter, (L. Allen), 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.
4 units, summer, (Shaftel), MTWThF 11

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

4 units, summer, (Shaftel), MTWThF 11

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 Graduate Special 308 and Ed. 329 are not prerequisites, students are encouraged to take them first.

4 units, spring, (———), 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, (Sowards), TTh 1:15-3:05
summer, (———), MTWThF 1:15

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

4 units, autumn, (Coladarci), MW 2:15-4:05
winter, (Cronbach), MW 2:15-4:05

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.

351a. 3 units, winter, (Olkin), to be given in 1965-66
351b. 3 units, spring, (Olkin), to be given in 1965-66

352. Individual Testing—Instruction and practice in the administration and interpretation of individual tests of intelligence and their use in connection with other diagnostic instruments.

Spring, (P. Sears), by arrangement

353. Problems in Measurement—For prospective research workers. Critical examination of classical measurement theory including concepts of reliability and validity. Decision theory as a model for testing. Prerequisites: 216 or Psychology 60; 215; and Psychology 152, or 155, or equivalent.

4 units, autumn, (Cronbach), MW 2:15-4:05

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, winter, (Politzer), W 7-10 p.m.
4 units, summer, (———), TTh 2:15-4:05 and by arrangement

384. Recent Developments in Secondary School English—Recent research, materials, methods in secondary school English. For teachers who have had experience teaching English.

4 units, summer, (———), MTWThF 11

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

3 units, autumn, (Iverson), W 7-10 p.m.
summer, (Iverson), MTWTh 8

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, (Politzer), W 7-10 p.m.

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

2 units, winter, (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, (Begle), MW 2:15-4:05

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

4 units, summer, (———), MTWThF 8
394. Recent Developments in Secondary School Science—Current problems in 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 2:15-4:05
- 3 units, summer, (Hurd), MW 2:15-4:05


- 4 units, summer, (———), MW 2:15-4:05 and by arrangement


- 4 units, autumn, (Shaftel), MTWTh 9
- summer, (Hanna), MTWThF 1:15


- 4 units, summer, (———), MTWThF 8

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

- 3 units, winter, (Iverson), W 7-10 p.m., to be given in 1965-66
- 4 units, summer, (Iverson), MTWThF 9

Mass Communications in Society—See Communication 220.
Non-Commercial Station Operation—See Communication R201.
Music for Elementary Teachers—See Music 288.
Teaching by Television—See Communication R203.
Television Production—See Communication R214.

Seminar 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, (Hanna, Spindler, Textor, Staff), W 12
- 2 units, winter, spring, (Hanna, Spindler), Th 12 and by arrangement
- summer, (Hanna, Textor, Staff), W 12 and by arrangement

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

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

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

- 4 units, autumn, (Cronbach), by arrangement
- 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 1965–66

3 units, spring, (Atkinson), Th 7–10 p.m.

420. Seminar for Administrative Interns—Designed for interns in general school administration and for selected assistants in the School Planning Laboratory. Analysis of problems and opportunities emerging from internship assignments.
2 units, autumn, winter, spring, (Boyce), by arrangement

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

421. Seminar in School-Community Relations—Factors related to effective communication between schools and communities. Basis in communication theory for working techniques and principles for evaluating effectiveness. Research related to effective school-community relations.
3 units, spring, (Carter), by arrangement

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

423a. 3 units, autumn, (MacConnell, Strand), Th 7–10 p.m.
423b. 3 units, winter, (MacConnell, Strand), Th 7–10 p.m.
423c. 3 units, spring, (MacConnell, Strand), Th 7–10 p.m.

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

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, Krumboltz), by arrangement

431. Guidance Seminar—Designed for all doctoral candidates in guidance. Analysis of professional problems in guidance and personnel work. May be repeated for credit.
1 unit, autumn, (Krumboltz), Th 7:30–9:30 p.m.
winter, spring, (McDaniel, Krumboltz), Th 7:30–9:30 p.m.
summer, (McDaniel, Krumboltz), by arrangement

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

440. Seminar in the School Curriculum—Designed for advanced graduate students preparing for leadership positions in either public schools or colleges of education. Prerequisites: recent post-A.M. work in the foundations of education and post-credential work in the elementary and/or secondary school curriculum.
4 units, spring, (Bush), TTh 3–5
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, (Hanna), TTh 2:15–4:05
winter, (Shaftel), TTh 1:15–3:05
spring, (Sowards), TTh 8–10
summer, (Sowards), TTh 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 1:15-3:05 (Administration emphasis)
- spring, (Bush), W 3:15-5:05 (Teacher Personnel emphasis)

- 4 units, summer, (Bush), TTh 3:15-5:05 and by arrangement (Student Personnel emphasis)

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

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

- 3 to 5 units, autumn, winter, spring, (Bush, Boyan, ———), 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, (———), 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, (———), by arrangement

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

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

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

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

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

- 2 to 3 units, winter, (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
SCHOOL OF EDUCATION

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 FOR MEN

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.

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 minor in Physical Education in order to qualify for the Standard Teaching Credential in Secondary Education in the State of California. Course work in this minor program in Physical Education may begin in the sophomore or junior year, and continue through the first graduate year. Interested students should obtain their A.B. degree in a department of the School of Humanities and Sciences. For the requirements of the general 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 minor program described above.

Information

For details concerning any of the above major or minor 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

158. Community Recreation—Theory, principles, and research in community recreation with emphasis upon the philosophy of leisure and the role of recreation in modern society.
   3 units, winter, (Nixon), MWF 9, to be given in 1965–66

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, to be given in 1965–66

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.
siders 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 majors and minors. Not open to freshmen.

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

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

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

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

171g. Athletic Conditioning.
2 units, any quarter, (Jarvis), by arrangement

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

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

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, (Ruff), MW 3:15 and by arrangement

171s. Tennis.
2 units, autumn, (Staff), 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. Prerequisites: 155 and Anatomy 114.

4 units, spring, (Ruch), MWF 1:15-3:05

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

4 units, winter, (Lidster, Williams), MW 1:15-3:05 and F by arrangement

356. Current Literature and Research in Physical Education—Critique of significant recent literature in physical education, and the theory and principles of basic and applied research in physical education.

3 units, autumn, (Nixon), MW 10

4 units, summer, (Ruff), 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, autumn, (Nixon), by arrangement

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.
2 units, summer, (Ruff), by arrangement

HEALTH EDUCATION

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

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

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

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

TEACHING CREDENTIALS

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

PROGRAMS OF STUDY

Through the School of Education, the Department of Health Education offers the A.B., A.M., and Ed.D. degrees with specialization in health education. Candidates not interested in the field of education may secure the A.B. and A.M. degrees through the Department of Health Education. A minimum of 30 units from the curriculum of the Department of Health Education plus 15 units in certain basic sciences is required for the A.B. degree. Candidates for the Master of Arts degree must complete at least 36 units of graduate work in the Department of Health Education. The degree of Doctor of Education may be recommended for those candidates who satisfy the requirements of the School of Education and who devote approximately one-half of their course work on the graduate level to certain offerings from the Department of Health Education. Complete information on this degree may be secured from the office of the Dean of the School of Education.

UNDERGRADUATE COURSES

H50. Science of Health—Function, structure and application of component segments of contemporary medical science. Emphasis placed on health needs of the individual and resources available through application of scientific medical knowledge. Physician specialists are used as guest speakers when appropriate.
3 units, autumn, winter, spring, (Cobb), MWF 9

H106. Personal Mental Health—Group discussions of the specific personal mental health problems of students enrolled in the class against the background of the problems which the present-day college atmosphere presents.
3 units, autumn, (Byrd), to be given in 1965–66
SCHOOL OF EDUCATION

H107. Safety—A consideration of accidents as they occur—on the highway, at home, in schools, in recreation, etc.—and the means of prevention. Emphasis is placed upon looking at the individual and his values and at the environment as factors in accident prevention.

3 units, autumn, (Cobb), MWF 10

H109. Community Health—Programs and agencies now functioning to maintain and improve the health of groups of people; a careful look at the interrelationships of individual and community responsibilities in the field of health.

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

H121. Marriage and Family—A comprehensive look at marriage and the resulting family, both as a significant phenomenon of the culture and a probable, personal concern of students. Emphasis on those areas where knowledge and adjustment most crucial for happy marriage—courtship and mate selection, finances, sex, religion, and interpersonal relations with other family members. Spring quarter class open to juniors and seniors only.

3 units, autumn, (Russell), Th 7-10 p.m.
winter, (Russell), MW 4:15-5:30
spring, (Russell), MWF 9

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

3 units, spring, (Russell), MWF 11

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

3 units, spring, (Cobb), to be given in 1965-66

GRADUATE COURSES


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

H214. School Health Programs—Survey of functions of school health programs as related to instruction, healthful school environment, school health services. For education majors only.

4 units, winter, (Byrd), MTWTh 9
summer, (Byrd), by arrangement

H215. Teaching Units—Preparation of teaching materials in health education; designed to supplement preparation of teachers, prospective teachers. For education majors only.

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

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, (Russell), TTh 2-4
H291b. 3 units, winter, (Russell), by arrangement
H305. Practicum in School Nursing—Participation in work of school nurse under supervision of school district and University Department.
    4 to 12 units, any quarter, (Byrd), by arrangement

H400. Individual Study in Health Education.
    2 to 15 units, any quarter, (Staff), by arrangement

H405. Seminar in Health Education—Consideration of current issues and controversies in health education. Limited to advanced graduate students in health education, other graduate students with at least six courses in health, and advanced medical and nursing students.
    2 units, spring, (Russell), W 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
Professors of Engineering: William Shockley, 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 A, Algebra, and/or Mathematics C, Trigonometry, in addition to the normal graduation requirements. High school courses in physics, chemistry, machine drawing, biological science (biology, botany, or zoology), and more advanced mathematics are recommended but are not required.

Preparation Recommended for Transfer Students

Students who do the early part of their college work elsewhere and then transfer to Stanford to complete their engineering programs should follow an engineering or pre-engineering program at the first school, selecting insofar as possible courses applicable to the requirements of the School of Engineering i.e., courses comparable
to those included in the list of "Courses Normally Taken by All Engineering Students"). Some transfer students may require more than four years to obtain the B.S. degree. However, Stanford affords great flexibility in planning and scheduling individual programs which makes it possible for transfer students having wide variations in preparation to plan full programs for each quarter and to progress toward graduation without undue delay.

Transfer credit will be applied to School of Engineering requirements whenever the courses are equivalent or substantially similar. Substitution of transfer credits for courses that are required by the General Studies Program is administered by the University Committee on General Studies. The policy of the School of Engineering is to study each transfer student's preparation and make a reasonable evaluation of the courses taken prior to transfer. Inquiries may be addressed to the Dean of Engineering at Stanford.

**UNDERGRADUATE PROGRAMS OF STUDY**

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

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

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

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

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

All 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 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.

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

Courses Normally Taken by All Engineering Students

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56, 57. Engineering and Atomic Physics</td>
<td>18*</td>
<td></td>
</tr>
<tr>
<td>Math. 41, 42, 43, 44. Analytic Geometry and Calculus (See Note 1)</td>
<td>18*</td>
<td></td>
</tr>
<tr>
<td>Chemistry (See Note 2)</td>
<td>8 or 13*</td>
<td></td>
</tr>
<tr>
<td>Statistics (See Note 3)</td>
<td>3 or 4*</td>
<td></td>
</tr>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>History 1, 2, 3. History of Western Civilization</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>General Studies Humanities (See approved list of courses)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>General Studies Social Sciences (See approved list of courses)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>English 129. Scientific Writing</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Speech 20. Public Speaking (See Note 4)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Engr. 9. Engineering Drawing</td>
<td>4*</td>
<td></td>
</tr>
<tr>
<td>Engr. 11, 12. Engineering Mechanics</td>
<td>6*</td>
<td></td>
</tr>
<tr>
<td>Engr. 15. Mechanics of Materials (See Note 5)</td>
<td>3*</td>
<td></td>
</tr>
<tr>
<td>Mechanics of Fluids (See Note 6)</td>
<td>3 or 4*</td>
<td></td>
</tr>
<tr>
<td>Thermodynamics (See Note 7)</td>
<td>3 or 5*</td>
<td></td>
</tr>
<tr>
<td>Engr. 41, 41L, 42, 42L. Circuits, Electronics, Electromechanics</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Engr. 50. Introductory Science of Materials</td>
<td>3*</td>
<td></td>
</tr>
<tr>
<td>Engr. 161. Engineering Economy (See Note 8)</td>
<td>3*</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>124 to 133</td>
<td></td>
</tr>
</tbody>
</table>

Note 1—The 3-unit mathematics sequence (Math. 10, 11, 21, 22, 23, 44) is an alternative which necessitates postponing physics until the second year and hence may delay graduation in some curricula. Math. 24 may be substituted for Math. 44 if no additional mathematics courses are to be taken.

Note 2—Chemical Engineering majors take Chemistry 1, 2, 3, General Chemistry, 13 units; all others take Chemistry 1, 2, General Chemistry, 8 units.

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

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

Note 5—This requirement is also satisfied by taking Engr. 18, Mechanics of Deformable Bodies.
Note 6—Engr. 21, Mechanics of Fluids, 4 units, or (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.

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

Scheduling of Courses

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

- Engr. 5 is available for freshmen 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>Ch.E. 10.</td>
<td>Industrial Chemical Calculations</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 120a, b.</td>
<td>Chemical Engineering Thermodynamics</td>
<td>6</td>
</tr>
<tr>
<td>Ch.E. 130b.</td>
<td>Transport Processes</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 140a, b, c.</td>
<td>Chemical Engineering Unit Operations</td>
<td>9</td>
</tr>
<tr>
<td>Ch.E. 141a, b.</td>
<td>Chemical Engineering Laboratory</td>
<td>6</td>
</tr>
<tr>
<td>Ch.E. 150.</td>
<td>Applied Chemical Kinetics</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 121, 123.</td>
<td>Organic Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Chem. 122.</td>
<td>Organic Preparations</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 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>Approved Electives (See Note 1 below)</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

Total 70

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

Note 1—Some suggested electives are: Ch.E. 102, 103; Chem. 112, 113, 116, 125; Math. 45, 46, 106, 107, 131, 132, 136, 137, 138; Physics 57; Engr. 42, 42L.

2. Supplementary Requirements, Civil Engineering

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

Elective Courses as below ........................................ 13

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 (3 units) (or I.E. 133a, 5 units); C.E. 151, Highway Engineering (3 units); C.E. 183, Structural Design (2 units); Psych. 113, Industrial Psychology (3 units); Psych. 192, Industrial Relations (4 units).

**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); C.E. 161, Hydraulic Engineering (3 units).

**Hydraulics and Fluid Mechanics**—C.E. 161, Hydraulic Engineering (3 units); C.E. 163, Hydraulic Machinery (2 units); C.E. 166, Sanitary Engineering (3 units); Math. 106, Complex Variable (3 units); Math. 130, 131, 132, Differential Equations (9 units).

**Hydrology**—C.E. 161, Hydraulic Engineering (3 units); C.E. 166, Sanitary Engineering (3 units); 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. 166, Sanitary Engineering (3 units); C.E. 172, Environmental Radioactivity (3 units); Math. 130, Differential Equations (3 units); Mat.Sci. 231, Nuclear Reactor Materials (3 units).

**Public Works Administration**—Pol.Sci. 100, Public Administration (5 units); C.E. 166, Sanitary Engineering (3 units); C.E. 170, Man and his Environment (3 units); I.E. 133, Industrial Accounting (3 units).

**Sanitary Engineering**—Biology 1 and 2 (6 units); Medical Microbiology 101, General Bacteriology (5 units); C.E. 166, Sanitary Engineering (3 units); C.E. 170, Man and his Environment (3 units); C.E. 172, Environmental Radioactivity (3 units).

**Structural Design**—C.E. 183, Structural Design (2 units); C.E. 184, Statically Indeterminate Structures (3 units); C.E. 161, Hydraulic Engineering (3 units); C.E. 166, Sanitary Engineering (3 units); Math. 130, Differential Equations (3 units).

**Structural Mechanics**—C.E. 184, Statically Indeterminate Structures (3 units); Math. 130 and 131, Differential Equations (6 units); Math. 45, Advanced Calculus (3 units); Engr. 104, Dynamic Response (3 units).

**Water Resources**—C.E. 161, Hydraulic Engineering (3 units); C.E. 166, Sanitary Engineering (3 units); C.E. 170, Man and his Environment (3 units); I.E. 133, Industrial Accounting (3 units); Pol.Sci. 100, Public Administration (5 units).
Strict adherence to one of these programs is not required. Students whose interests lie primarily in engineering administration may select industrial engineering courses as electives.

### 3. Supplementary Requirements, Electrical Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 103.</td>
<td>Principles of Fields and Waves</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 104*, 105, 106.</td>
<td>Circuits</td>
<td>10</td>
</tr>
<tr>
<td>E.E. 128.</td>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 150, 151, 152.</td>
<td>Electronics</td>
<td>9</td>
</tr>
<tr>
<td>E.E. 156, 157.</td>
<td>Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>E.E. 138 or E.E. 170.</td>
<td>Laboratory; or C.S. 136. Use of Digital Computers</td>
<td>3</td>
</tr>
<tr>
<td>Optional program “A,” “B,” or “C” as below</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

Total: 53

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

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

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

### List A

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<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>3</td>
</tr>
<tr>
<td>E.E. 159.</td>
<td>Microwave and High-Power Tubes</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 161, 162.</td>
<td>Electronic Circuits, Radio Engineering</td>
<td>3, 3</td>
</tr>
<tr>
<td>E.E. 200.</td>
<td>Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Engr. 5.</td>
<td>Computer Programming for Engineers</td>
<td>2</td>
</tr>
<tr>
<td>C.S. 136.*</td>
<td>Use of Automatic Digital Computers</td>
<td>2</td>
</tr>
<tr>
<td>Math. 130.</td>
<td>Ordinary Differential Equations</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 18 units of work are to be taken from the following list. The first course, Math. 130, is required; others are optional, depending on the student’s interest.

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

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 124</td>
<td>Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 159</td>
<td>Microwave and High-Power Tubes</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 161, 162</td>
<td>Electronic Circuits, Radio Engineering</td>
<td>3, 3</td>
</tr>
<tr>
<td>E.E. 170*, 171, 172</td>
<td>Electronic Measurements</td>
<td>3, 3, 3</td>
</tr>
<tr>
<td>E.E. 220</td>
<td>Principles of Pulse and Timing Circuits</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 235</td>
<td>Introduction to Network Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 138*</td>
<td>Control Systems Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 108</td>
<td>Illumination</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 200</td>
<td>Seminar</td>
<td>1</td>
</tr>
<tr>
<td>C.S. 136*</td>
<td>Use of Automatic Digital Computers</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 52</td>
<td>Electric and Magnetic Properties of Materials</td>
<td>3</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 12 units are to be elected from reasonably advanced courses in engineering, physics, mathematics, and chemistry (such as Engr. 52, E.E. 138, 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.)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys. 110, 111</td>
<td>Intermediate Mechanics</td>
<td>6</td>
</tr>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 161</td>
<td>Electronic Circuits</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 235</td>
<td>Introduction to Network Synthesis; or E.E. 240</td>
<td>Linear Systems</td>
</tr>
<tr>
<td>Electives, restricted as above</td>
<td></td>
<td>10 or 12</td>
</tr>
<tr>
<td>Omissions as above</td>
<td></td>
<td>(-9)</td>
</tr>
</tbody>
</table>

Total ................................................................. 18

### 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>6</td>
<td></td>
</tr>
<tr>
<td>Restricted Electives in Engineering Science (see below)</td>
<td>21 or more</td>
<td></td>
</tr>
<tr>
<td>Restricted Electives in Basic Science (see below)</td>
<td>9 or more</td>
<td></td>
</tr>
<tr>
<td>Unrestricted Electives (see below)</td>
<td>17 or more</td>
<td></td>
</tr>
</tbody>
</table>

Total ................................................................. 53 or more
Restricted Electives in Engineering Science—A total of 21 units selected from the following list of technical courses, including a minimum of 3 units in laboratory work chosen from the first six courses listed: 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, Materials Science Laboratory (3 units); E.M. 205, Experimental Stress Analysis (3 units); C.E. 107, Mechanics of Fluids (2 units); C.E. 114, Mechanics of Materials (3 units); C.E. 118, Materials Engineering (3 units); C.E. 180, Elementary Structural Analysis (4 units); C.E. 281, Theory of Structures (3 units); C.E. 282, Statically Indeterminate Structures (3 units); E.E. 103, Principles of Fields and Waves (3 units); E.E. 104, 105, 106, Electric Circuits (10 units); E.E. 124, Electromechanics II (3 units); E.E. 128, Control Systems (3 units); E.E. 150, 151, 152, Electronics (9 units); E.E. 161, Electronic Circuits (3 units); E.E. 234, 235, Network Synthesis and Analysis (6 units); E.E. 240, Linear Systems (5 units); E.E. 270n, Elementary 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); Engr. 52, Electric and Magnetic Properties of Materials (3 units); C.S. 136, Use of Automatic Digital Computer (3 units); Mat.Sci. 121, Solid State Physical Chemistry (3 units); Mat.Sci. 122, Solid State Thermodynamics (3 units); Mat.Sci. 124, Structural Control in Materials I (3 units); Mat.Sci. 125, Structural Control 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, b, c</td>
<td>Advanced Product Design</td>
<td>9</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. 140</td>
<td>Comparative Social Systems</td>
<td>4</td>
</tr>
<tr>
<td>Anthr. 154</td>
<td>Peoples of Africa</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 150</td>
<td>Transportation Engineering</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 170</td>
<td>Man and His Environment</td>
<td>3</td>
</tr>
<tr>
<td>Econ. 118, 119</td>
<td>Economic Development: Structure and Theory; Policies and Case Studies</td>
<td>10</td>
</tr>
<tr>
<td>Geog. 4</td>
<td>Economic Geography</td>
<td>5</td>
</tr>
<tr>
<td>Ed. 206</td>
<td>Comparative Education</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 180a, b, c</td>
<td>Seminar in Resource Strategy</td>
<td>6</td>
</tr>
<tr>
<td>E.E.S. 212</td>
<td>Water-resources Planning</td>
<td>3</td>
</tr>
<tr>
<td>E.E.S. 320</td>
<td>Economic Development Planning</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 100</td>
<td>Industrial Organization</td>
<td>4</td>
</tr>
<tr>
<td>Pol.Sci. 113</td>
<td>Seminar in Government and Natural Resources</td>
<td>5</td>
</tr>
<tr>
<td>Pol.Sci. 127</td>
<td>Government and Politics of Africa South of the Sahara</td>
<td>5</td>
</tr>
<tr>
<td>Sociol. 175</td>
<td>The Evolution of Underdeveloped Societies</td>
<td>5</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, 153</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. 113</td>
<td>Industrial Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Psych. 192</td>
<td>Industrial Relations, or Econ. 145. Labor Economics</td>
<td>4 or 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 ........................................................................... 58-60

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>Engr. 5</td>
<td>Computer Programming for Engineers</td>
<td>2</td>
</tr>
<tr>
<td>Chem. 3</td>
<td>General Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>Chem. 171, 175</td>
<td>Physical Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Math. 130</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 121</td>
<td>Solid State Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 122</td>
<td>Solid State Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 123</td>
<td>Materials Science Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 124</td>
<td>Structural Control in Materials I</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 125</td>
<td>Structural Control in Materials II</td>
<td>4</td>
</tr>
<tr>
<td>Mat.Sci. 127</td>
<td>Crystallography and X-Ray Analysis</td>
<td>4</td>
</tr>
<tr>
<td>Mat.Sci. 130</td>
<td>Mechanical Behavior of Solids</td>
<td>3</td>
</tr>
<tr>
<td>Physics 172</td>
<td>Physics of Solids or Mat.Sci. 52. Electrical and Magnetic Properties of Materials</td>
<td>3</td>
</tr>
</tbody>
</table>

Optional program “A” or “B” as below ........................................ 16

Total ........................................................................... 61

Courses to complete the undergraduate program will be selected according to the student’s interest. The following two lists of courses are suggested. Different programs can be arranged to combine materials science with work in some other department.
List A provides professional training for a physical metallurgical or materials engineer together with preparatory training for graduate work in materials science.

**List A**

<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>Min.E. 105.</td>
<td>Extractive Metallurgy Processes</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 107.</td>
<td>High Temperature Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Mat.Sci. 120.</td>
<td>Industrial Report</td>
<td>1</td>
</tr>
<tr>
<td>Mat.Sci. 126.</td>
<td>Materials Engineering Design</td>
<td>2</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

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

**List B**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 45.</td>
<td>Advanced Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Math. 131.</td>
<td>Differential Equations</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>13</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Omissions</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

**8. Supplementary Requirements, Mechanical Engineering**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 5.</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>
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<tr>
<td>M.E. 132.</td>
<td>Engineering Thermodynamics</td>
<td>3</td>
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<tr>
<td>M.E. 136.</td>
<td>Mechanics of Compressible Fluids</td>
<td>4</td>
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<tr>
<td>Math. 45.</td>
<td>Advanced Calculus II</td>
<td>3</td>
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<tr>
<td>Math. 130.</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
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<tr>
<td>Optional Program, from those listed below</td>
<td>23</td>
<td></td>
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<tr>
<td>Total</td>
<td></td>
<td>57–58</td>
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</table>
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: Math. 46, Advanced Calculus III (3 units); Physics 61, Optics and Wave Motion (3 units); M.E. 134, Introduction to Kinetic Theory and Statistical Mechanics (3 units); A.A. 100, Introduction to Aerodynamics (3 units); Engr. 113, Rigid Body Dynamics (3 units); E.E. 103, Principles of Fields and Waves (3 units); E.E. 128, Control Systems (3 units); A.A. 240b, c, Aircraft and Missile Structures (3 units each); A.A. 279a, Dynamics of Space Vehicles (3 units); A.A. 227, Introduction to Space Physics (2 units); A.A. 228, Introduction to Astronomy and Astrophysics (3 units); A.A. 280a, Rocket Propulsion Fundamentals (3 units).

Engineering Design—23 units minimum from the following: Math. 46, Advanced Calculus III (3 units); M.E. 112a, Rapid Visualization (3 units); M.E. 112b, Introduction to Product Design (3 units); M.E. 114b, Mechanical Engineering Design (4 units); M.E. 114c, Design of Mechanical Engineering Systems (3 units); M.E. 123, Mechanical Engineering Laboratory (4 units); M.E. 135, Heat, 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); Engr. 52, Electric and Magnetic Properties of Materials (3 units); E.E. 103, Principles of Fields and Waves (3 units); E.E. 255, 256, Semi-Conductor Theory (3 units each); M.E. 161, Engineering Vibrations (3 units); E.E. 128, Control Systems (3 units); E.M. 211, Elementary Theory of Plasticity (3 units).

ROTC

Reserve Officers' Training Corps are maintained at Stanford by the Army, the Navy, and the Air Force (see Air, Military, and Naval Science in this Bulletin). Students following a curriculum to obtain a Bachelor of Science degree in Engineering, without specification of a major field, will be able to graduate in four years while pursuing an ROTC program. Students following an accredited engineering curriculum will usually require more than four academic years (twelve quarters) in the University to obtain a baccalaureate degree.
The individual requirements of each of the Air, Military, and Naval Science programs are so varied in the nature of specialized work that the appropriate sections of this bulletin should be consulted in preparing an engineering program including ROTC. The additional units of specialized work together with those of the accredited engineering programs will normally require from one to three extra quarters of study depending upon individual circumstances. ROTC students staying for more than one extra quarter may often arrange their programs to include one or even two sequences of graduate courses in their major while working for their baccalaureate degrees. Residence credit toward an advanced degree, however, cannot be obtained until the baccalaureate degree program has been completed.

Comprehensive Five-Year Programs

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

Dual Degree Programs

Stanford University cooperates with certain liberal arts colleges (presently Central College at Fayette, Missouri, Claremont Men's College, the College of Idaho, Hastings College, Knox College, Pacific Lutheran College, George Pepperdine College, The University of Redlands, Whittier College, and Willamette University) in providing a program that leads to concurrent award of the A.B. degree by the college and the B.S. degree by Stanford. These programs comprise three years of study at the college, with some emphasis on mathematics and science, followed by two years of study of engineering at Stanford. Inquiries may be addressed to the Dean of Engineering at Stanford, or to the above listed colleges. See description of Four-Two program 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**

<table>
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<th>Subject</th>
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<tr>
<td>Aerodynamics</td>
<td>Guidance and Control</td>
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<tr>
<td>Aircraft, Missile and Spacecraft</td>
<td>Physical Gasdynamics</td>
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<tr>
<td>Structures</td>
<td>Plasma Dynamics and</td>
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<tr>
<td>Astronautics</td>
<td>Magnetoaerodynamics</td>
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<tr>
<td>Experimental Methods</td>
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</tbody>
</table>
Chemical Engineering

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

Civil Engineering

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

Electrical Engineering

Administration
Electronic Systems Techniques
Electron Tubes
Illumination
Medical Electronics
Microwaves
Network Theory
Radio Science: Ionospheric Propagation, Radio and Radar Astronomy, Space Electronics
Solid-State Electronics
Transistor Electronics

Engineering Mechanics

Controls
Dynamics
Experimental Mechanics
Fluid Mechanics
Mechanics of Solids
Vibrations

Engineering Science

Biomedical Engineering
Nuclear Engineering

Institute in Engineering-Economic Systems

Hydrology (See separate section in this Bulletin.)

Industrial Engineering

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

Materials Science

Physical Metallurgy
Physical Ceramics
Photoelectronic Properties of Solids
Defects in Crystalline Solids and Their Effects on Electronics, Magnetic and Mechanical Properties
Magnetic Behavior of Solids
Mechanical Behavior of Solids
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., Biomedical Engineering, 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., Biomedical Engineering, 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.
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. Computer Programming for Engineers—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 A and C, or equivalent.
   2 units, autumn, (Staff), WF 11
   winter, (Staff), TTh 1:15
   spring, (Staff), WF 11

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 2
   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, Mathematics 43.

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


4 units, autumn, (Vennard, Staff), MWF 9; lab. T or W, 1-4 or 3-6
winter, (Vennard, Staff), MWF 9; lab. T or W, 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, 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), MTThF 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), MTThF 9

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

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


3 units, autumn, (Cannon), by arrangement

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, (——–), T WThF 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, and Physics 57.

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

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

3 units, autumn, winter, (Staff), T 1:15 and one lab. by arrangement

176. Radiochemistry Laboratory—Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisites: 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, to be given in 1965-66

198. Computer Programming—Any undergraduate student may enroll on an individual basis for guidance in solving engineering problems with the electronic digital computer facilities of the University's Computation Center.

Priority will be given to regular course problems assigned in the Engineering or departmental courses. Units will be awarded individually in accordance with the amount of work performed. 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

204. Introduction to Plasma Physics I—(Theory illustrated by applications to laboratory, geophysical and astrophysical phenomena.) Atomic processes: ionization, recombination, radiation; plasma balance equations; surface phenomena. Orbit theory: drifts, adiabatic invariants; synchrotron radiation. Elementary magnetohydrodynamics: derivation of fluid equations; equilibrium configurations and flow patterns; simple stability theory; MHD waves. Prerequisites: Physics 122 or E.E. 271 or, preferably, Physics 212 or 222.

3 units, autumn, (Sturrock), MWF 11

205. Introduction to Plasma Physics II—Boltzmann and Fokker-Planck equations; Coulomb collisions; Rosenbluth potentials. Relaxation and transport phenomena. Electromagnetic waves: Landau damping; Cerenkov effect. Velocity-space instabilities. Prerequisite: 204.

3 units, winter, (Sturrock), MWF 11


3 units, spring, (Sturrock), MWF 11

AERONAUTICS and ASTRONAUTICS

Emeritus: Alfred Salem Niles (Professor)

Executive Head: Nicholas John Hoff (on leave autumn quarter)
Associate Executive Head: Max Anliker
Associate Professors: Max Anliker, I-Dee Chang, Chi-Chang Chao (on leave 1964-65), Wilfred Henry Horton, Krishnamurty Karamcheti, Jean Mayers, William Nachbar
OFFERINGS AND FACILITIES

This Department prepares the student for a professional career in aeronautics and astronautics by offering a comprehensive program of graduate teaching and research. Particular emphasis is given to structural, aerodynamic, and guidance and control problems of aircraft, missiles and spacecraft. The teaching program provides courses leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy. The Department of Aeronautics and Astronautics offers two curricula for the Master of Science and Doctor of Philosophy—one oriented toward the sciences, the other emphasizing engineering. Specific programs are available in the following areas:

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

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

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

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

FACILITIES FOR INSTRUCTION AND RESEARCH

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

The Guggenheim Laboratory houses classrooms, aerodynamic laboratory and offices. In the laboratory are a 7.5-foot subsonic wind tunnel (with six-component balance, propeller dynamometer, pressure recording and scaling equipment, etc.) which, with special equipment, is being used, at present, for extensive jet flap studies. A newly constructed zirconium-oxide pebble-heater blow-down tunnel is available for investigations of a structural nature in a hypersonic airflow at total temperatures up to 4,000 degrees Fahrenheit.

The Durand Laboratory houses a library, research laboratories for structures and gasdynamics, an aerophysics laboratory, a machine shop, and faculty offices. The library contains a collection of text and reference books, reports of the principal aeronautical research organizations, and files of scientific journals and technical periodicals. The structures laboratory is set up with particular emphasis on equipment suitable for the study of structural behavior at high temperatures. Quartz-lamp heaters and a plasma jet are used to produce rapid changes of temperature both in space and time. Ovens capable of maintaining temperatures of 1,000 degrees Fahrenheit are also used to investigate the effects of creep on stress distribution and structural stability. The gasdynamics laboratory includes a 15-inch arc-discharge wind tunnel for the investigation of hypersonic flows at Mach numbers up to 20 and total tem-
temperatures up to 14,000 degrees Fahrenheit. The facilities in the aerophysics laboratory include a supersonic jet; a small low-turbulence air flow apparatus; hot wire equipment and apparatus for studying hydrodynamic sound production; a shock tube; optical equipment, including schlieren and interferometer apparatus; ballistic free-flight equipment; and associated control and recording devices.

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

ADMISSION AND REGISTRATION

To be eligible for registration in the Department a student must have received the Bachelor's degree in engineering, physical science, mathematics, or an acceptable equivalent. Students with a good engineering background should be able to qualify for the Master's degree in three quarters of work at Stanford. Students with a Bachelor's degree in physical science or mathematics may find it necessary to take certain undergraduate engineering courses, which may lengthen the time required to obtain the Master's degree.

PROGRAMS OF STUDY

Master of Science

The University's basic requirements for the Master's degree are outlined in the section "Degrees" in this Bulletin. The following are Departmental requirements.

Engineering Curriculum—To secure the recommendation of the Department for the Master's degree with a specialization in aero- and astronautical engineering, a candidate must complete a minimum of 21–25 units of course work selected from the following basic areas of aeronautics and astronautics: aerodynamics, propulsion, aircraft and missile structures, dynamics and control. In addition, 6 units of mathematics are required, plus a minimum of 9 units of advanced courses in one of the basic areas and 5–9 units of approved electives, making in all 45 units of course work. A detailed list of the requirements can be obtained upon request to the Department. No thesis is required. A minimum grade point average of 2.75 is expected.

Science Curriculum—To secure the recommendation of the Department for the Master's degree with a specialization in aero- and astronautical sciences, a candidate must complete 21–25 units of basic courses to be selected from the same areas as listed for the Engineering Curriculum, 9 units of mathematics, 9 units of advanced courses chosen from a list of physical science subjects, and 2–6 units of approved electives. A detailed list of the requirements can be obtained upon request to the Department. No thesis is required. A minimum grade point average of 2.75 is expected.

Engineer

The University's basic requirements for the Engineer degree are outlined in the section "Degrees" in this Bulletin. The following are Departmental requirements. In addition to satisfying the Department's requirements for the Master's degree, the candidate must complete: (a) 24 units of approved electives, of which 15 will usually be taken in one of the following fields: (1) Aerodynamics, (2) Aircraft, Missile and Spacecraft Structures, (3) Astronautics, (4) Guidance and Control, (5) Experimental Methods, (6) Physical Gasdynamics, (7) Plasma Dynamics and 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 Aeronautics and Space Administration, National Science Foundation, Douglas Aircraft Company, Sloan Foundation, Stanford University, and Affiliates of Stanford University in Aeronautics and Astronautics carry grants up to $3,500 for the nine-month academic year.

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

Stipends for research assistants vary, depending on qualifications and on the division of time between research and study. Research assistants may use their work as a basis for an Engineer or Ph.D. thesis and for University credit toward an advanced degree.

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

UNDERGRADUATE PROGRAM IN AERONAUTICS AND ASTRONAUTICS

A study program in aeronautics and astronautics leading to the Bachelor of Science degree is available in the form of the Aeronautics and Astronautics Option in the Mechanical Engineering Department.

COURSES AVAILABLE TO BOTH UNDERGRADUATE AND GRADUATE STUDENTS

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

2 units, autumn, (Reid), TTh 9

104. Dynamic Response—Analytical models for physical elements: linearization

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

240a. Aircraft and Missile Structural Analysis—Strength of thin-walled structures in bending, shear, torsion; introduction to shear lag and diagonal tension behavior; potential energy principle, direct and indirect methods of the calculus of variations, deflection analysis of beams, including effects of nonuniformity of loading and sectional properties. Prerequisite: Engineering 15.

3 units, autumn, (Mayers), MWF 2
winter, (Mayers), MWF 2

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

3 units, winter, (Mayers), MWF 10

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

3 units, spring, (Mayers), MWF 10
and prediction of performance of aircraft powered by reciprocating and turboprop engines. Influences of design and operating parameters upon characteristics of controllable, constant speed, and dual rotation propellers are examined in some detail. Prerequisite: 200a.

2 units, winter, (Reid), TTh 9


3 units, autumn, (Flügge-Lotz), MWF 1


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

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. 238a, or permission of the instructor.

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

209. Dynamics of Viscous and Non-Newtonian Fluids—General conservation laws and constitutive equations. Dynamics of a fluid containing small solid particles. Theory of Brownian motion. Motion of drops and bubbles in fluid media. Introduction to the physics of non-Newtonian fluids. Examples illustrating the motion of non-Newtonian fluids. Selected topics in physiological and chemical hydrodynamics. Prerequisite: 207 or permission of instructor.

3 units, autumn, (Chang), by arrangement

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.

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, (Karamcheti), MWF 1:15

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

3 units, spring, (Karamcheti, Staff), 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
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SCHOOL OF ENGINEERING

211c. **Physical Gasdynamics**—Kinetic theory of gases in translational nonequilibrium: concepts from statistical mechanics; Boltzmann equation; molecular encounters and related concepts; conservation equations; H-theorem; Maxwell distribution; Chapman-Enskog method; viscosity and thermal conductivity for different molecular force models; selected applications. Prerequisites: 292 and acquaintance with basic equations of viscous flow, or consent of instructor.

3 units, autumn, (Karamcheti), 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


2 units, winter, (Lomax), TTh 9

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

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

217. **Aerodynamic Heating**—Definition of, and factors that influence aerodynamic heating; relation of aerodynamic heating rates to structural temperature 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 1964-65

218. **Turbulence Theory**—Statistical description of a turbulent velocity field; energy transfer in homogeneous turbulence; steady fully developed turbulence; free turbulence; turbulent free convection; turbulent diffusion of scalar quantities (e.g., temperature) and vector quantities (e.g., magnetic field); geophysical and astrophysical applications.

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

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

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

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


3 units, autumn, (Bershader), T 2:15-3:05 and Th 2:15-4:05

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

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

227. Introduction to Space Physics—Introduction to selected topics of geophysics and astrophysics with emphasis on conditions in the solar and terrestrial atmospheres and in interplanetary space. Solar-terrestrial relations, sun spots, flares, solar wind, geomagnetic storms, ionospheric disturbances. Theory of motion of charged particles in electric and magnetic fields, drifts, adiabatic invariants, mirroring and trapping in a dipole field, magneto-ionic theory, with application to Van Allen belts, cosmic rays and radio wave propagation in the ionosphere.

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

229. Colloquium on Life Science Problems in Space Exploration—Basic physiological principles with special emphasis on the cardiovascular, respiratory, metabolic and endocrine systems and their responses to space-related environmental stresses. Aspects of life-support protective systems and habitability of spacecraft. Human behavior under flight conditions.

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

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

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

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, (R. M. Carlson), M 3:15-5:05, alternate years, to be given in 1964-65

242a. Classical Dynamics I—Dynamics of a particle, relative motion, inertia forces, dynamics of systems of particles, D'Alembert's principle, general theorems of momentum and energy, applications to satellite motion, impact, dynamics of rigid bodies, laws of impulsive motion, Euler angle transformations.

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

summer (Anliker, Staff)

242b. Classical Dynamics II—Brief review of rigid body dynamics and the dynamics of systems of particles. Basic concepts of analytical mechanics, generalized coordinates, holonomic and non-holonomic mechanical systems, Lagrange's equation, elements of calculus of variations, Hamilton's principle, canonical equations of motion, canonical transformations, the partial differential equation of Hamilton-Jacobi.

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

3 units, winter, (Anliker), MWF 12

244. Basic Problems in Aeroelasticity—Deformation of aircraft structures under static and dynamic loads, lift distribution on elastic wings, static aeroelastic phenomena, approximate methods of computing natural mode shapes and frequencies, general outline of flutter analysis, dynamic response phenomena, statistical methods of loads analysis.
3 units, spring, (Anliker, Staff), MWF 8

3 units, autumn, (Goodier), MWF 9

3 units, winter, (Goodier), MWF 10

3 units, winter, (Flügge), MWF 9

3 units, spring, (Flügge), MWF 9

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

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

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

3 units, spring, (Hoff, Nachbar), TTh 1:15-2:30, alternate years, to be given in 1965-66
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, spring, (Nachbar), M 3:15-6:00

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, (R. L. Carlson), MWF 11

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

3 units, autumn, (Horton), 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, interferometric methods, optical projectors and comparators; brittle lacquers, photoelastic coating tests, analog and model techniques; nondestructive test systems for field use including liquid penetrant, eddy-current, magnetic and ultrasonic tests.

3 units, winter, (Horton), TTh 2:15-4:05

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), 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. Space vehicle dynamics and attitude control. Aircraft stability and response. Automatic flight-control-system synthesis. Prerequisites: 242a (or E.M. 222) and E.E. 128.

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


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

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

274. High Speed Flight Trajectories in the Atmosphere—The flight mechanics of powered and coasting vehicles at speeds up to several times orbit speed, the problems associated with the boost and entry phases of space flight such as trajectory selection to maximize payload or to minimize heating and acceleration loads and the techniques for guidance and navigation during these critical phases. Prerequisites: 271 and 279b 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 mechanization. Prerequisites: 279a and 272a or consent of instructor. (279a or 272a 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 include 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

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. Rigid body dynamics of space vehicles; 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 Bronwer, 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.

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 elec-
tromagnetic means. Electrical power sources in space. Ballistic analysis of electrical systems. Prerequisite: Electromagnetic theory or consent of instructor.

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


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


3 units, winter, (Chang), MWF 10


3 units, spring, (Chang), MWF 10

286. Conducting Fluids in a Magnetic Field—Interactions of conducting fluids and electromagnetic fields in situations of aerodynamic interest: boundary layers, channel flows, upstream and downstream wakes, shock layers, lifting bodies. Primary emphasis will be on physical interpretation of continuum flow theory and electromagnetism. Prerequisite: 285b or equivalent familiarity with plasma theory.

2 units, autumn, (Griffith), W 2:15-4:00

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

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

290. Problems in Aeronautics and Astronautics—Investigation, experimental or theoretical, of problems in aeronautics and astronautics. Offers opportunity to students to work in any field of special interest.

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

291. Linear Transforms and Their Applications to Engineering Problems—Introduction to linear integral transforms: Fourier, Laplace, Hankel, Mellin transforms. Applications to boundary value problems in solid and fluid mechanics, heat conduction, wave propagation. Inverse transformation, contour integration, approximations. Methods of steepest descent and stationary phase. Prerequisite: Mathematics 106 (may be taken concurrently).

3 units, autumn, (Kelly), MWF 11

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


3 units, winter, (Lee), TTn 11:00-12:15

294. 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. 214.) Prerequisites: 293 or 245a and E.M. 209.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Description</th>
<th>Units</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>295</td>
<td>Seminar in Solid Mechanics</td>
<td>Problems in all branches of solid mechanics. All Ph.D. candidates in solid mechanics are normally expected to attend. Registration for a unit of credit, without letter grade, is optional; a letter grade is given for students presenting talks. (Enroll in E.M. 295.)</td>
<td>3</td>
<td>spring, (Lee), MWF 10</td>
</tr>
<tr>
<td>296</td>
<td>Seminar in Fluid Mechanics</td>
<td>Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are expected to attend. 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.)</td>
<td>1</td>
<td>autumn, winter, spring, (Goodier), Th 3:15</td>
</tr>
<tr>
<td>297</td>
<td>Seminar in Flight Control and Guidance</td>
<td>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.</td>
<td>1</td>
<td>autumn, winter, spring, (Cannon), by arrangement</td>
</tr>
<tr>
<td>298</td>
<td>Seminar in Space Technology</td>
<td>Study of recent advances in the design and operation of spacecraft, particularly their propulsion (including electric propulsion) and structures. Aspects of guidance, communications, and the space environment will be discussed when appropriate. Registration for 1 unit optional.</td>
<td>1</td>
<td>autumn, winter, spring, (Seifert), W 4</td>
</tr>
<tr>
<td>300</td>
<td>Thesis</td>
<td>Investigation of some engineering problem. Required of candidates for degree of Engineer.</td>
<td>2 to 15</td>
<td>any quarter, (Staff), by arrangement</td>
</tr>
<tr>
<td>301</td>
<td>Thesis</td>
<td>Dissertation for degree of Doctor of Philosophy.</td>
<td>2 to 15</td>
<td>any quarter, (Staff), by arrangement</td>
</tr>
</tbody>
</table>

CHEMICAL ENGINEERING*

Executive Head: David Malcolm Mason (on leave 1964-65)
Acting Executive Head: Andreas Acrivos
Professors: Andreas Acrivos, Michel Jean Boudart, David Malcolm Mason (on leave 1964-65)
Associate Professors: William Herman Schwarz, Douglass James Wilde
Assistant Professor: Robert Ernst Johnk
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 interested in applied chemistry 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 and re-

* The curriculum leading to the B.S. Degree in Chemistry is described elsewhere in this Bulletin.
search 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 research. The general University regulations for these advanced degrees are described in the section “Degrees” in this Bulletin. The departmental requirements are summarized below.

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

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. A description of some of the available fellowships may be found in the University Information Bulletin. Application forms may be procured by writing the Department of Chemical Engineering. Applications should be made 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.

<table>
<thead>
<tr>
<th>First Year</th>
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<tbody>
<tr>
<td><strong>Course No.</strong></td>
</tr>
<tr>
<td>Chem. 1, 2, 3. General Chemistry</td>
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<tr>
<td>English 1, 2, 3. Freshman English</td>
</tr>
<tr>
<td>History 1, 2, 3. Western Civilization</td>
</tr>
<tr>
<td>Math. 41, 42, 43. Analytical Geometry and Calculus</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
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</table>

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<thead>
<tr>
<th>Second Year</th>
</tr>
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<tbody>
<tr>
<td><strong>Course No.</strong></td>
</tr>
<tr>
<td>Ch.E. 10. Introduction to Chemical Engineering</td>
</tr>
<tr>
<td>Ch.E. 140a. Unit Operations : Stage Operations</td>
</tr>
<tr>
<td>Chem. 121, 123. Organic Chemistry</td>
</tr>
<tr>
<td>Chem. 122. Organic Preparations</td>
</tr>
<tr>
<td>Engr. 9. Engineering Drawing</td>
</tr>
<tr>
<td>Engr. 11. Engineering Mechanics (Statics)</td>
</tr>
<tr>
<td>Humanities Electives</td>
</tr>
<tr>
<td>Physics 51. Mechanics</td>
</tr>
<tr>
<td>Physics 52. Mechanics Laboratory</td>
</tr>
<tr>
<td>Physics 53. Electricity</td>
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<tr>
<td>Physics 54. Electricity Laboratory</td>
</tr>
<tr>
<td>Speech 20. Public Speaking : Practice and Criticism</td>
</tr>
<tr>
<td>Social Science Electives</td>
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<tr>
<td><strong>Totals</strong></td>
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<tr>
<th>Third Year</th>
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<tbody>
<tr>
<td><strong>Course No.</strong></td>
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<tr>
<td>Ch.E. 120a, b. Chemical Engineering Thermodynamics</td>
</tr>
<tr>
<td>Ch.E. 140b. Unit Operations : Fluid Flow and Heat Transfer</td>
</tr>
</tbody>
</table>
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.

**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>Engr. 9.</td>
<td>Engineering Drawing</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English 1,2,3.</td>
<td>Freshman English</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>History 1,2,3.</td>
<td>Western Civilization</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Math. 41, 42, 43.</td>
<td>Analytical Geometry and Calculus</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Physics 52.</td>
<td>Mechanics Laboratory</td>
<td>4</td>
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<tr>
<td>Physics 53.</td>
<td>Electricity</td>
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<td>4</td>
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<td>Physics 54.</td>
<td>Electricity Laboratory</td>
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<tr>
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<td>16</td>
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**Second Year**

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<tr>
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<tr>
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<td>Ch.E. 140a.</td>
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<td>Engr. 11.</td>
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<td>Engr. 15.</td>
<td>Mechanics of Materials</td>
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<td>Engr. 41.</td>
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### Third Year

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<td>Chem. 171, 173, 175.</td>
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### Fourth Year

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<th>Course No.</th>
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<td>Ch.E. 130b.</td>
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<tr>
<td>Ch.E. 150.</td>
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<tr>
<td>Ch.E. 160.</td>
<td>Chemical Engineering Plant Design</td>
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<td>Engr. 161.</td>
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<td>Stat. 27.</td>
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<td><strong>Totals</strong></td>
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*3 units, autumn, (Wilde), MWF, hour by arrangement*

2. **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), MWF, hour by arrangement*

3. **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), MWF, hour by arrangement*

4. **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, (Johnk), MWF, hour by arrangement*

5. **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, (Schwarz), MWF, hour by arrangement*
140a. Unit Operations: Stage Operations—Application of the equilibrium-stage concept to design of mass-transfer processes; phase relationships; countercurrent multistage extraction and distillation processes, simplified graphical and computer design methods; optimization.

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

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, (Schwarz), MWF, hour by arrangement

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, (Johnk), MWF, hour by arrangement

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, (Johnk), by arrangement

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

3 units, spring, (Johnk), by arrangement

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

3 units, spring, (Boudart), MWF, 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), Th 7-9 p.m.

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

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

3 units, autumn, (Boudart), by arrangement


3 units, autumn, (Wilde), by arrangement

202. Multivariable Optimization—Finding the optimum values of design or operating variables affecting a given economic objective. Optimum seeking methods: Fibonacci, contour tangent, steep ascent, parallel tangents, pattern search, and stochastic approximation. Optimization of serial, branching, and cyclic systems by
extensions of dynamic programming. Open to undergraduates with consent of instructor.

3 units, winter, (Wilde), by arrangement

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), 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), by arrangement

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, (Acrivos), by arrangement

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, (Johnk), by arrangement


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

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

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

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 1964-65
232b. Electrochemical Thermodynamics and Kinetics—Continuation of 232a. (Enroll in Chemistry 277b.)  
2 units, spring, (Van Rysselberghc), TTh 9, alternate years, to be given in 1964-65

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

280% Chemical Engineering Advanced Research—Laboratory or theoretical work for graduate students on specific, approved, advanced chemical engineering problems leading to partial fulfillment of requirements for M.S. or Ph.D. degrees. Credits are not given until a satisfactory report is received for M.S. students or until a dissertation is approved for Ph.D. students.  
(Staff), by arrangement

CIVIL ENGINEERING

Emeriti: Eugene Lodewick Grant, Charles Moser, Alfred Salem Niles, Stephen P. Timoshenko, James Bertrand Wells (Professors); Eugene Valentine Ward (Lecturer)

Executive Head: Ray K. Linsley  
Associate Executive Head: Joseph B. Franzini  
Assistant Executive Head: Robert L. Street  
Professors: Jack R. Benjamin, Rolf Eliassen, Wilhelm Flügge, Joseph B. Franzini, James M. Gere, Miklos Hetényi, Ray K. Linsley, Julius Margolis, Clarkson H. Oglesby, John K. Vennard, Harry A. Williams, Donovan H. Young  
Associate Professors: James Douglas, John W. Fondahl, En Yun Hsu, Paul Kruger, Perry L. McCarty, Henry W. Parker, Byrne Perry, Vincent J. Roggeveen, Cedric W. Richards  
Assistant Professors: Norman H. Crawford, Robert L. Street, William Weaver, Jr.  

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 hydraulics laboratory and the newly renovated George Havas Building which houses water quality, sanitary, structural, and strength of material laboratory facilities. Office space is provided for most of the graduate students who are acting as research or teaching assistants.

PROGRAMS OF STUDY

Bachelor of Science

In addition to the basic University requirements for the B.S. degree, students in civil engineering must complete the specific course requirements for all engineers and for Civil Engineering. Because of the considerable amount of time allotted to other than civil engineering in the undergraduate program, qualified students should seriously consider graduate study to equip themselves for advanced professional work.

Master of Science

Programs are available leading to the degree of M.S. in civil engineering with special designation on the diploma as follows: 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 mini-
mum 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 temp. adviser until such time as a member of the faculty has agreed to direct the dissertation research. Insofar as possible the program of study is adapted to the interests and needs of the student within the framework of the requirements of the Department and the University. In the second year of graduate study the student is expected to pass the Departmental Qualifying Examination, and to complete a substantial amount of the required foreign language work in order to be admitted to candidacy.

FINANCIAL ASSISTANCE

The Department maintains a continuing program of financial aid for graduate students. Fellowship or scholarship awards range from $500 to $4,000. Teaching assistantships carry stipends for one-third time work as teaching aides during the academic year. Research assistantships are also available; research results may be used as a basis for a doctoral thesis. Assistantships and support may be supplemented by fellowship and scholarship awards. Continued support is available for further study toward the Engineer or Doctor of Philosophy degree when performance justifies such support. Detailed information may be obtained by writing to the Department of Civil Engineering.

UNDERGRADUATE COURSES

20. Elementary Surveying—Care and use of instruments; leveling; transit-tape and stadia traverses; topographic surveying; triangulation; plotting and adjusting of field data; computing of areas and topographic mapping. (Limited to 36 students per section.)

3 units, spring, (Douglas), 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, (Weaver), MWF 8

spring, (Young), MWF 11

116. Plain Concrete—Physical properties of concrete and its constituents. (Limited to 20 students per section.)

3 units, autumn, (Douglas), T 1:15-5:05 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 11; lab. W 1:15-4:05

126. Advanced Surveying—Highway reconnaissance and location, horizontal and vertical curves, earthwork computations, photogrammetry, construction surveys, ad-
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SCHOOL OF ENGINEERING

justment of instruments, city and land surveying, plane table, engineering astronomy. Prerequisite: 20.
4 units, spring, (Parker), 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, (Oglesby), 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, (Staff), TTh 8; lab. M 1:15-4:05
winter, (Staff), 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, (Roggeveen), 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, (Oglesby), TTh 8; lab. M 1:15-4:05

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

160. Hydrology 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, (Franzini), MTThF 9

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

2 units, winter, (Vennard), TTh 9

166. Elements of Sanitary Engineering—Water purification, sewage treatment, refuse disposal. Open to senior, graduate engineering students; others by permission.
3 units, winter, (McCarty), TTh 8; lab. T 1:15-4:05

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, (Kruger), TTh 11 and one hour by arrangement

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. (Enroll in Engineering 172.)

3 units, autumn, (P. 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. Prerequisites: Engineering 172 or 175 or consent of instructor. (Enroll in Engineering 176.)

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

180. Elementary Structural Analysis—Analysis of beams, trusses, frames; influence lines for beams, girders, trusses; 3-dimensional trusses; cable structures; deflections by virtual work, moment-area, elastic loads; indeterminate analysis by superposition equations, slope-deflection, moment distribution; introduction to matrix methods of analysis. Prerequisite: Engineering 15.

4 units, 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, (Weaver), MWF 9

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

3 units, winter, (Weaver), MWF 8

183. Design of Timber Structures—Loads, structural elements, fastenings, connectors; design of timber trusses, glued-laminated frames and arches, plywood shell roofs; lateral analysis using sheathed diaphragms. Prerequisites: 180 and 181.

2 units, spring, (Weaver), TTh 10

184. Statically Indeterminate Structures—Analysis of statically indeterminate structures by advanced methods. Prerequisite: 180.

3 units, spring, (Weaver), MWF 11

190. Soil Mechanics and Foundations—Soil as an engineering material; application of soil mechanics to foundation design; footings, retaining walls; various types of foundations. Prerequisite: 182.

4 units, spring, (Williams), MWF 9; lab. T or W 1:15-4:05

198. Senior Report—Practice in execution of a simple engineering investigation, preparation of a written report on the investigation. Required of all candidates for the Bachelor's degree during either of the last two quarters before graduation.

1 unit, 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

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

3 units, autumn, (Vennard), MWF 10

207. Advanced Hydraulic Laboratory—Prerequisite: 107, or equivalent.

2 units, winter, spring. (Vennard, Hsu), by arrangement

3 units, winter, (Vennard), MWF 11

209. **Hydraulics of Open Channels**—Varied flow, hydraulic jump, hydraulics of open-flow structures; intakes, transitions, measuring flumes, spillways, culverts, etc. Prerequisite: 107.

3 units, spring, (Vennard), MWF 8


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

215. **Advanced Work in Experimental Mechanics**—Individual projects on selected subjects. Limited enrollment. By arrangement with instructor. (Same as E.M. 273.) Prerequisite: 214.

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

216. **Mechanical Properties of Materials**—Elastic, inelastic behavior, failure of ductile and brittle materials. Theories of strength of solids. Fatigue, impact, creep. (Same as E.M. 215.) Prerequisite: 114.

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. By permission of instructor.

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

232. **Decision Making in Structural Engineering**—Applications of statistical decision theory in structural engineering practice; decision theory; value; prior; posterior; expected value; formulation of problems; economic analysis; study of office practice. Prerequisite: 297.

2 units, spring, (Benjamin), MW 8

240. **Operations Analysis for Work Improvement in Construction**—Application of crew balance, process charts, time-lapse motion pictures, and operations research techniques to construction operations. Accident prevention. Prerequisite: graduate standing.

2 units, autumn, (Oglesby), TTh 2-3; 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, autumn, (Fondahl), TTh 10 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

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

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, winter, (Fondahl), TTh 2:15

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

4 units, spring, (Parker), MWF 9 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 and 145.

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, (Oglesby), by arrangement

250. Transportation Planning—Planning of facilities for all modes of transportation with emphasis on current developments in systems analysis, application of computers, urban land use-transportation models, etc. By permission of instructor. (Same as E.E.S. 311.)

3 units, spring, (Roggeveen), MWF 1:15, alternate years, to be given in 1965-66

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

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

260. Advanced Hydrology—Meteorology, climatic data, precipitation, evapotranspiration, and streamflow, techniques of measurement and interpretation.

4 units, autumn, (Linsley), MWF 9; 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: 261.

2 units, spring, (Franzini), MW 9

265. Flow in Permeable Media—Fluid mechanics of subsurface flow. Basic concepts, Darcy's law, potential flow theory with application to groundwater and seepage flow, effects of varying permeability and capillary action. Formulation of boundary-value problems and solution by series and complex variable techniques. Prerequisites: 107, and Mathematics 130 or permission of the instructor.

3 units, winter, (Perry), TTh 9 and one hour 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 ship waves, torques on supercavitating hydrofoils, unsteady flow in open channels, wave forces on structures, steady and unsteady seepage flow, density currents, stability of jets, flow over weirs and spillways. (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, (Franzini), T 4:15-6:05

269. Hydraulic Engineering Seminar—Discussions on all phases of hydraulic engineering.

2 units, spring, (Franzini), W 3-5

270. Water Quality Control I—Natural and man-made characteristics of water quality; effect of quality on the use of water; unit operations of water quality control for municipal and industrial use. Prerequisite: 166 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

278. Radioactivation Analysis—The use of radioactivation as a research tool: radioactivation, properties of radioisotopes, sources of irradiation, practices and uses in biology, chemistry, and engineering. An additional unit is optional for a report on an original activation analysis experiment.

1 unit, winter, (P. Kruger), T 1:15


3 units, autumn, (Young), MWF 8

281a. Matrix Analysis of Structures—Introduction to matrix algebra; use of matrix methods in the analysis of statically and kinematically indeterminate structures; flexibility and stiffness methods. Prerequisite: 114.

3 units, 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, (Weaver), MWF 11

283. Advanced Structural Analysis—Membrane stresses in tanks, shell roofs; discontinuity stresses in domes, tanks, barrel shell roofs; introduction to plane plate theory. Prerequisite: 281.

4 units, spring, (Flügge), TTh 11 and two afternoons by arrangement
284. Design of Prestressed Concrete Structures—Analysis and design of prestressed slabs, beams, and columns; special problems; design and testing of beam in laboratory. Prerequisite: 182.
   2 units, autumn, (Benjamin), 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

289. Plastic Design of Steel Structures—Limit design concepts applied to the design of steel frames; collapse loads, deflections, secondary considerations, special problems. Prerequisites: 181, and 285, or E.M. 211.
   2 units, winter, (Weaver), TTh 10

290. Soil Mechanics—A re-examination of fundamentals of soil mechanics; advanced theory. Problems studied concern consolidation and settlement, shear of soil masses, pore pressure, and bearing failures. Prerequisite: 190.
   2 units, autumn, (Williams), TTh 9

291. Soil Mechanics—Seepage and flow nets; slope stability; embankment design; earth retaining structures. Prerequisite: 190.
   3 units, winter, (Williams), TTh 11 and M 4:15

   2 units, spring, (Williams), TTh 9

293. Foundation Design—Design, construction of foundations for buildings, bridges, Prerequisite: 190.
   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 11

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, (Weaver), TTh 9

297. Statistics for Structural Engineers—Applications of probability and statistical analysis to structural engineering; probability theory; descriptive statistics; safety; recognition of variation; statistical inference; regression analysis.
   3 units, winter, (Benjamin), MWF 10

298. Stability Problems—Beam-columns; elastic buckling of columns; non-pris-
matic 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


2 units, autumn, (Hetényi), TTh 10

Civil engineering graduate students with interests in special fields will also take appropriate courses in other schools and departments of the University including the Graduate School of Business, Division of Engineering Mechanics, the 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


PROGRAMS OF STUDY

Undergraduate

Students desiring to specialize in electrical engineering during their undergraduate period may do so by following the curriculum given earlier in the general discussion of the School of Engineering. Variations of this curriculum are encouraged if there is good reason for change. Attention is also called to the Engineering Science curriculum in the same general section.

Advanced Degrees

The practice of the profession of electrical engineering requires broad ability in both scientific thinking and the art of working with men. As education for those who wish to engage in this profession with competence, four years of undergraduate study and at least one year of postgraduate study are strongly recommended. The undergraduate and graduate curricula at Stanford are planned to offer as much as possible of the breadth of education needed for leadership in the profession as well as knowledge of the physical sciences and the basic professional techniques.

The Electrical Engineering Department offers graduate work in the following fields:

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

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 on page 82. In preparing a program of graduate study the following four basic requirements should ordinarily be satisfied.

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

2. Fundamental Courses—If the following courses or reasonable equivalents have not been taken previously, they should be included in the graduate program: ordinary differential equations (Mathematics 130), atomic physics (Physics 57), circuits; transmission lines (E.E. 107), electronic circuits (E.E. 150, 151, 152), Control Systems (E.E. 128), and elementary electromagnetic theory (E.E. 103 or 270n). 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.

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<tr>
<th>Course No.</th>
<th>Subject</th>
<th>First Year</th>
<th>Second Year</th>
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<td>A</td>
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<tr>
<td>Engr. 41, 42, 41L, 42L. Circuits, Electronics, and Electromechanics</td>
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<tr>
<td>E.E. 104, 105. Circuits</td>
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<td>E.E. 106, and 270n, 107 and 235 or 240. Circuits, networks</td>
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<td>E.E. 103. Fields</td>
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<td>E.E. 128. Control Systems</td>
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<td>E.E. 150, 151, 152, 161. Electronics</td>
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<td>E.E. 156, 157, 170, 171. Laboratory</td>
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<td>E.E. 200. Seminar</td>
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<td>E.E. 220. Pulse and timing circuits</td>
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<td>Mathematics 130. Differential equations</td>
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<td>Physics 57, 110, 111. Atomics, mechanics</td>
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<td>Optional courses selected from the following list</td>
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<td>Totals</td>
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List from which optional courses are selected include:

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<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
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<th>Spring</th>
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<tr>
<td>E.E. 124. Electromechanics</td>
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<td>E.E. 138. Control systems</td>
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<td>E.E. 162. Radio Engineering</td>
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<td>E.E. 231, 232. Amplifier circuit theory</td>
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<td>E.E. 226. Two-Port Network Theory</td>
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<td>E.E. 236, 237. Network synthesis</td>
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<td>E.E. 250a, 250b. System Analysis</td>
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<td>E.E. 244, or 251a, 251b. Theory of communication</td>
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<td>E.E. 253a. Detection Theory</td>
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<td>E.E. 271, 272. Applied electromagnetic theory</td>
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<td>Mathematics 106. Complex variable</td>
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**FELLOWSHIPS, SCHOLARSHIPS, AND ASSISTANTSHIPS**

The Department each year awards a number of fellowships, scholarships, and assistantships which are available to graduate students. Detailed information concerning these may be obtained by addressing the Assistantship Committee of the Electrical Engineering Department.

Areas of research include:

- Adaptive Components
- Aerospace Electronics
- Antennas and Interferometry
- Circuit and Device Applications
- Controls
- Defense Systems Engineering
- Digital Switching Networks
- Electron Dynamics
- Illumination
- Ion Propulsion
- Magnetic, Electronic, and Optical Properties of Solids
- Microsystem Electronics
- Microwave and Optical Propagation
- Microwave Tubes
- Network 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.


104, 105, 106. Circuits—Analysis of networks, including both transient and steady states of operation: methods of analysis for simple circuits, substitution methods, nonlinear devices, Fourier analysis, polyphase circuits, resonance, graphical analysis, network equations based on Kirchhoff's two laws, network theorems, exponential series, and Fourier integral, transients and the complex frequency plane, Laplace transformation, two-terminal-pair networks. Prerequisites: Mathematics 22 or 42, Physics 53, and Engineering 41 and a C+ average in analytic geometry, calculus, physics, and electrical engineering courses taken. E.E. 105 and 106 may be taken concurrently.

104. 3 units, autumn, (——), MWF 9
     winter, (——), MWF 9
     105. 3 units, winter, (——), MWF 10 or 11
          spring, (——), MWF 8
     106. 4 units, autumn, (——), MTThF 9
          spring, (——), MTThF 10 or 11

107. Circuits: Transmission Lines—Differential equations of transmission lines and circuits with distributed constants; traveling wave solution; standing wave solution; trigonometric, hyperbolic functions of complex arguments; typical characteristics of lines in power, telephone, radio practice; impedance matching; approximations valid at high frequency; lines as circuit elements. Prerequisites: E.E. 104, and preferably E.E. 103.

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.

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. 106 and Engineering 42.

3 units, autumn, (——), MWF 10
winter, (——), MWF 8
spring, (——), TThS 11


3 units, winter, spring, 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. 104.

150. 3 units, autumn, (——), MWF 8 or 9
winter, (——), MWF 11
spring, (——), MWF 11

151. 3 units, winter, (——), MWF 8 or 9
spring, (——), MWF 11

152. 3 units, autumn, (——), MWF 11
spring, (——), MWF 8 or 9


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. Electronic Circuits and Processes—Frequency conversion, signal processing and noise; emphasis on engineering applications and considerations; continuation of E.E. 152 with particular attention to modulation, detection, spectrum analysis, characteristics of modulation systems, etc.; physical sources of noise, noise figure and temperature concepts, basic statistics of noise. Prerequisites: E.E. 106 and 152.

3 units, winter, (——), MWF 8 or 1:15

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. 161.

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, spring, summer, (McWhorter, Staff)

170, 171, 172. Electronic Measurements—Primarily laboratory, one or two lectures per week; principles and methods of electronic measurement. Prerequisites: E.E. 152, 157; 107 and 161 should precede or be taken concurrently with 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. Design Project—Individual or team project emphasizing creative design of
electrical devices or systems to meet specifications. Prerequisite: senior standing.
3 units, spring, ( ), TTh 9 and 3-hour lab. weekly by arrangement

191. Special Studies in Electrical Engineering—Special studies, laboratory work, reading, etc. under direction of faculty member. Student must find faculty sponsor and have approval of his adviser. A term paper is required.
2 to 3 units, ( ), by arrangement

COURSES PRIMARILY FOR GRADUATE STUDENTS

200. Seminar—Weekly discussion of special topics of current interest in electrical engineering. Normally taken each quarter for 3 quarters by graduate students.
1 unit, autumn, winter, spring, (Garriott), Th 11

208. Illumination Seminar—Discussions on current literature, research, developments in all branches of illumination engineering. Students desiring to do special research in illumination should register under this number. Prerequisite: E.E. 108 or equivalent.
2 or more units, autumn, winter, spring, (Brown)

For description of Courses 209p-219p, see Applied Physics 255-378


210p. Advanced Microwave Theory—(Enroll in Applied Physics 256.)
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.)

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.
2 to 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)

228. **Transistor Electronics**—Discussion of linear amplifiers, active circuits, nonlinear switching and regenerative circuits based on the network theory of E.E. 226 and the circuit models developed for transistors in E.E. 227. Prerequisites: E.E. 226 or 236 with approval of instructor, and 227.

3 units, spring, (J. Linvill, Staff)

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. (Given as E.E. 221 in 1963-64.)

3 units, winter, (McWhorter, Staff)


3 units, spring, (McWhorter, Staff)

234. **Nonlinear Network Analysis**—Introduction to the analysis (steady-state and transient) of networks containing nonlinear elements, both passive and active. Energy considerations. Discussion of methods of analysis with emphasis on approximate methods (graphical, numerical, analytical), particularly averaging techniques. Resonance. The describing function. Oscillators (waveshapes, amplitude limitation), elementary control systems. Prerequisites: E.E. 106, 128, and 152.

3 units, spring, (Tuttle)

235. **Introduction to Network Synthesis**—A one-quarter survey of the principal ideas of network theory, for both passive and active networks. Properties of networks, practical limitations on their performance, and procedures for their synthesis. (The study of network synthesis is continued in E.E. 236 and 237 for those interested in advanced work in the subject.) Prerequisite: E.E. 106.

3 units, autumn, (Tuttle, Staff)

236, 237. **Advanced Network Synthesis**—A continuation, with greater detail and more extensive coverage, of the study of Network Synthesis begun in 235. Topics include: rigorous discussion of the basic limitations on network performance, synthesis of two- and four-terminal networks of various classes, methods of approximation (with particular attention to the potential analogy), conventional and insertion-loss methods of filter design, transformerless and transmission-line networks. Prerequisite: E.E. 235.

236. 3 units, winter, (Tuttle, Staff)

237. 3 units, spring, (Tuttle, Staff)

of linear systems to random signals. Applicability of transform methods to topics such as Wiener filtering microwave optics, TV image formation, antenna pattern analysis, modulation. Prerequisite: E.E. 106 or equivalent. Concurrent or prior registration in Statistics 116 or Mathematics 123 is recommended.

5 units, autumn, spring, (Abramson, Bracewell)

244. Introduction to Communication Theory—Mathematical representation of determined and random signals; sampling theorems and signal space; information measure, channel capacity, coding; shot-noise model, gaussian random process; network analysis with random signals. Not intended for students who plan to take E.E. 251, 252, and 254. Prerequisite: E.E. 106. Previous or concurrent registration in Statistics 27 or Statistics 116 is desirable.

3 units, winter, (Harmon)


3 units, winter, (Widrow)


3 units, spring, (Widrow)


3 units, autumn, (Franklin)

248. Seminar on the Theory of Systems—Discussion of research problems and current literature in the theory of systems as applied to control, communication, and computation by faculty, students, and outside specialists.

1 unit, autumn, winter, spring, (Fliigge-Lots, Staff)


3 units, spring, (Widrow)


3 units, winter, spring, (W. Linvill)


3 units, winter, (Abramson, Kailath)
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, (Abramson, Kailath)


3 units, winter, (Kailath, Abramson)


3 units, spring, (Kailath, Abramson)

253c. Communication Channels—Study of communication channels with more than two inputs. Channel capacity. Calculation of channel capacity and error probability of Gaussian channels and of discrete memoryless channels. Application of error-probability bounds to problems of signal design, input and output quantization, and probabilistic decoding. Convolutional encoding with successive, sequential and threshold decoding. Prerequisite: E.E. 253b.

3 units, autumn, (Kailath)

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, (Abramson)


3 units, winter, (———)

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, (———)

257a, b, c. Solid State Electronics Laboratory—Experiments 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.

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. Quantum Mechanics for Engineers—Introduction to the concepts of quantum mechanics; the postulates of quantum mechanics; observables, wave functions, and probability density; the Schrödinger equation; complimentary 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; time independent perturbation theory. Prerequisites: Physics 57, 110 and 111, and Mathematics 130 and 131, or equivalent.

3 units, autumn, (White)

260. Quantum Mechanics for Engineers—Time dependent perturbation theory; transition probability; identical particles and exchange; the Dirac relativistic electron; energy levels of atoms; elementary band structure; symmetry properties of wave functions. Prerequisite: E.E. 259.

3 units, winter, (White)


3 units, autumn, (Staff)


3 units, winter, (Staff)

266. Digital Computer Circuitry—Arithmetic operations in digital computers. Survey of storage, switching, input-output devices finding applications in computing, data processing, control systems, communication systems. Prerequisites: E.E. 152 and Mathematics 44.

3 units, spring, (Peterson, Mattson)


2 units, summer, (Peterson)


3 units, autumn, (Garriott, Pantell)


271. 3 units, autumn, winter, (Buncman, Staff)

272. 3 units, winter, spring, (Buncman, Staff)

273. Guided Waves—Review of uniform wave guide theory. Wave guide modes; microwave network 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. 272.

3 units, spring (Kino)

masers and other amplifiers. Prerequisites: E.E. 270n or equivalent, and either E.E. 260, or Physics 132, or equivalent.

3 units, autumn, (Siegman)


3 units, winter, (Heffner)

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. 286, or permission of instructor.

3 units, winter, (Helliwell)


3 units, spring, (Bracewell)

277. Theory and Application of Radio Wave Scattering—Theory of radio wave scattering from electron ensembles (e.g., meteor trails), and from turbulent and thermal fluctuations in a plasma. Scattering from metallic and dielectric spheres, cylinders, and laminas, of small and large size. Emphasis on physical descriptions and on applications to communications, radar astronomy, and space probes. Prerequisites: E.E. 271 and 286, or permission of instructor.

3 units, autumn, winter, (Eshleman)

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)

286. Elementary Plasma Dynamics—Plasma as a new medium; its significance in space and fusion research; collective and individual phenomena; oscillations; waves; instabilities; Boltzmann and Vlasov equations; dispersion; propagation and Landau damping in cold and hot plasmas, without and with magnetic field; plasma boundaries; sheaths; magnetic confinement. Prerequisite: E.E. 271.

3 units, spring, (Buneman)


290. Special Studies and Reading in Electrical Engineering—Special studies, under direction of a faculty member, for which academic credit may properly be allowed. (This course number is used to give credit for laboratory work, directed reading, etc. A grade of + indicates satisfactory work; no letter grade will be assigned.)

By arrangement

291. Special Studies and Reports in Electrical Engineering—Special studies, under direction of a faculty member, leading to written report or end-quarter examination. Letter grade indicates quality of written work; if letter grade based on written work is not applicable, student should enroll in E.E. 290.

By arrangement

292. Special Seminars—Seminars on particular subjects will be given from time to time. See the Time Schedule for detailed announcements. Subjects of seminars that have been given in the past include:
Crossed Fields  
Medical Electronics  
Digital Devices  
Biocommunications  
Binary Coding Theory  

Laboratory Plasma  
Magneto Phenomena Devices  
Electrodynamics of Moving Media  
Optical Properties of Solids  
Communication Channels

295. Electrical Engineering Instruction—Open to a very limited number of Electrical Engineering students who plan to make teaching their career. (Harman), 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.

1 unit, winter, (Skilling), to be given in 1965-66

297. Faculty Seminar—Discussion meetings arranged by certain faculty members.

1 unit, by invitation

300. Thesis and Thesis Research—Limited to students who have established candidacy for the degree of Engineer or Ph.D. A grade of + indicates satisfactory work; no letter grade is assigned.

By arrangement

Numerical Methods and Theory and Operation of Computing Machines

—See Mathematics 137, 138, 239.

Elementary Nuclear Physics, Quantum Mechanics and Atomic Physics, and Solid State Physics—See Physics 130, 140, 172.

Introduction to Nuclear Engineering—See M.E. 171.


DIVISION of ENGINEERING MECHANICS

Emeriti: Stephen Prokofievich Timoshenko, Lydik Siegumfeld Jacobsen (Professors)

Executive Committee: James Norman Goodier (Chairman), Wilhelm Flügge, Irmgard Flügge-Lotz, Miklos Hetényi, Thomas R. Kane, Erastus Henry Lee, Donovan Harold Young (Professors)

Affiliated Faculty


Associate Professors: Max Anliker, Chi-Chang Chao, Krishnamurty Karamcheti, Byrne Perry, William Craig Reynolds, Cedric W. Richards. Acting: 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 universities and institutes of technology. It also offers programs of study for mechanical, aeronautical, and civil engineers who find that their work involves them in advanced mechanics, and necessitates a year or more of graduate study to acquire a deeper grasp of fundamental concepts and advanced methods.
The Timoshenko Center of Engineering Mechanics provides facilities for special experimentation in conjunction with the laboratories of the Departments of Civil and Mechanical Engineering. Individual accommodation is provided for the work of each research student. Weekly seminar meetings acquaint the students with a great variety of subjects in their field, and give opportunity to practice speaking on a selected topic.

The Division also conducts government-sponsored research projects. Qualified students participate in these as research assistants, engaged in thesis research, in close working association with the faculty director and fellow students. The projects include original experimental and theoretical investigations in the strength and deformability of elastic and anelastic elements of machines and structures, vibrations and nonlinear dynamics, controls and system theory, and the flow dynamics of liquids and gases.

PROGRAMS OF STUDY

Bachelor of Science

The Division operates exclusively on the graduate level and requires the B.S. degree for admission. Suitable preparation for graduate study can be found in the undergraduate curriculum of Engineering Science, in the option Engineering Mechanics of the Department of Civil Engineering, and in the option Mathematics, Physics, and Engineering Mechanics of the Department of Mechanical Engineering.

Master of Science

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin. The following are Divisional requirements.

To secure the recommendation of the Division for the Master's degree, a candidate must include a minimum of 6 graduate units in each of the four subdivisions: (1) Advanced Dynamics, (2) Elasticity and Plasticity, (3) Fluid Mechanics, and (4) Mathematics. 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 the student is adequately prepared to undertake graduate study in Engineering Mechanics and that he has already had the equivalent of the following Stanford courses: C.E. 114 (Mechanics of Materials), Mathematics 130 (Ordinary Differential Equations), and M.E. 160 (Engineering Vibrations). A student who, at the time of admission, is deficient in any or all of these 9 units will be required to make them up during his graduate study; in which case, more than the three quarters of residence normally required to complete the program may be necessary.

Engineer

The University's basic requirements for the degree of Engineer are discussed in the section "Degrees" in this Bulletin. 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, except that candidates who have a strong interest in
Control Engineering may be allowed to substitute appropriate Electrical Engineering courses for one of the subdivisions (2) and (3) above. Reading proficiency in German or Russian must be demonstrated before dissertation research is begun.

FELLOWSHIPS AND ASSISTANTSHIPS

University Fellowships are open to all (prospective) graduate students. See “Scholarships” in the Information Bulletin obtainable from the Registrar. In addition, several special fellowships and research assistantships are offered by the Division. Information and application forms (due March 1) may be obtained through the Secretary, Division of Engineering Mechanics.

COURSES

3 units, autumn, (Young), MWF 8

3 units, autumn, (Hetényi), MWF 9

3 units, winter, (Hetényi), MWF 10

2 units, winter, (Goodier), TTh 1:15

2 units, spring, (Goodier), TTh 1:15

204. Advanced Theory of Elasticity—Topics from contact stress, thermal stress, static instability and finite deformation, dynamic instability, selected in relation to current research. Prerequisites: 202a, b.
2 units, spring, (Goodier), TTh 11, to be given in 1965–66

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 1964–65

2 units, winter, (Goodier), TTh 11, alternate years, to be given in 1964–65

2 units, spring, (Goodier), TTh 11, alternate years, to be given in 1964–65

3 units, winter, (Flügge), MWF 9


3 units, spring, (Flügge), MWF 9


3 units, autumn, (Flügge), MWF 11


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


3 units, autumn, (Flügge), MWF 10


3 units, winter, (Flügge), MWF 11


3 units, spring, (Lee), MWF 10


3 units, autumn, (Richards), TTh 10 and one lab. by arrangement

216a. Physical Structure and Mechanical Strength—Atomic structure of solids. Imperfections. Dislocation theory of yielding, strain hardening, precipitation hardening, recovery, recrystallization. High temperature materials. (Same as Mat.Sci. 205.)

3 units, spring, (Richards), TTh 10 and one lab. by arrangement


3 units, winter, (Tetelman), TTh 1:15-2:45


3 units, autumn, (Flügge), MWF 2:15

218. Advanced Theory of Viscoelasticity—Equivalent mathematical representations of stress-strain relations and connections between them. Stress analysis problems for simple boundary conditions, mixed conditions; and consideration of moving
boundaries. Temperature effects. Wave propagation. Prerequisites: 202a, 217, and 250.

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


2 units, autumn, (Young), TTh 9

222. Dynamics—Dynamics of a rigid body. General momentum and energy theorems; applications to variable mass systems, impact, gyroscopes. Prerequisites: Mathematics 130 and E.M. 221.

2 units, winter, (Young), TTh 9

223a. Advanced Dynamics—Brief review of D'Alembert's principle, momentum and energy principles, laws for impulsive motions. Generalized particle and rigid body kinematics, inertia properties, forces, and force functions. Lagrange's form of D'Alembert's principle. Prerequisites: 221 and 222, or equivalent.

3 units, spring, (Kane), T 9-11 and Th 9


3 units, autumn, (Kane), T 9-11 and Th 9

223c. Advanced Dynamics—Hamilton's principle, the principle of Least Action, Hamilton's canonical equations, the Hamilton-Jacobi differential equation. Integration in series, ignoring of coordinates, use of the energy integral, integral invariants, contact and point transformations. Prerequisite: 223b.

3 units, winter, (Kane), T 9-11 and Th 9


3 units, autumn, (Anliker), MWF 12


3 units, winter, (Anliker), MWF 12


3 units, autumn, (Kane), TTh 2:15 and Th 10


3 units, winter, (Kane), TTh 2:15 and Th 10


3 units, winter, (Flügge-Lotz), MWF 9
241. **Advanced Mechanics of Fluids**—Similitude and dimensional analysis; fluid friction for incompressible fluids in tubes, boundary layers, through granular media; lubrication theory; cavitation. (Same as C.E. 206.) Prerequisite: C.E. 107.

3 units, autumn, (Vennard), MWF 10


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


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

244. **Mechanics of Viscous Flow**—Navier-Stokes equations. Very slow motion. Boundary layer equations for incompressible laminar flow. Energy equation for thermal boundary layers; compressible laminar boundary layer flow. Stability of boundary layer flows; introduction to turbulent flow. Prerequisites: 242 and A.A. 210a, or M.E. 238b, or permission of the instructor.

3 units, spring, (Flügge-Lotz), 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 ship waves, forces on supercavitating hydrofoils, unsteady flow in open channels, wave forces on structures, steady and unsteady seepage flow, density currents, stability of jets, flow over weirs and spillways. Prerequisite: E.M. 246.

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

265. **Special Problems in Structural Mechanics**—General theory of linear structural problems. Energy theorems, reciprocal theorems, normal functions. Applications to spatial deformation of skeletal structures. Extensions to nonlinear aspects. (Same as C.E. 385.) Prerequisite: 200.

2 units, autumn, (Hetényi), TTh 10

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

1 to 5 units, any quarter, (Staff), by arrangement
273. **Advanced Work in Experimental Mechanics**—Individual projects on selected subjects. Limited enrollment. By arrangement with instructor. (Same as C.E. 215.) Prerequisite: 205.

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

295. **Seminar in Solid Mechanics**—Problems in all branches of solid mechanics. All Ph.D. candidates in solid mechanics are normally expected to attend. Registration for a unit of credit, without letter grade, is optional; 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 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, Vai Dyke, Vincenti), T 4:15

300. **Thesis**—Thesis for the degree of Engineer.

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

301. **Dissertation**—Dissertation for degree of Doctor of Philosophy.

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

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**ENGINEERING SCIENCE**

*Program Advisers:* James M. Gere (Chairman), Andreas Acrivos, Richard H. Bube, Von R. Eshleman, Robert H. Eustis, Wilhelm Flügge, Krishnamurty Karamcheti

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.

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**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

*Acting Assistant Professors:* Roy E. Lave, David G. Luenberger

*Lecturer:* John Johnson
OFFERINGS AND FACILITIES

The central theme of the Institute in Engineering-Economic Systems is to carry on research projects in various areas in which planning and systems considerations dominate. In particular, stress is placed on study of physical or operational systems with complicated interaction between parts; those situations in which decision making must take place under uncertainty; those situations in which characteristics or states evolve with time and in which control is a significant factor; generally, model-making and computer simulation are stressed; the various optimization procedures receive strong attention.

The work of the Institute in Engineering-Economic Systems is centered around the development of a research program and a program of graduate courses in the systems and planning area. The interdisciplinary program includes affiliated faculty members from the Departments of Civil, Electrical, and Industrial Engineering, Economics, Political Science, Statistics, and the Graduate School of Business. The field of Engineering-Economic Systems is still evolving and no degree is offered presently by the Institute; students can earn their degrees in the departments of the School of Engineering, in the Operations Research Program, the Economics Department, or in a Graduate Division Special Program.

RESEARCH PROGRAMS

The research program stresses three kinds of activities which have somewhat different emphases: the projects on engineering-economic planning stress problems of planning of public works projects in which improved criteria and methodology for decision making will be developed; the projects on industrial development planning are concerned with industrial development usually in the private sector; feasibility studies, market surveys, technological evaluations and simulation of operations are important considerations; the projects on planning and system design for computer-coordinated systems emphasize the technico-economic problems of automation. In the automation studies both the physical problems of system analysis and design and the economic problems of evaluation, justification, and planning are considered. In both kinds of projects the research is aimed at establishing specific results in specific areas as well as developing general theoretical results.

The project on Engineering-Economic Planning under the directorship of Professor Linsley has received its initial support through a grant from the Ford Foundation. The Ford Foundation grant will permit distinguished visiting faculty to be in residence during the academic year, provide support for resident faculty and for research, and provide fellowships to unusually competent students in the planning area.

The projects on computer-coordinated systems have a mixture of industrial, governmental, and foundation support. In order to provide adequate interaction with practical work and to provide implementation and follow-through on specific projects, an internship program with private industries has been developed. Governmental and foundation support is obtained for exploratory work on new projects and for development of general theoretical results. Graduate students receive fellowships, research assistantships, and some are industrial interns. The industrial internship program is unconventional and involves periods of University study and research alternated with strongly related engineering projects with affiliated industrial concerns.

In both the planning area and the system area direct attention is given to developing a strong theoretical basis for the new field. Mathematical and statistical principles have been applied to optimum allocation of effort, optimal control, system theory, analysis and simulation of multivariable systems, and scheduling and traffic control problems. Continued research in these areas will be encouraged and supported independently of the immediate application. The meaningfulness of theoretical work is enhanced by correlating it to practical areas. To provide a strong practical orientation to both the course work and to the theoretical research work, a fairly broad set of specific planning and system research projects is carried on.
The list below represents a partial list of practical projects. Not all projects are active at any one time but are underway when there is some particular interest in them. No exclusiveness is intended in the listing of practical areas. The aim is to undertake whatever practical projects are technically interesting, have practical significance at the moment, and involve theoretical considerations of general interest. Many of the projects listed are managed within one engineering department and almost all are operated by individual professors rather than by an Institute Committee. Generally the function of the Institute committee is to provide the interdepartmental interaction necessary to develop interdisciplinary areas.

I. Projects on Public Engineering-Economic Planning

1. Development of Water Resources
   a) Hydrology and hydraulic engineering.
   b) Water quality control.
   c) Planning and financing of water projects.
   d) Legal aspects of water resource planning.

2. Construction and Transportation Planning
   b) Methods and equipment for heavy construction.
   c) Transportation Planning: Comparison of costs and benefits of all modes of transportation; urban land use—transportation models; computer simulation of traffic flow.
   d) Legislation and financing of transportation system.

3. Analysis of Foreign Policy and Military Problems
   a) Analysis of military weapons systems.
   b) Production planning of military systems.
   c) Physical analysis of military equipment and simulation of its operations.
   d) Logistics planning for military operations.
   e) Development of requirements for weapons systems.
   f) Analysis of international conflict situations.
   g) Control of American foreign policy.

II. 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.

III. 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.

**PROGRAMS OF STUDY**

**Master of Science and Engineer Degrees**

The Master of Science and Engineer degrees may be earned in Civil and Industrial Engineering with designation Engineering-Economic Planning. To secure this designation, students must meet the degree requirements of their respective departments and include about 20 units of courses selected from the list of core or casework courses below. The selection must meet the approval of a department adviser who is one of the affiliated faculty in Engineering-Economic Systems. For the Engineer's degree the research project should be in the systems or planning area.

**Doctor of Philosophy**

The program of courses and research has not yet been formalized to the point that a degree is awarded by the Institute for Engineering-Economic Systems. Generally if a program largely falls within one department the doctorate is awarded by that department. Theses generally are reviewed by interdepartmental committees. For a course of study involving several departments a special doctoral program as described in the section "Graduate Division Special Programs" in this Bulletin is encouraged.

**COURSES OF STUDY**

There are many more courses available in the systems area than any one student would want to take. Generally, each program should be selected so as to give a broad coverage of the whole area as well as work in depth in one or more specialty areas. There are three categories of courses which fit into the program: (1) foundation courses from physical sciences, social sciences, and mathematics; (2) general core courses being developed in engineering; (3) casework courses for the various particular practical areas.

1. **General Foundation Courses**

   **Mathematics**
   114a, b. Linear Algebra
   115, 116. Analysis
   136, 137, 138. Numerical Analysis
   120, 121. Modern Algebra
   205a, b, c. Real Variables
   206a, b, c. Complex Variables
   220a, b, c. Methods of Mathematical Physics

   **Statistics**
   116. Theory of Probability
   217a, b. Introduction to Stochastic Processes
   219, 220. Statistical Inference

   **Physics**
   210, 211, 212. Introductory Theoretical Physics
Economics
106. Price Theory and Policy
108. Intermediate Mathematical Economics
109. Income and Employment
202. Price and Allocation Theory
241. Public Finance and Taxation
255. The Structure of Industry

Political Science
100. Public Administration
110. Administrative Behavior

2. Core Courses in Systems

Analysis
E.E. 240. Introduction to Linear Systems
I.E. 152, 252, 253. Operations Research
E.E. 244, or 251, 252, 254. Information Theory
E.E. 245, 246, 247. Control Systems
E.E.S. 250a, b. System Analysis
Stat. 255. Linear Programming
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. 229, 230. Engineering Economy
I.E. 232. Capital Budgeting
Econ. 159 or E.E.S. 211. Economics of Public Works
E.E.S. 214. Public Finance
E.E.S. 313. Institutional Setting for Public Works Planning
E.E.S. 316. Cost Allocation for Multiple-Purpose Projects
Pol. Sci. 113. Seminar in Government and Natural Resources
Pol. Sci. 115. Seminar in Administrative Responsibility
Pol. Sci. 116. Seminar in Administrative Regulation

3. Casework Courses in Engineering-Economic Systems
E.E.S. 304, 315. Development of Electric Power Industry
C.E. 250, 251; E.E.S. 213, 310, 311. Transportation Planning
E.E.S. 312. Decision Problems in National Defense
E.E.S. 314. Developing Nations
E.E.S. 246. The Engineering and Organization of Small Businesses
E.E.S. 247, 248. Economic Development Programming

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—A review of the functions of an economic system; economic efficiency, pricing, costs, and outputs with different market structures; the price system and resource allocations.
3 units, autumn, (Margolis), by arrangement
211. Economics of Public Works—Criteria for investment and pricing decisions in public works programs for national resources, public facilities, and national defense. Prerequisite: E.E.S. 210 or consent of instructor.

3 units, winter, (Margolis), TWTh 10

212. Water-Resources Planning—Integration of technical, economic, political and social factors in decisions relating to water resources.

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.

3 units, spring, (Oglesby), MWF 9


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

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

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. Prerequisites: 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.

2 units, autumn, (Boon), TTh 1:15

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.

2 units, winter, (Boon), TTh 1:15

250a, b. System Analysis—Analytical concepts of modelmaking 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

3 units, spring, (Luenberger), by arrangement

299. **Directed Reading and Research in Engineering-Economic Planning**—Directed study and research on subject of mutual interest to student and staff member. Required of all doctoral candidates prior to their qualifying examination.

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

304. **Seminar in Electric Power Resources**—Discussion by faculty, students, and guest specialists of factors influencing long-range decisions on the development of electric power resources. Reference will be made to expected technological developments in the processes for generating, transmitting and distributing electric power; the problem of long-range planning in the face of uncertain demands in specific areas at specific times; costs and benefits or interconnection as a means of matching up diverse power loads and sources of supply in individual geographical regions. Particular reference will be made to the interactions between technological and economic factors.

1 unit, autumn, winter, 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, (Roggeveen), MWF 1:15, alternate years, to be given in 1964–65

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, (Roggeveen), 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, (———), MWF 8, alternate years, to be given in 1965–66

313. **The Institutional Setting for Public Works Planning**—The role of government organization and policy in decision making. (Enroll in Political Science 113.)

5 units, autumn, (Marshall), M 2:15-4:05, alternate years, to be given in 1964–65

314. **Public Works Problems of the Developing Nation**—Study of the special problems involved in planning public works in the developing nations.

3 units, autumn, (———), MWF 1:15, alternate years, to be given in 1964–65

315. **Public Utility Regulation**—The nature of regulation and its effect on the planning and operation of public utilities.

3 units, winter, (Staff), MWF 10, alternate years, to be given in 1964–65

316. **Cost Allocation in Public Works and Public Utilities**—A critical examination: the purposes, techniques, and limitations of cost allocations.

3 units, autumn, (Grant), TTh 9, alternate years, to be given in 1965–66

317. **Water Law**—A survey of water law and its relations to water resources planning and economics.

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

318. **Planning and Management of Local Public Works**—A study of decision problems in public works planning at the level of local government.

2 units, winter, (Johnson), by arrangement, alternate years, to be given in 1965–66

319. **Depreciation**—An examination of the appraisal, accounting, and income tax aspects of depreciation in the United States and elsewhere. Impact of tax treatment of depreciation on decision making regarding private investment.

3 units, autumn, (Grant), MWF 11, 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

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**GENERAL ENGINEERING**

*Program Advisers:* James M. Gere (Chairman), Frank R. Arnold, Robert H. McKim, David A. Thompson, David F. Tuttle

**PROGRAM OF STUDY**

The program for the Bachelor of Science degree in General Engineering, without designation of a field of specialization, is intended to prepare students for appropriate, definite career objectives involving engineering. It is well suited for those who desire a general engineering education as preparation for a management or a military career, or who wish to incorporate more humanities before specializing in an engineering field later. It is also for students who desire a background involving unusual combinations in engineering that do not fit into the other professional curricula, e.g., Product Design (see “Supplementary Requirements” for General Engineering).

The curriculum requires completion of the “Courses Normally Taken by All Engineering Students,” as well as sufficient additional units to bring the total to at least 180. The same standards of academic performance are required 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.

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**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.

*Acting Assistant Professors:* James Victor Jucker, Roy Ellis Lave, Jr.
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 six fields: Data Processing, Engineering Economy, Engineering-Economic Planning, Engineering Statistics and Quality Control, Operations Research, Production. Detailed statements of the general requirements for the Master's degree and the specific course requirements for the special fields may be secured by request to the Industrial Engineering Department.

Students having Bachelor's degrees in industrial engineering normally can satisfy requirements for the M.S. degree in a year of graduate work of satisfactory quality. Those students who have the Bachelor's degree in some other field of engineering will be required to make up certain basic undergraduate industrial engineering courses, and should enter in the summer quarter if they wish to complete the requirements in one calendar year.

Doctor of Philosophy

The degree of Doctor of Philosophy is offered under the general regulations of the University. The program requires a minimum of three years (nine quarters) of graduate study, at least one year of which must be at Stanford. The first year is represented by the M.S. program. The completion of an acceptable dissertation may occupy most of the third year of study.
The program of study will be arranged by the candidate with the advice of a Faculty Committee of three appointed by the Department head and having as chairman the faculty member who will direct the thesis work. The final program must be approved by the Department.

ASSISTANTSHIPS AND SCHOLARSHIPS

A limited number of fellowships and assistantships with stipends of $750 to $3,260 a year are awarded each year. Application forms and detailed information may be obtained by writing the Department of Industrial Engineering. Applications 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 available scholarships and fellowships and 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, (——), TWFThF 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

   3 units, autumn, winter, (Jucker), MWF 9, (not given after 1964-65)

110. Systems and Procedures Design—Techniques of analysis and principles of design of systems for repetitive administrative functions. Applications in manufacturing organizations, particularly to inventory management and production control. Prerequisites: 100 and knowledge of basic accounting.
   3 units, autumn, winter, (——), MWF 1:15
   winter, (——), MWF 10, (not given after 1964-65)

118. Work Design and Measurement Problems Laboratory—Design and case study analysis of practical problems in industry. Prerequisite: 108.
   1 unit, autumn, winter, (Staff), T1:15-4:05, (not given after 1964-65)

119. Production Engineering Laboratory—Production tooling, layout design practice. Plant visits. Prerequisites: 109 and 118.
   1 unit, winter, (Staff), Th 1-4
   spring, (Staff), T 1-4, (not given after 1964-65)

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, (Hillier), 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, (Lieberman), MWF 11
spring, (Hillicr), 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, (Oakjord), MWF 2:15
winter, spring, (Jucker), MWF 1:15
summer, (Jucker), 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, autumn, winter, (Hillier), MWF 4:15-5:30

3 units, winter, (Veinott), MWF 1:15
spring, (Veinott), MWF 11

3 units, autumn, (———), MTWF 8, to be given first in 1965-66
winter, spring, (———), MTWF 2:15

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. Prerequisite: 155.
3 units, autumn, (———), MTWF 9
winter, (———), MTWF 1:15, to be given first in 1965-66

190. Seminar—Special topics by guest speakers. Students prepare a formal engineering report on approved subject.
1 unit, winter, (Staff), Th 10, (not given after 1964-65)

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, (———), T 1:15-4:05, to be given first in 1965-66
COURSES PRIMARILY FOR GRADUATE STUDENTS

201. Seminar in Organizational Theory—Selected topics in organizational theory and behavior, concentrating on a major topic in the field. May be taken twice for credit. Prerequisites: 100 or consent of instructor and an elementary course in statistics.

2 units, winter, spring.

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.

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: 110 and 141.

2 units, spring.

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.


2 units, autumn.


2 units, winter.

231. Problems in Engineering Economy—Independent study of selected problem in engineering economy. Prerequisites: 130 and consent of instructor.

1 or more units.

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.

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.

247. Advanced Production Engineering—Advanced problems in factory planning, materials handling, production-line techniques, automation, plant facilities. Prerequisite: 109 (I.E. 109 may be taken concurrently.)

3 units, autumn.
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, (-----), TTh 11, to be given in 1965-66

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. (Same as Statistics 252.) Prerequisites: Calculus and Statistics 27 or 110 or 116.
   4 units, autumn, (Veinott), MWF 4:15-5:20

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. (Same as Statistics 253.) Prerequisites: at least two courses in operations research.
   3 units, spring, (Veinott), MW 4:15-5:30

   3 units, winter, (Veinott), MWF 10

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

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. (Same as Statistics 257.) 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. (Same as Statistics 258.) Prerequisites: Statistics 217a, b or 116 and 252, or equivalent.
   3 units, spring, (Hillier), MWF 9

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, (Lave), MWF 2:15
   spring, (Oakford), 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
294. Industrial Engineering Problems—Directed study on subject of mutual interest to student and staff member. Student must find a faculty sponsor. 
   2 or more units, (Staff), by arrangement

305. Dissertation—Required for degree of Engineer. 
   Autumn, winter, spring, (Staff), by arrangement

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

MATERIALS SCIENCE

Emeritus: Welton J. Crook (Professor)

Executive Head: O. Cutler Shepard
Professors: Robert A. Huggins, O. Cutler Shepard, Oleg D. Sherby, William A. Tiller
Associate Professors: Richard H. Bube, John C. Shyne, William E. Spicer, David A. Stevenson, Robert L. White. Acting: Alan S. Tetelman
Assistant Professors: Victor G. Macres, William D. Nix
Lecturers: Claus G. Goetzler; Donald R. Mash

OFFERINGS AND FACILITIES

Materials science is concerned with the relation between the structure and properties of materials, factors which control the internal structure of solids and processes for altering the structure and properties of solids. It brings together in a unified discipline the developments in physical metallurgy, ceramics and the physics and chemistry of solids. The undergraduate program of the Department, described under School of Engineering, provides professional training for the physical metallurgist or materials engineer and also preparatory training for graduate work in materials science. Able students are encouraged to take at least one year of graduate study to extend their course work and to obtain training in research. Graduate programs lead to the degrees of Master of Science, Engineer, and Doctor of Philosophy.

FACILITIES FOR INSTRUCTION AND RESEARCH

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

The Department, together with physics, chemistry, and solid state electronics, participates in an interdisciplinary Center for Materials Research that has been established at Stanford by funds from the Advanced Research Projects Agency. The
Center, with a budget of a million dollars a year, provides equipment, service facilities and funds for faculty and student research. Construction will start this year on a new building, which will supply 35,000 square feet of additional space for materials research.

PROGRAMS OF STUDY

Bachelor of Science

The undergraduate Materials Science program provides training in solid state fundamentals and in physical metallurgy. In addition to the General Studies requirements, the curriculum includes the "Courses Normally Taken by All Engineering Students" and the Materials Science supplementary requirements. Electives are available so that students with broad interests can combine Materials Science with work in another science or engineering department.

Advanced Degrees

Graduate admission and registration are described under the "Graduate Division" section of the School of Engineering.

Master of Science

The University's basic requirements for the Master of Science degree are discussed in the section "Degrees" in 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 10 units of such work may be counted as part of the minimum total of 45 units.

2. Completion of 45 units of an approved program. A minimum grade point average of 2.75 for course work is expected. The program should contain the following:
   a) A minimum of 20 units of advanced courses in the general area of Materials Science (excluding research and special problems), including:
      Mat.Sci. 222. Statistical Thermodynamics
      Mat.Sci. 230. Materials Science Colloquium
      Mat.Sci. 233. Introduction to Solid State Quantum Theory
      Mat.Sci. 237. Defects in Crystalline Solids
   b) A minimum of 9 units of courses outside of the Materials Science Department.
   c) A minimum of 6 units of Mat.Sci. 200 (Special Problems) with a Master's Research Report approved by two faculty members.

3. Passing a comprehensive written examination to test the candidate's proficiency in Materials Science and related fields of knowledge.

Engineer

The University's basic requirements for the degree of Engineer are outlined in the section "Degrees" in this Bulletin.

The following are Departmental requirements:

1. Completion of the substantial equivalent of the requirements for the Master of Science degree in Materials Science.

2. Completion of an acceptable thesis and 30 units of approved advanced course work beyond the requirements of the Master of Science degree.

Doctor of Philosophy

The University's basic requirements for the Ph.D. degree are outlined in the section "Degrees" in this Bulletin.

The following are Departmental requirements:
1. Complete the substantial equivalent of the requirements for the Master of Science degree in Materials Science.
2. Obtain a high score on a comprehensive Materials Science written examination.
3. Pass a Departmental oral qualifying examination.
4. Satisfactorily complete one of the Modern European Language courses, G10 or R10, or French 10 before being admitted to candidacy for the Ph.D. degree. Subsequently, candidates must translate three technical papers and present an approved copy of each to the Department.
5. 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 45 course units beyond the M.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.) Prerequisites: Physics 57 and Mathematics 23 or 43.
   3 units, autumn, (Huggins), MWF 9
   winter, (Nix), MWF 11
   spring, (Tetelman), MWF 10
   summer, ( ), MTWTh 9

52. Electrical and Magnetic Properties of Materials—Introduction to the physical basis of conduction of electricity, dielectric and magnetic properties. Review of atomic theory, molecular and atomic polarization, metallic conduction, band theory, semiconductors, physical processes in transistors, magnetic materials, magnetic resonance phenomena. (Enroll in Engineering 52.) Prerequisites: Physics 57 and Engineering 50.
   3 units, spring, ( ), MWF 11

107. High Temperature Laboratory—Lectures and laboratory experiments relating to high temperature processes, atmosphere control and vacuum technology; thermodynamic and kinetic measurements. (Enroll in Mineral Engineering 107.) Prerequisite: Mineral Engineering 105.
   2 units, spring, (Parlee), TTh 1:15-4:05

120. Industrial Report—Report covering at least two consecutive months of industrial experience related to Materials Science.
   1 unit, any quarter, (Staff), by arrangement

   3 units, spring, (Stevenson), MWF 9

122. Solid State Thermodynamics—Systematic development of thermodynamic relations and applications to solid state phenomena including phase equilibria, phase transformations and solution thermodynamics. Prerequisite: Chemistry 173.
   3 units, autumn, (Stevenson), MWF 9

123. Materials Science Laboratory—Introduction to laboratory techniques for the study of materials: metallography, photomicrography, thermal analysis, dilatometry and pyrometry. Prerequisite: Engineering 50.
   3 units, autumn, (Shyne), Th 1:15; lab. TTh 2:15-5:05

124. Structural Control in Materials I—Relation of structure to physical properties; energy of surfaces and internal boundaries; diffusion; first and second order phase changes. Free energy relations; binary and ternary phase diagrams. Prerequisite: Engineering 50.
   3 units, autumn, (Sherby), MWF 10
125. **Structural Control in Materials II**—Solidification; recovery and recrystallization; kinetics of diffusion controlled and martensitic transformations; effect of structural transformations on properties; formation and control of heterogeneous structures; surface treatments, hardenability. Prerequisites: 123 and 124.

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: 125.

2 units, spring, (Shepard), TTh 9

127. **Crystallography and X-Ray Analysis**—Crystal geometry and the reciprocal lattice; fundamentals of x-ray absorption, diffraction and spectroscopy with applications to crystalline materials. Prerequisite: Physics 55.

4 units, autumn, (Macres), MWF 11; lab. M 1:15-4:05 or by arrangement

130. **Mechanical Behavior of Solids**—Elements of dislocation theory. Mechanisms of plastic deformation. Elastic, anelastic and plastic properties of single crystalline, polycrystalline, amorphous and high polymeric materials. Relation of the defect solid state to mechanical properties. Prerequisite: 50.

3 units, winter, (Sherby), MWF 8

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

200. **Special Problems.**

Any quarter, (Staff), by arrangement


3 units, autumn, (Tetelman), TTh 1:15-2:45


2 units, winter, (Goetsel), by arrangement

212. **High Temperature Materials**—Applications, product specifications, properties, and fabrication methods for refractory metals, dispersion alloys, reactive metals, graphite, ceramics, cermet, and intermetallic compounds. Prerequisite: 210.

2 units, spring, (Goetsel), by arrangement

219. **Solid State Phase Equilibria**—Thermodynamics of phase equilibria; quasichemical approach to alloy phases; binary and ternary equilibrium diagrams; microstructural problems; effects of pressure.

2 units, winter, (Nix), TTh 10

220. **Phase Transformations in Solids**—Thermodynamic, kinetic and crystallographic aspects of nucleation and growth reactions, martensitic transformations and second order transitions in solids. Prerequisite: 125.

3 units, spring, (Shyne), MWF 10

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

3 units, winter, (Stevenson), MWF 11

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), three lecs. by arrangement, to be given in alternation with Mineral Engineering 227 in odd numbered years
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 9

230. Materials Science Colloquium.
1 unit, autumn, (Shepard); winter, (Nix); spring (Stevenson); summer, (Shepard), M 4:15

3 units, spring, (Mash), MWF 9

232. 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, lattice vibrations. Prerequisite: 52 or Physics 172.
3 units, autumn, (Bube), MWF 1:15

234. Electrical Transport Processes in Crystals—Time-dependent wave mechanics, electrical conductivity, mobility and scattering mechanisms, localized levels in the imperfect crystal, galvanometric effects, thermal effects. Prerequisite: 233.
3 units, winter, (Bube), MWF 1:15

3 units, spring, (Bube), MWF 1:15

3 units, winter, (Macres), TTh 9; lab. by arrangement

237. Defects in Crystalline Solids—Theory of dislocations, vacancies and other defects; their effects on mechanical and physical properties of materials. Prerequisite: 130.
3 units, autumn, (Nix), MWF 8

3 units, winter, (Tetelman), TTh 1:15-2:45

239. Seminar in Advanced Mechanical Metallurgy—Prerequisite: 238.
1 unit, spring, (Tetelman), by arrangement

3 units, spring, (Macres), 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, (Shync), TTh 10

247. Solidification and Crystal Growth—Seminar on thermodynamic, kinetic, and structural aspects of the nucleation and growth of crystals. Prerequisite: 125.
2 units, spring, (Huggins), W 2:15-4:05

248. Magnetic Phenomena in Solids—Physical basis of magnetic phenomena in solids. Emphasis on ferromagnetic, ferrimagnetic behavior; structural, imperfection, time effects. Prerequisite: 52 or Physics 172.
3 units, winter, (Huggins), TTh 3:15-4:45
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, (Macres), by arrangement

306. Research.
   Any quarter, (Staff), by arrangement

MECHANICAL ENGINEERING

Emeriti: Boynton Morris Green, Lydik Siegumfeldt Jacobsen, Stephen P. Timoshenko (Professors)

Executive Head: William Morrow Kays
Division Directors: Stephen Jay Kline (Thermosciences), Thomas Joseph Connolly (Nuclear) ———, (Design)
Associate Professors: Frank Robert Arnold, Thomas Joseph Connolly, Robert Horton McKim, William Craig Reynolds, Rudolph Sher
Assistant Professors: Peter Zane Bulkeley, Joel Henry Ferziger, James Paul Johnston, Robert Edward Keller, Charles Herman Kruger, Bernard Roth

OFFERINGS AND FACILITIES

The courses and degrees offered in Mechanical Engineering provide a background for careers in research, development, design, and manufacture in a wide variety of industries concerned with the handling of mechanical, thermal and nuclear energy (generation, transmission, conversion, metering, control, utilization), the handling of fluids, the construction of mechanical devices (tools, mechanisms, machines, mechanical instruments, control systems), and the conception of systems involving mechanical and thermal components together with electrical, chemical, and human components. Graduates at all degree levels typically go into the aerospace industries (especially in propulsion systems), nuclear power industry, gas turbine and internal combustion systems industries, and to a lesser extent into the chemical and petroleum process, transportation, and product manufacturing industries.

The Department is organized into three divisions—Thermosciences, Design, and Nuclear, each of which maintains its own laboratory, shops, and secretarial services. The Thermosciences Division offers courses and specialized work in the areas of thermodynamics, thermal power systems, energy conversion, fluid mechanics, and heat transfer. The Design Division is concerned with mechanical component design, comprehensive systems design, and industrial product design. The Nuclear Division offers work in reactor physics and all aspects of nuclear reactor technology. It should be noted that this Department does not offer specialized work in the areas of engineering mechanics, and students interested in concentrating in engineering mechanics should consult the Division of Engineering Mechanics section of this Bulletin. How-
ever, students studying for any of the degrees offered by the Department will ordi-
narily take courses in engineering mechanics, as well as in several other departments
of the University.

Facilities

All three Divisions of the Department maintain modern laboratories which are
used for both undergraduate and graduate instruction, and graduate research work. The
Thermosciences Division laboratories are equipped with representative gas,
liquid, combustion, and refrigeration machinery, a gas turbine, high and low velocity
wind tunnels, a gas dynamics facility, a magnetohydrodynamics power conversion sys-
tem, a shock tube, extensive heat transfer equipment, as well as adequate instrumenta-
tion, utilities, and space for research, together with a machine shop.

The Design Division maintains shops for both student instruction and construc-
tion of research apparatus, drafting rooms, an analog computer, and instrumentation
and space for instruction and graduate research work in stress analysis, dynamics,
mechanics, and control systems.

The Nuclear Division laboratories include a 10 KW pool-type research reactor,
a sub-critical assembly, a radiochemistry laboratory, a reactor heat transfer labora-
tory, 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 under-
graduate 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 demon-
strate that he is capable of handling graduate level work and will be able to complete
the requirements for the M.S. degree. Students whose undergraduate backgrounds
are entirely devoid of some of the major subject disciplines of mechanical engineer-
ing (for example, fluid mechanics, applied thermodynamics, applied mechanics, circuit
theory) may be required to take some undergraduate courses to fill in obvious gaps
and prepare themselves to take graduate courses in these areas. Such students may
require more than three quarters to fulfill the Master's degree requirements, as the
make-up courses may not be used for other than the free electives (see item 4 below)
in the M.S. degree program. However, it is not the policy to require fulfillment of
mechanical engineering B.S. degree requirements in order to obtain an M.S. degree,
and furthermore students who have already fulfilled certain categories of the M.S.
degree requirements as a result of their undergraduate work may find they have
sufficient time under item 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 mechanical engineering. Although considerable depth may be attained in a few areas, a high degree of specialization can only be attained by continuing toward the degrees of Engineer or Doctor of Philosophy, or by including more than 45 units in the M.S. degree program.

The Departmental requirements which must be met for the degree of Master of Science are:

1. **6 units** of mathematics from E.M. 250, 251, 252; Math. 106, 131, 132. (Ordinary differential equations, e.g., Mathematics 130, may not be used to fulfill this requirement; it may be taken as a free elective, item 4 below.)

2. *Two courses* in each of two of the following five categories, plus *one course* in two of the remaining categories (14 to 18 units total).
   a) Mechanical Engineering Design
      M.E. 214a, 217a, 218a, 222
   b) Solid Mechanics
      E.M. 202a, 202b, 205, 208, 210, 215, 222, 223a, 223b
   c) Fluid Mechanics
      M.E. 238b, 238c; E.M. 242, 244; A.A. 210b, 210c
   d) Thermodynamics and Heat Transfer
      M.E. 231a, 231b, 233a, 233b; 211a, 211b, 237a
   e) Nuclear Engineering
      M.E. 271a, 271b, 273, 282, 283, 285

3. **18 units** of approved electives (approved by adviser); these should ordinarily be in mathematics, physics, chemistry, or engineering, and may include any courses in the above lists not used to satisfy area minimum requirements. Courses in this category should be graduate level courses or, if in another department, they should be at least junior level courses with a minimum of introductory courses; specific exceptions are Engineering 104, 113, 152, 171, 172, 173; M.E. 114c, 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. **3 to 7 units** of free electives, to make up 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 9 units of course work in courses presented in the Department.

Students may choose or will be assigned an adviser in the Division that most nearly fits their major interests and will ordinarily use their electives to develop a program with some depth in those interests.

Candidates for the degree of Master of Science will be expected to have a minimum scholastic average of 2.75 in 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.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 114b</td>
<td>Mechanical Engineering Design</td>
<td>4</td>
</tr>
<tr>
<td>M.E. 214a</td>
<td>Philosophy of Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 214b</td>
<td>Human Factors in Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 215</td>
<td>Seminar in Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 299a, b, c</td>
<td>Product Design Project</td>
<td>15</td>
</tr>
<tr>
<td>Art 259b</td>
<td>Product Design</td>
<td>4</td>
</tr>
<tr>
<td>Approved electives</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Free electives</td>
<td>5-6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>46-47</td>
<td></td>
</tr>
</tbody>
</table>

The grade point average requirements for this program are the same as for the ordinary Mechanical Engineering Master's Degree.

Degree of Engineer

The basic University requirements for the degree of Engineer are discussed in the section "Degrees" in this Bulletin.

This degree represents nominally an additional year of study beyond the Master of Science degree, and includes a research thesis. This program is designed for students who desire to do professional engineering work upon graduation, and who desire an opportunity to engage in more specialized study than is afforded by the Master's degree alone.

The admission standards for this program are substantially the same as indicated under the Master's degree. However, since thesis supervision is required, and the availability of thesis supervisors is strictly limited, the Department cannot admit a student to candidacy until he has personally arranged with some member of the faculty to supervise a research project. This will frequently involve a paid research assistantship, and research assistantships are awarded by individual faculty members (usually from the funds of sponsored research projects under the direction of individual faculty members) and not by the Department, so again a personal arrangement is necessary. Students studying for their Master's degree at Stanford and desiring to continue to the Engineer degree ordinarily make such arrangements during their M.S. degree year. Students holding Master's degrees at other universities will be admitted and allowed to register if they are sufficiently well qualified. However, the Department cannot guarantee thesis supervision or financial assistance, and the student must make such arrangements himself during his first quarter or two of residence.

The Departmental requirements for the degree include an acceptable thesis for
which up to 15 units credit will be allowed. In addition to the thesis 30 units of approved advanced course work in mathematics, science, and engineering are expected beyond the requirements for the Master of Science degree, the choice of courses being subject to the approval of the adviser. Students who have not fulfilled the Stanford M.S. degree requirements will be required to do so (with due allowance for approximate equivalence of courses taken elsewhere).

All candidates for the degree of Engineer will be expected to have a minimum scholastic grade point average of 3.00 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.

Doctor of Philosophy

The basic University requirements are discussed in the section "Degrees" in this Bulletin. The Doctor's degree is intended primarily for students who desire to pursue a career in research, advanced development, or teaching, where a broad background in mathematics and the engineering sciences, together with intensive study and research experience in a specialized area, are the necessary requisites. The degree requires a minimum of two years beyond the Master's degree, with three years being the most common time.

The Department will allow a minor field of study, but does not require one. However, if a minor is waived, the candidate must show breadth of training by taking a group of courses in one or more related fields or departments.

A student studying for the Ph.D. degree ordinarily will not take an Engineer degree, although this is not precluded. However, he must have a Master's degree, and must fulfill in essence the requirements for the Stanford M.S. degree in Mechanical Engineering.

Admission to the program involves much the same consideration as described under the Engineer degree. A sufficiently well-qualified student from Stanford or elsewhere will be admitted, and will be assigned to an adviser who will assist him in attempting to arrange with an appropriate faculty member for supervision of his research, if he has not already done this before admission. However, the Department cannot guarantee research supervision, as this involves a personal arrangement between the student and the individual faculty member, and such an arrangement is entirely the responsibility of the student. Once a student has obtained a research supervisor, this supervisor becomes thereafter his academic adviser. Research supervisors may require that the student pass the Departmental Oral examination before starting on research work and before awarding a paid research assistantship. Note that research assistantships are awarded by the individual faculty research supervisors and not by the Department.

Prior to being formally admitted to candidacy for the Ph.D. degree the student must demonstrate his knowledge of engineering fundamentals by passing the Departmental qualifying oral examination. The academic level and subject matter of this examination correspond approximately to the Master of Science degree program described above. A student must have the approval of his adviser, and at least a tentative arrangement for research supervision, in order to take the examination. The examination is offered during the winter quarter and may in addition be offered at other times as the need arises. Normally the examination will be taken during the first post-Master's year. Details may be obtained from the Department 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. In so far as the laboratory schedule permits, students will be allowed, with due regard to priority of application, to arrange their own sections and laboratory periods. Enrollment with the instructor concerned, on registration day or the first day of University instruction, is essential in order that the laboratory schedule may be prepared. Enrollment later than the first week will not be permitted under any circumstances.

4. **Manufacturing Processes**—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, F 12:15_

_winter, (Staff), MWF 11_
112a. **Rapid Visualization**—Freehand perspective and shading techniques for rapidly visualizing design concepts. Emphasis is upon two-dimensional visual communication which is lucid and quickly executed. Lecture and laboratory combined. Prerequisite: Engineering 9 or consent of the instructor.

3 units, autumn, (McKim), MW 1:15-4:05

112b. **Introduction to Product Design**—A study, through lecture and laboratory exercises, of the human values in product design, including functional, human engineering, psychological, and esthetic factors. Laboratory exercises consist of developing simple product concepts three-dimensionally, with rapid model making techniques. Prerequisite: 112a.

3 units, winter, (McKim), MW 1:15-4:05

112c. **Product Design and Presentation**—A continuation of 112b, with emphasis shifted to the influence of mass production methods and materials upon design. Presentation techniques for communicating design concepts to others, especially to non-designers, will also be considered. Prerequisite: 112b.

3 units, spring, (McKim), TTh 2:15-5:05

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. **Advanced Product Design**—Invention and development of new product concepts with emphasis upon methods for determining unfulfilled human needs. Each design concept is developed into a working model. Prerequisite: 112c.

3 units, autumn, (Staff), TTh 12:00-2:05

116b. **Advanced Product Design**—Continuation of 116a, with emphasis upon the influence of technology, especially "technological breakthrough," upon the formulation of new product concepts. Prerequisite: 116a.

3 units, winter, (Staff), TTh 12:00-2:05

116c. **Advanced Product Design**—Continuation of 116a, b, with emphasis upon developing a large, complex design to solve a "big" need, i.e., mass transportation or city planning. Prerequisite: 116b.

3 units, spring, (Staff), 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-

3 units, autumn, (Kays), 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 Mathematics 130.

3 units, autumn, (——), MWF 11


4 units, winter, (——), MWF 10; one lab. by arrangement

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 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


3 units, winter, (Connolly), MWF 9

175. Nuclear Measurements Laboratory—Principles and techniques of radiation detection and measurement; radiation characteristics and calibration methods; beta and gamma spectrum analysis; statistical analysis of counting; radiation safety. (Enroll in Engineering 175.) Prerequisites: Concurrent 171, or 172, or consent of instructor.

3 units, autumn, winter, (Staff), 1:15 and one lab. by arrangement

192. Engineering Problems and Experimental Investigation—Directed study and research for the undergraduate student on a subject of mutual interest to student and staff member. Student must find faculty sponsor and have approval of his adviser.

1 to 5 units, any quarter, (Staff), by arrangement
COURSES PRIMARILY FOR GRADUATES

ENGINEERING DESIGN

214a. Philosophy of Design—An introduction to the philosophy of comprehensive design. A discussion of the attitudes and viewpoints of the designer and a thorough investigation of the techniques of analysis, synthesis, and evaluation that he uses. Emphasis will be placed on understanding of the creative process, and the factors that influence it. Limited registration. Prerequisite: permission of instructor.

3 units, winter, (——), M or T 2:15-5:05

214b. Human Factors in Design—A study of man’s strength and weaknesses in opposition to and/or in cooperation with machines. The problems associated with the transfer of information, energy, and matter between man and machine will be investigated. Limited registration. Prerequisite: 214a.

3 units, spring, (——), M or T 2:15-5:05


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.

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

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 centrosides. 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

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. 134).
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 nonequilibrium; concepts from statistical mechanics; Boltzmann equation; molecular encounters and related concepts; conservation equations; H-theorem; Maxwell distribution; Chapman-Enskog method; viscosity and thermal conductivity for different molecular force models; selected applications. Prerequisites: A.A. 292 and acquaintance with basic equations of viscous flow or consent of instructor.
3 units, autumn, (Karamcheti), MWF 1:15

212. Kinetic Theory of Transport Processes—Review of kinetic theory given in 211c. 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: 211c or 271c.
3 units, winter, (Ferziger), MWF 2:15

3 units, autumn, (Leppert), 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 treat-
ments 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, (Kline), TTh 2:15, alternate years, to be given in 1964–65

236. Combustion—Analysis of thermodynamics and kinetics of flow systems undergoing chemical change. Application of principles of mass and heat transfer to homogeneous and heterogeneous combustion phenomena, including flame propagation, liquid and solid propellant combustion, and ignition. Prerequisites: 211a or 134, and 135 or equivalent.

3 units, spring, (Wise), MWF 4:15

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, to be given in 1965–66

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, (Johnston), MWF 9, alternate years, to be given 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 1964–65

248. Thermionic Power Conversion—Principles of thermionic emission. Consideration to analysis and design of devices for direct conversion of heat to electricity employing the thermionic principle. Applications to space solar and nuclear power systems.

2 units, summer, (Olds), MWF 1:15

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 princi-
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, (Eustis), MWF 1:15


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

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, (———), MWF 11


3 units, winter, (———), 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: 238b or E.M. 244.

2 units, autumn, (Abbott), TTh 11

**Nuclear Engineering**

271a. **Nuclear Reactor Theory**—Neutron diffusion and slowing down theory. Homogeneous reactors. Two-group theory. Prerequisite: concurrent Physics 140 or consent of instructor.

3 units, autumn, (Sher), MWF 10


3 units, winter, (Sher), MWF 11

271c. **Nuclear Reactor Theory**—Advanced topics in reactor physics. The Boltz-

3 units, spring, (Sher), MWF 10


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


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


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


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


2 units, spring, (Sher), TTh 10


2 units, winter, (Fersiger), TTh 10

Directed Study

215. Seminar in Design—Problems touching on all aspects of design. For all graduate students in both Product Design and Engineering Design. Speakers from industry and Stanford illustrating the cross-discipline responsibilities of the designer will be featured. Registration for one unit of credit, with + or − grade, is optional; a letter grade is given for students presenting talks.

1 unit, autumn, winter, spring, (Staff), W 4:15

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

296. Seminar in Fluid Mechanics—Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are expected to attend. One unit of credit without letter grade is open to students having M.S. degree; a letter grade is given for those presenting talks. (Enroll in E.M. 296.)

1 unit, autumn, winter, spring, (Staff), T 4:15

299a. Design Project—Consists of a minor and a major project. Ten-week minor project emphasizes economic and marketing determinants. Three-quarter major project requires student to identify an unexplored problem area which will exercise all design determinants. In the first quarter, student submits statement of intent and
performs research. In the second and third quarters he performs analysis, experimentation, and synthesis, culminating project with a working prototype of his design concept. For Product Design students only.

5 units, autumn, (McKim), by arrangement

299b. Design Project—Continuation of 299a.

5 units, winter, (McKim), by arrangement

299c. Design Project—Continuation of 299b.

5 units, spring, (McKim), by arrangement


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


2 to 15 units, any quarter, (Staff), by arrangement
SCHOOL of HUMANITIES and SCIENCES

Dean: Robert R. Sears.
Associate Deans: Richard W. Lyman, Halsey Royden
Assistant Dean: Raymond F. Bacchetti

ORGANIZATION

The School of Humanities and Sciences includes all members with the rank of instructor or above of the Departments of Air Science, Anthropology, Art and Architecture, Asian Languages, Biological Sciences, Chemistry, Classics, Communication, Economics, English, French and Italian, History, Humanities, Mathematics, Military Science, Modern European Languages, Music, Naval Science, Philosophy, Physics, Political Science, Psychology, Sociology, Speech and Drama, and Statistics, together with appointees to the Faculty at Large.

Members of the School of Humanities and Sciences are listed under their respective departments, or under the staff for Special Interdepartmental Programs.

UNDERGRADUATE PROGRAMS

A student wishing to take a departmental major leading to the degree of Bachelor of Arts should consult appropriate sections of the announcements following. Further information concerning requirements may be obtained from the department concerned.

A student desiring to fulfill the requirements for the degree of Bachelor of Arts or Bachelor of Science in one of the special interdepartmental programs (see Humanities Special Programs, Physical Sciences General Program, and Social Sciences Special Program in following sections of this Bulletin) should consult the Director of Special Programs in the Humanities, the Chairman of the General Program in the Physical Sciences, or the chairman of the interdepartmental program in the Social Sciences. For general statements of the requirements for the degree of Bachelor of Arts or Bachelor of Science in these programs, students should see appropriate sections of the announcements following.

The School of Humanities and Sciences offers several survey courses in Geography which are listed separately in this publication. It is not possible, however, for a student to elect Geography as a major or minor field.

ROTC—Reserve Officers' Training Corps are maintained at Stanford by the Army, the Navy, and the Air Force (see Air, Military, and Naval Science in this Bulletin). Students enrolled in Chemistry or Physics who are also enrolled in an ROTC program will usually require more than the usual four years (twelve quarters) in the University to obtain a baccalaureate degree. Because of the 36 units of credit required for the Air, Military, and Naval Sciences, the Chemistry or Physics courses require additional time for graduation which will vary from one to three quarters depending upon the circumstances in each case.

GRADUATE PROGRAMS

Candidates for the degree of Master of Arts, Master of Science, or Doctor of Philosophy should consult appropriate sections of the announcements following and should also consult the department in which they intend to specialize.
AIR SCIENCE

Executive Head: Joseph E. Terry (Lieutenant Colonel, USAF)
Professor: Joseph E. Terry (Lieutenant Colonel, USAF)
Assistant Professors: Charles E. Fulbeck (Lieutenant Colonel, USAF), John W. Dobbs (Captain, USAF)

GENERAL
The Department of Air Science offers a course of instruction and pre-commission training which, in conjunction with a baccalaureate degree, qualifies a student for a commission in the United States Air Force.

CURRICULUM
The Air Science course of study is divided into a Basic Course, the freshman and sophomore years, and an Advanced Course during the junior and senior years. A four-week summer training period at an Air Force Base is required. This training is normally accomplished between the junior and senior years.

The two years' Basic Course is designed to provide a fundamental understanding of aerospace power and its implications in the conduct of world affairs. Basic Course students earn two hours' credit in the spring quarter of the freshman year and in the autumn and winter quarters of the sophomore year. (See listing of yearly courses.) A one-hour drill period is scheduled weekly in each quarter.

The Advanced Course provides instruction designed to develop the leadership and professional potential of each cadet. Close attention is given to his ability to communicate, to think clearly, and to organize and lead the activities of others. The Advanced Course develops the cadet's knowledge and understanding of global and space concepts and Air Force operational principles. Stress is placed on that framework of knowledge of principles, attitudes, and operating procedures which will prepare the student for active service in the Air Force. Cadets earn four units of academic credit per quarter. Four hours of classroom instruction and a one-hour drill period are scheduled for each week.

Throughout the Air Force ROTC courses of study, cadets follow an educational program complementary to fields of study in the University. Air Science courses satisfy the Group Activity requirement of the General Studies Program and acceptably replace the University's physical education requirement. While the Air Science program is intended to prepare cadets as Air Force officers, the course of instruction will develop leadership abilities of value in professional or industrial careers.

The curriculum also includes many features to stimulate the cadet's interest in the Air Force and help him to develop the qualities of an Air Force officer. Tours of Air Force installations are offered to acquaint cadets with the facilities and operations required to accomplish Air Force missions. Orientation flights, often in jet aircraft, are offered to selected students. The Peter Duncan McArthur Group and the Laplher Squadron of the Arnold Air Society sponsor social activities and inter-ROTC competition. Through these activities students have many opportunities to apply principles of leadership, management, and staff work in actual working situations. A number of awards and their appropriate certificates for academic and leadership distinction are made each year to freshman, sophomore, junior, and senior cadets.

DEFERMENT—DELAY
Cadets enrolled in the AFROTC program are granted deferment from selective service induction. This deferment can insure completion of undergraduate and graduate courses of study. Upon commissioning and graduation, educational delay (postponement of active duty) may be granted to students pursuing graduate studies. This delay will be commensurate with the time required for completing graduate objectives.
EMOLUMENTS

All necessary military textbooks and uniforms are furnished without cost to the students. Advanced Course students receive subsistence at the rate of $27 per month. During the summer training period, cadets receive $78 plus a travel allowance of 5 cents per mile to and from the training unit.

DISTINGUISHED GRADUATES

Under provisions of federal law, advanced students who are outstanding, both academically and in leadership, in military courses and in campus activities are designated Distinguished AFROTC Graduates upon the concurrent recommendation of the Professor of Air Science and the President of the University. Such graduates are given special consideration and may apply for regular commissions in the Air Force prior to graduation. Note: Other graduates may apply for a regular commission after 18 months’ service in a commissioned status.

AIR FORCE INSTITUTE GRADUATE PROGRAM

Distinguished graduates who accept regular Air Force commissions and exceptionally qualified cadets may apply for graduate education in fields of study which meet Air Force requirements. These courses lead to advanced degrees and are offered either at selected civilian colleges and universities or in residence at the Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio.

When selected for this program the officer is called to active duty at the educational institution. He receives full pay and allowances during his period of study, and the Institute pays his tuition, textbooks, and other school expenses.

COURSE SUBSTITUTION

A continuous effort is made to determine the courses offered by the University which cover the same material as those courses required by the AFROTC program. Whenever possible, the University course is substituted for the AFROTC course. An explanation of the substitution is included, when appropriate, in the course descriptions. Attendance in Overseas Campus will be credited toward AFROTC requirement.

FIRST-YEAR COURSES

13. University General Studies requirements or options will be substituted for and will satisfy the Air Science academic requirement during this quarter. One hour of drill or leadership training per week is required.

Activity credit, autumn

14. University General Studies requirements or options will be substituted for and will satisfy the Air Science academic requirement during this quarter. One hour of drill or leadership training per week is required.

Activity credit, winter

15. National Security—An introductory course exploring the causes of present world conflict as they effect the security of the United States. United States position in world affairs, the armed forces as an instrument of national policy, democracy and communism.

2 units, spring, (Dobbs), TTh 10 or 1:15

SECOND-YEAR COURSES


2 units, autumn, (Dobbs), TTh 10

2 units, winter, (Dobbs), TTh 10

39. University General Studies requirements or options will be substituted for and will satisfy the Air Science academic requirement during this quarter. One hour of drill or leadership training per week is required.

Activity credit, spring

THIRD-YEAR COURSES

125. History of United States Air Power and Nature of War—A survey of the nature of war; development of Air Power in the United States; mission and organization of the Department of Defense. Air Force concepts, doctrine and employment of aerospace power. Three class hours and one hour of supervised research per week. Term paper required.

4 units, autumn, (Fulbeck), MWF 9 and Th 2:15

126. Astronautics and Space Operations—United States Space programs, administrative control, vehicles, systems and problems in space exploration. Three class hours and one hour of supervised research per week. Term paper required.

4 units, winter, (Fulbeck), MWF 9 and Th 2:15

127. Astronautics and Space Operations—Soviet space program. Future development in United States and Soviet aerospace projects. Technical barriers, cost factors and economic implications of space explorations. Three class hours and one hour of supervised research per week. Term paper required.

4 units, spring, (Fulbeck), MWF 9 and Th 2:15

FOURTH-YEAR COURSES

142. International Relations—(Enroll in Political Science 20.)

autumn

143. Military Aspects of World Political Geography—(Enroll in Geography 191.)

winter

144. International Relations—(Enroll in Political Science 145.)

spring

199. Leadership Laboratory—Open only to Advanced Course cadets on the Staff, and Squadron Commanders with the concurrence of the Professor of Air Science; directed by the Commandant of Cadets.

1 unit, autumn, winter, spring

ANTHROPOLOGY

Executive Head: Bernard Joseph Siegel
Professors: Joseph Harold Greenberg, Benjamin David Paul, Bernard Joseph Siegel, George Dearborn Spindler
Associate Professors: Alan Robin Beals, Bert Alfred Gerow, Antone Kimball Romney, Robert Bayard Textor
Assistant Professors: Francis Alexander Cancian, Roy Goodwin D'Andrade, Charles Oliver Frake, 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. Graduate students should apply formally through the Admissions Office, which will submit their names to the Department for approval when application requirements are completed. In addition to the general requirements for admission to graduate standing, all applicants are required to take the Aptitude Test of the Graduate Record Examination. Candidates expecting to take this examination at scheduled centers in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming; Alaska, Australia, Canada (Alberta and British Columbia), Hawaii, Mexico, and all Pacific Islands should write to the Educational Testing Service, Box 1025, Berkeley, California.

Candidates who plan to take the Graduate Record Examination at a center in any state or place not listed above should write to the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey.

Every candidate is required to file with the Educational Testing Service a formal application for examination and to pay an examination fee. Initial inquiries may also be addressed directly to the Department.

PROGRAMS OF STUDY

Bachelor of Arts

For the Bachelor's degree in anthropology, 45 units of work in the Department are a requirement. The program of courses can be arranged in consultation with the adviser to meet the special needs and interests of the student. The following basic course requirements will be included in the 45 units, unless specifically excepted: Anthropology 1; Anthropology 5; Sociology 1 or other approved sociology course; Psychology 1 or other approved psychology course; Anthropology 191 (Senior Seminar). To be recommended for the Bachelor's degree, the student must have an average grade of C or higher for work in the major field.

A Department Honors Program gives Department majors with superior 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
ANTHROPOLOGY

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); 120 (The Growth of Cultures); 130 (Social Anthropology); 140 (Comparative Social Systems); 148 (Cultural Ecology); 163 (Cultural Dynamics); 164 (Culture and Personality).

For majors in humanities fields the following anthropology courses are correspondingly brought to special attention: 1 (General Anthropology); 5 (Development of Man); 120 (The Growth of Cultures); 141 (Anthropological Approaches to Religion and Philosophy); 144 (Mythology and Folklore); 170 (Prehistoric Archaeology); 176 (Language and Culture); 177 (Anthropological Linguistics).

For students in the biological sciences the most relevant courses are: 5 (Development of Man); 148 (Cultural Ecology); 175 (Physical Anthropology).

It will also be noted that regional courses are given, especially in fields where Stanford has strong teaching and research interests: Western Europe; South, Southeast, and East Asia; the Pacific Islands; North, Central, and South America; Africa; India.

Interested students may take part in field work on local archaeological sites. They may also obtain training in museum methods by doing directed work relating to the Stanford Museum anthropological collections. See 180, 182.

Master of Arts

To undertake a program of study for the degree of Master of Arts in anthropology a student is required to have a Bachelor's degree, or evidence of equivalent training, in anthropology. In addition he must complete an introductory course in statistics.

To be recommended for the Master's degree a candidate must complete an approved course of graduate study at this University amounting to not less than 45 units of credit, normally the equivalent of three quarters of work. It must include one of the following plans: (a) With the approval of the Department and the acceptance of a member of the staff as director, a candidate may complete a thesis which may be submitted for a maximum of 12 units of the 45 units required; or (b) the candidate may obtain his training in research by participating in one of the formal research programs within the Department for a maximum of 12 units. In the approved course of graduate study no units will count which do not have a grade of C or higher, and the candidate must receive an average grade of B or higher. Candidates must have completed the following courses or equivalent work: Anthropology 120, 130, 140, 163, 164, 170, 175, 177. They will also take approved graduate seminar work. Within the program of approved seminars, all incoming graduate students will be required to take a one-year sequence consisting of the Proseminars, Anthropology 200, 201, and 202.

Doctor of Philosophy

To be recommended by the Executive Head of the Department to the University Committee on the Graduate Division for admission to candidacy for the degree of Doctor of Philosophy in anthropology, the student must satisfy the following requirements:

(1) He must have demonstrated in his initial graduate work an ability and preparedness to pursue advanced studies to the professional level; (2) he must present, ordinarily by the beginning of his second quarter of doctoral work, a comprehensive plan of study, including an area of interest for his dissertation; and (3) he must meet the foreign language requirements of the University and of the Department. These
consist of *either* demonstrating competence in two foreign languages approved as contributing to his professional training and advancement, *or* demonstrating competence in one foreign language, and completing not less than 15 units of work in approved courses which give greater control of symbolic operations (e.g., statistics, symbolic logic) beyond the regular requirements of the Department program. The sequence of work would be established in consultation between the student and staff. Competence in one foreign language has to be certified by the Department to the University Committee on the Graduate Division with the formal application for doctoral candidacy; the second language or the alternative 15 units will ordinarily be completed prior to taking the written and oral examinations.

The major emphasis in the doctoral program is on cultural anthropology, including training in linguistics for research and field work use. General competence is also required in physical anthropology, archaeology, and museum work. To be recommended for this degree the candidate must (a) demonstrate in Departmental written examinations and in the University oral examination his scholarly proficiency in cultural anthropology, and (b) complete an acceptable doctoral dissertation, which will include evidence of adequate field-work training and experience. The Departmental written examinations and the University oral examination will cover the following fields: (1) History and Modern Viewpoints (Ethnology and Ethnography, Social Anthropology); (2) a regional field (e.g., North America, Middle America, Oceania, East Asia); (3) at least two other fields of specialization approved by the staff from among such topics as Social Organization, Culture and Personality, Cultural Dynamics, Cultural Ecology, Archaeology, Linguistics, Folklore, Applied Anthropology, Educational Anthropology, Medical Anthropology. For each field a faculty member will be appointed as adviser. The approved program will ordinarily consist of:

A. History and Modern Viewpoints, a regional field, three areas of specialization, and a course of study of at least 15 units of graduate work in some other department, the work to be related directly to the elected fields of specialization, *or*

B. History and Modern Viewpoints, a regional field, two areas of specialization, and a minor in some other department.

Comprehensive written examinations in the candidate's selected fields will be arranged by the Executive Head of the Department. They must be passed satisfactorily by the candidate before he may be certified for the University oral examination for the degree. Ordinarily the written and oral examinations will be taken several weeks apart and in the same quarter.

Candidates for the degree of Doctor of Philosophy who wish to offer anthropology for their minor must have completed at Stanford or elsewhere courses in anthropology amounting to not less than 35 units of credit as a general background before working in their special minor fields. In order to satisfy the Department that they are properly qualified to undertake this work, candidates may be required to submit to brief qualifying oral examinations by designated staff members.

To be recommended for the degree of Doctor of Philosophy with anthropology as the minor subject, a candidate must acquire scholarly proficiency in two of the recognized fields of the minor. The selection of these fields is subject to the approval of the Department. When the candidate has passed a written examination in each of the two fields chosen, the Department will recommend to the University Committee on the Graduate Division that he be permitted to take the University oral examination. Ordinarily the written and oral examinations will be taken within the same quarter.

A special minor is offered in social anthropology, with a study program concentrated in those anthropological fields of greatest relevance to the behavioral sciences. Choice of fields, to be worked out in consultation with the Departmental adviser, might cover such areas of specialization as Culture and Personality Studies, Social
Organization, Cultural Dynamics, Educational Anthropology. For the graduate student electing to take a coordinated program in social anthropology as alternative to a minor such courses as 120, 130, 140, 163, 164, and 176 are suggested; at least one approved graduate seminar should also be taken.

TEACHING ASSISTANTSHIPS AND FELLOWSHIPS

The Department annually nominates graduate students for appointment as teaching assistants. The service expected consists for the most part of conducting sections of 1 (General Anthropology). A teaching assistant devotes approximately a third of his time to the work, and receives $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, (Siegel), MTWThF 1:15
   spring, (Spindler), MTWThF 1:15
   4 units, summer, (———), MTWThF 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), MTWThF 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.)

120. The Growth of Cultures—Varieties, historical development, and distribution of world cultures and civilizations. Emphasis is placed upon theories and methods of investigating long-term cultural change. Prerequisite: 1.
   4 units, spring, (———), MTWTh 11

130. Social Anthropology—Theories and schools in social anthropology, including contemporary functional, psychological, interactional studies. Prerequisite: 1, or Sociology 1, or Psychology 1, or permission of instructor.
   4 units, winter, (Beals), MTWTh 9

140. Comparative Social Systems—Analysis of social structure, including kinship, community, other principles of organizing social life; comparison of non-Western with Western societies. Prerequisite: 1, or Sociology 1, or permission of instructor.
   4 units, winter, (Siegel), MTWTh 10
141. Anthropological Approaches to Religion and Philosophy—Examination of anthropological theories relating to the origin and nature of religion; these fields of creativity and experience looked at cross-culturally, and in relation to the total social and cultural life. Prerequisite: 1.
4 units, winter, (Beals), MTWTh 1:15

144. Mythology and Folklore—Anthropological contributions to understanding of these fields of human creativity; comparisons with Western literature. Prerequisite: 1.
4 units, autumn, (Gerow), MTWTh 9

149. Peoples of Europe—Anthropological contributions to understanding of the peoples and cultural traditions in the various European regions; opportunities to read on special areas, including those in which Stanford campuses are located. Prerequisite: 1 or consent of instructor.
4 units, winter, (Cancian), MTWTh 10

150. Peoples of the Pacific—Racial, linguistic, cultural backgrounds and characteristics of the Oceanic islanders; opportunities to read on special areas. Prerequisite: 1, or consent of instructor.
4 units, autumn, (Frake), MTWTh 10

152. Peoples of East Asia—Racial, linguistic, cultural backgrounds and characteristics; opportunities to read on special areas. Prerequisite: 1 or consent of instructor.
4 units, winter, (———), MTWTh 1:15

153. Peoples of India—Anthropological contributions to understanding of peoples, community development, and cultural traditions of India. Special attention to recent “village” studies. Prerequisite: 1, or consent of instructor.
4 units, spring, (Beals), to be given in 1965–66

154. Peoples of Africa—Racial, linguistic, cultural backgrounds and characteristics; opportunities for special work on chosen areas. Prerequisite: 1, or consent of instructor.
4 units, spring, (———), MTWTh 10

155. Indians of North America—Racial, linguistic, cultural backgrounds and characteristics; cultural relationships with “nuclear” America. Prerequisite: 1, or consent of instructor.
4 units, winter, (———), MTWTh 11

161. Peoples of Middle America—Survey of cultural development of the peoples of Middle America during the last 3,000 years. Special emphasis is placed upon modern village studies. Prerequisite: 1, or permission of instructor.
4 units, winter, (Hotchkiss), MTWTh 10

163. Cultural Dynamics—Interrelations between cultural, social, psychological processes in dynamics of cultural growth and change, including acculturation. Prerequisite: 1, or Sociology 1, or Psychology 1, or permission of instructor.
4 units, winter, (Paul), MTWTh 11

164. Culture and Personality—Anthropological contributions to understanding the role of culture in personality development; comparative studies; present status of problem. Prerequisites: 1 and Psychology 1, or permission of instructor.
4 units, autumn, (D’Andrade), MTWTh 9

165. Economics of Primitive and Peasant Societies—Patterns of production, trade and consumption; with emphasis on their relation to other aspects of social structure. Prerequisite: 1.
4 units, spring, (Cancian), MTWTh 1:15

170. Prehistoric Archaeology—Methods, findings in this field; correlations of prehistory of Europe and Near East with that of other zones over the world. Prerequisite: 5, or permission of instructor.
4 units, autumn, (Gerow), MTWTh 11
175. Physical Anthropology—Methods, findings relating to human evolution, fossil man, racial differences, bodily growth; includes laboratory exercises. Prerequisite: 5, or Biology 1, 2, 3, or permission of instructor.
   4 units, spring, (Gerow), MTWTh 9

176. Language and Culture—Contributions of anthropology to study of linguistics; symbolic nature of language; structural and comparative studies; metalinguistic theory. Designed for students in language and other departments as well as in anthropology. Prerequisite: 1.
   4 units, winter, (Frake), MTWTh 9

177. Anthropological Linguistics—Descriptive linguistics, including phonemic and morphological analysis and comparative techniques. Prerequisite: 1.
   4 units, autumn, (Greenberg), MTWTh 1:15

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, (Siegel), M 2:15-4:05

199. Honors Program—Directed independent study and honors thesis work for students admitted to this program.
   Any quarter, (Staff), by arrangement

COURSES PRIMARILY FOR GRADUATES

200. Proseminar—Replication of major research strategies in ethnology and social anthropology. To include problems in such areas as, e.g., culture history, life history, controlled comparison, cross-cultural method, genealogical method, etc. Use of HRAF materials, myth and folklore compendia, culture element lists, and other data compilations, including field notes.
   4 units, autumn, (Beals, Cancian), T 2:15-5:05

201. Proseminar—Continuation of 200.
   4 units, winter, (Cancian, Hotchkiss), T 2:15-5:05

202. Proseminar—Quantitative analysis of anthropological materials. Recent applications of various forms of symbolic analysis to anthropological materials: statistics, mathematical models, set theory, etc. Prerequisites: elementary statistics, and graduate standing, or seniors by permission.
   4 units, spring, (Cancian, ———), T 2:15-5:05

204. Phonetics and Phonemics—Field-oriented training in linguistic analysis as applied to the sound systems of languages. Lecture-discussion and laboratory.
   4 units, winter, (Greenberg), MWF 11

205. Morphology and Syntax—Field-oriented training in linguistic analysis as applied to grammatical systems. Lecture-discussion and laboratory. Prerequisite: 204, or permission of the instructor.
   4 units, spring, (Greenberg), to be given 1965-66

220. Advanced Ethnology—Seminar or directed individual work, oriented topically or toward intensive study of chosen areas, e.g., North America, Latin America, India, Southeast Asia, Africa, Soviet Union. Prerequisite: graduate standing or permission of instructor.
   Any quarter, (Staff), by arrangement
Regional Study—Directed group or individual study in the region chosen as a field for specialization in the doctoral program.
Any quarter, (Staff), by arrangement

Advanced Social Organization—Seminar or directed individual work, following up that given in Anthropology 140. Prerequisite: graduate standing or permission of instructor.
4 units, spring, (Frake), W 2:15-5:05

Advanced Cultural Dynamics—Seminar covering selected problems, especially at the community level. Prerequisite: graduate standing or permission of instructor.
4 units, spring, (Paul), M 3:15-6:05

Advanced Culture and Personality—Seminar following up Anthropology 164. Prerequisite: graduate standing or permission of instructor.
4 units, winter, (Spindler), M 2:15-5:05

Research Methods in Anthropology—Faculty-student seminar. Topics to be announced each year.
4 units, spring, (Staff), T 7-10 p.m.

Linguistic Field Methods—Seminar or directed individual work, following up Anthropology 177. Use of one or more informants and selected linguistic materials to demonstrate field methods and procedures for analysis of a language. Prerequisite: graduate standing or permission of instructor.
4 units, winter, (Gerow), W 2:15-5:05

Problems of Medical Anthropology—Seminar, analyzing theories of disease and therapy in selected societies, the relation of medical beliefs to other areas of culture, and similar problems of medical-anthropological interest. Prerequisite: graduate standing, or permission of instructor.
4 units, autumn, (Paul), W 2:15-5:05

Cultural Transmission—The transmission of values, implicit cultural assumptions, and the patterning of education in cross-cultural perspective, with special attention to American culture. (Same as Education 315.)
3 units, autumn, (Spindler), M 7-10 p.m.
4 units, summer, (———), MTWThF 9

Seminar—Special topics in cultural transmission. (Same as Education 416.)
3 units, winter, (Spindler), to be given in 1965-66

Directed Project Work—Special research projects undertaken for course credit.
Any quarter, (Staff), by arrangement

Directed Graduate Research—"Apprenticeship" plan. Research undertaken as alternative to Master's thesis.
Any quarter, (Staff), by arrangement

Any quarter, (Staff), by arrangement

Graduate courses offered in other departments and institutes within the University, such as in Anatomy, Geology, Sociology, Psychology, and the Hoover Institution, may also be elected for graduate credit provided the course concerned is approved by the adviser as fitting into the student's program. For the graduate statistics requirement in Anthropology, Statistics 7, Psychology 60, or Education 216 may be taken.

See also Senior Colloquia.
ART and ARCHITECTURE

Emeritus: Victor M. Arnauottoff (Assistant Professor)

Executive Head: Lorenz Eitner
Professors: Lorenz Eitner, Edward McNeil Farmer, Ray Nelson Faulkner, Daniel Marcus Mendelowitz, Victor King Thompson
Associate Professor: Matthew Seymour Kahn
Assistant Professors: Thomas Thole Williamson. Acting: Keith Boyle, Robert James Mullen, John-David Paul La Plante
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); Kathryn Imlay Stedman (Landscape Architecture); Myron D. Alexander (Law); Dwight A. Coddington (Mechanical Engineering); Harry L. Sanders (Planning); 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
18 units in courses in art history numbered from 200 to 237
2 units each—Art 40 and Art 50
Total units—49
Each undergraduate major in the history of art shall, in consultation with his advisor, select a coherent and substantial minor program in anthropology, classics, history, literature, philosophy, or some other area approved by the adviser. He shall, furthermore, take at least eight units of beginning German, French, or Italian, or present proof of reading ability in one of these languages.

**Master of Arts**

The University's basic requirements for the Master's degree are set forth in the section "Degrees" in this Bulletin. The following are Departmental requirements:

*Admission to Candidacy*—Completion of the University's requirements for a Bachelor of Arts degree in the history of art, or an approximately equivalent training, is required of students entering a program of study for the Master of Arts. Provisional enrollment may be permitted, however, in cases in which previous training has been deficient, with the understanding that the deficiency will be remedied in advance of Departmental approval of candidacy.

*Recommendation for the Degree*—To be recommended to the University Committee on the Graduate Division for the degree of Master of Arts with emphasis on the history of art, the student must have satisfied the following requirements:

a) Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.

b) 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.

c) Reading knowledge of two foreign languages, preferably German and French.

d) Completion of a thesis acceptable to the Department, or of two term papers of acceptable quality in courses in the history of art numbered 200 or above.

**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.

**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, 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:

a) The equivalent a Bachelor of Arts degree in art at this University.

b) A grade point average of B— in at least 65 units of undergraduate work in art.

c) Formal admission to candidacy granted by the University Committee on Graduate Study.
The requirements for the degree of Master of Arts are:

a) Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.

b) 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:

1. 12 units in one of the three areas of concentration: (a) Drawing and Painting, (b) Sculpture, or (c) Design
2. 6 units in each of the remaining two areas other than the area of concentration, to make a total of 12 units
3. 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.

**ARCHITECTURE**

The architectural arts program is concerned with the study of the 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. The arts of architecture, landscape architecture, and city and regional planning constitute the three major areas of study.

**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 city and regional planning 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.

**Required Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture 70, 71a, 71b, 170, 171</td>
<td>19</td>
</tr>
<tr>
<td>Landscape Architecture 85, 185</td>
<td>7</td>
</tr>
<tr>
<td>City and Regional Planning 90</td>
<td>3</td>
</tr>
<tr>
<td>Art 1, 5, 10, 40, 50</td>
<td>15</td>
</tr>
<tr>
<td>Physics 21, Sociology 1, Political Science 1, Geography 1, Psychology 1</td>
<td>24</td>
</tr>
<tr>
<td>Mathematics 10, 11</td>
<td>6</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 with a 2.50 grade point average. Candidates must complete the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture 270a, b, c; 272a, b, c; 273a, b; 274a, b, c, d; 275a, b, c, 276, 277, 278a, b, c; 301</td>
<td>66</td>
</tr>
<tr>
<td>Landscape Architecture 285a, b; 286a</td>
<td>9</td>
</tr>
<tr>
<td>City and Regional Planning 290a, b; 291a</td>
<td>9</td>
</tr>
<tr>
<td>Civil Engineering 20, 116; Electrical Engineering 108</td>
<td>9</td>
</tr>
<tr>
<td>30 units selected with approval of adviser from:</td>
<td></td>
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<tr>
<td>Art 150a, 160c; Mathematics 21, 22, 23; Engineering 5, 11, 15, 161; Civil Engineering 138, 144, 145, 150, 151, 160, 170, 180, 181, 182, 183, 190; Industrial Engineering 100; Mechanical Engineering 4, 112a, b, c; 116a, b, c; 214a, b; Political Science 100, 113; Geography 191</td>
<td></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, (Staff)
2. **Survey I**—Main currents in the history of art from prehistoric time to the end of the Middle Ages.
   - 3 units, autumn, winter, (Staff)
3. **Survey II**—Main currents in the history of art from the Renaissance to the present.
   - 3 units, winter, spring, (Staff)
Interterm Courses

100a. Ancient Art I — The Pre-Hellenic Cultures: Egypt, Mesopotamia, Crete.
   3 units, autumn, (Eitner)
   winter, (Eitner), to be given in 1965-66
   spring, (Eitner)

100b. Ancient Art II — Greece and Rome.
   3 units, autumn, (Eitner), to be given in 1965-66
   winter, (Eitner)
   spring, (Eitner), to be given in 1965-66

   3 units, autumn, (Staff), to be given in 1965-66

105b. Medieval Art II — Romanesque to late Gothic periods.
   3 units, winter, (Staff), to be given in 1965-66

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, spring, (Rose)

115a. Baroque Art I — Seventeenth and eighteenth century art in Italy and Spain.
   3 units, autumn, (Staff)

115b. Baroque Art II — Seventeenth and eighteenth century art in the North.
   3 units, winter, (Staff)

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, (Eitner)

120c. Modern Art III — Main currents of twentieth century art.
   3 units, spring, (Eitner)

125a. Oriental Art I — The arts of India, China and Japan from the Neolithic through the sixth century A.D.
   3 units, winter, (LaPlante)

125b. Oriental Art II — The arts of India, China and Japan from the seventh century A.D. to the present.
   3 units, spring, (LaPlante)

130a. American Art I — Architecture, sculpture, painting and the household arts from pre-Columbian times to the Civil War (1860).
   3 units, autumn, (Mendelowitz)

130b. American Art II — Architecture, sculpture, painting and the household arts from 1860 to today.
   3 units, winter, (Mendelowitz)

Advanced Undergraduate and Graduate Courses

   3 units, any quarter, (Staff)

201. Seminar in Ancient Art.
   3 units, any quarter, (Staff)

205. Studies in Medieval Art.
   3 units, any quarter, (Staff)

206. Seminar in Medieval Art.
   3 units, any quarter, (Staff)
   3 units, any quarter, (Rose)
211. Seminar in Renaissance Art.  
   3 units, any quarter, (Rose)
   3 units, any quarter, (Staff)
216. Seminar in Baroque Art.  
   3 units, any quarter, (Staff)
   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)
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)
   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.  
   2 units, autumn, winter, spring, (Staff)
#50. Studio II—Introduction to three-dimensional concepts through the use of clay, wire, wood construction, and plastic materials.  
   2 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, (Farmer)
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, (Mendelowitz)
   winter, spring, (Staff)
145b. **Painting II**—Extended problems in pictorial organization and content, with stress on oil painting. Prerequisite: 145a.
   3 units, winter, (Boyle, Staff)
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, Staff)
150a. **Sculpture I**—Introduction to figure modeling and human anatomy. Prerequisite: 50.
   3 units, autumn, (Mullen)
150b. **Sculpture II**—Introduction to carving, welding, and construction. Prerequisite: 50.
   3 units, winter, (Mullen)
150c. **Intermediate Sculpture III**—Emphasis on carving, modeling, and construction. Prerequisite: 150a or 150b.
   3 units, 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**—Continuation of Art 155a with fewer projects of a more complex nature. Emphasis on space, light, and motion. Prerequisite: 155a.
   3 units, spring, (Kahn)
155c. **Design III**—Laboratory problems in page composition, illustration, and typography, with emphasis on mass media. Prerequisite: 60; recommended: 155a.
   3 units, winter, (Staff)
160a. **Printmaking I**—Introduction to print media: serigraphy, intaglio, and lithography. Prerequisites: 60 and 140a.
   3 units, autumn, (Staff)
160b. **Printmaking II**—Continuation of Printmaking I, stressing work in chosen media. Prerequisite: 160a.
   3 units, winter, (Staff)
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)
245. Watercolor Landscape Painting—Prerequisite: 145a.
   4 units, spring, (Mendelowitz)
246. Portrait Painting—Prerequisite: 145c
   4 units, winter, (Mendelowitz), by arrangement
247. Advanced Research in Painting Techniques—Prerequisite: 145c.
   Winter, (Boyle, Staff), by arrangement, alternate years, to be given in 1965-66
250. Individual Work—Sculpture.
   Autumn, winter, spring, (Mullen), by arrangement
251. Advanced Figure Modeling—Prerequisite: 150a.
   4 units, autumn, (Mullen)
252. Advanced Carving, Modeling, and Construction—Prerequisite: 150c.
   4 units, winter, (Mullen)
253. Metal Casting—Prerequisite: 150c
   4 units, 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, (Faulkner)
258. Studio Seminar in Advanced Color—Prerequisites: 26, and experience in painting or design.
   4 units, (Faulkner), to be given in 1965-66
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
260. Advanced work in Photography.
   Spring, (Staff), by arrangement
261. Advanced Lithography.
   Winter, (Staff), 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, (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.
Human Factors in Design—See Mechanical Engineering 214b.
History of Costume—See Speech and Drama 170.
Costume Design—See Speech and Drama 172.
Costume Construction and Makeup—See Speech and Drama 174b.
Stage Design I—See Speech and Drama 175a.
Stage Design II—See Speech and Drama 175b.
Projects in Stage Costume—See Speech and Drama 260b.

COURSES IN ARCHITECTURE

Basic Courses

#70. Introduction to Architecture—Orientation to theories, design factors and practice.
  3 units, winter, (Williamson), WF 9
#71a. Architecture before 1500—History of architecture from building cultures of the world.
  4 units, winter, (Thompson), MW 10
#71b. Architecture since 1500—History of architecture from building cultures of the world.
  4 units, spring, (Williamson), TTh 9
85. Introduction to Landscape Architecture—Orientation to theories, design factors and practice.
  3 units, spring, (Faulkner), MW 10
#90. Introduction to City and Regional Planning—Orientation to theories, design factors and practice.
  3 units, autumn, (Thompson), MW 10

Intermediate Courses

170. Shelter—Functional, social and aesthetic problems in shelter design.
  4 units, autumn, (Faulkner), TTh 10 and Th 3:15-5:05
171. Materials and Structures—Aesthetic nature of basic building materials and structural systems.
  4 units, winter, (Williamson), WF 11 and Th 3:15-5:05
185. Green World of Plants—Plants as design elements of nature, inspiration for the arts, and attributes to environmental values. Plant growth principles and fundamental health needs.
  4 units, spring, (Stedman), TTh 11 and Th 3:15-5:05

Advanced Undergraduate and Graduate Courses

  3 units, autumn, (Williamson), WF 3:15-5:05
  3 units, winter, (Thompson, McCarthy), MW 1:15-3:05
  5 units, spring, (Williamson, H. Clark), TTh 1:15-3:05
271. Individual Work: Architecture—Independent study with permission of instructor.
  Any quarter, (Staff), by arrangement
  4 units, autumn, (Thompson, Hill), MW 3:15-5:05
4 units, winter, (Williamson, Green), WF 3:15-5:05

4 units, spring, (Thompson, Callister), MW 3:15-5:05

273a. Residential Buildings I—Houses, apartments, group housing and hotels.
4 units, autumn, (Williamson, Young), WF 1:15-3:05

273b. Residential Buildings II—Preparation of working drawings and specifications for a project selected from work in Architecture 273a.
4 units, winter, (Peterson), MW 1:15-3:05

4 units, autumn, (Worsley), T 3:15-5:05

274b. Steel Construction—Design and Technology.
4 units, winter, (Worsley), F 3:15-5:05

274c. Reinforced Concrete Construction—Design and technology.
4 units, spring, (Worsley), T 3:15-5:05

274d. Finish Materials—Qualities, detailing and specification.
2 units, winter, (B. Clark), MW 11

275a. Plumbing.
2 units, autumn, (Coddington), F 3:15-5:05

275b. Heating, Air Conditioning, and Acoustics.
2 units, winter, (Coddington), T 3:15-5:05

275c. Electrical Wiring, Illumination, and Elevators.
2 units, spring, (Coddington), F 3:15-5:05

276. Business Administration—Business and professional aspects of architecture.
3 units, autumn, (Peterson), M 1:15-3:05

2 units, spring, (Alexander), W 7-9 p.m.

278a. Office Procedures—Internship in an architect's office studying methods.
1 unit, autumn, (Peterson and cooperating architectural firms), M 3:15 and three hours by arrangement

1 unit, winter, (Peterson and cooperating architectural firms), M 3:15 and three hours by arrangement

278c. Supervision—Internship in an architect's office studying inspection procedures.
1 unit, spring, (Peterson and cooperating architectural firms), M 3:15 and three hours by arrangement

285a. Small Site Development—Small private gardens and public areas.
3 units, autumn, (Faulkner), WF 1:15-3:05, to be given in 1965-66

285b. Large Site Development—Large private gardens and public areas.
3 units, winter, (Staff), TTh 3:15-5:05, to be given in 1965-66

286a. Plant Materials—Identification and use of trees and shrubs.
3 units, spring, (Faulkner), MW 10-12, to be given in 1965-66

290a. Research Analysis—Basic quantitative methods for developing the planning program.
3 units, autumn, (Williamson), WF 10-12

290b. The Community—Development of an ideal community.
3 units, winter, (Thompson), MW 10-12

291a. Urban Form and Space—Composition of three-dimensional forms and spaces.
3 units, spring, (Williamson), TTh 10-12

301. Terminal Project—Independent work extending over three quarters evidencing the student's ability to solve a significant architecture problem.
1 unit, autumn, (Thompson), W 11
COURSES IN ART EDUCATION

180. Art in the Elementary School—(Enroll in Education 180.)
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.
Consulting: Sir George B. Sansom
Associate Professors: Patrick D. Hanan, David S. Nivison
Assistant Professors: David Y. Chen, Albert E. Dien, William H. McCullough
Instructors: Hiroshi Miyaji, Francis T. Motofuji
Lecturers: Kung-yi Kao, Eric S. Liu

CHINESE-JAPANESE LANGUAGE CENTER

Director: Patrick D. Hanan
Professors: Robert H. Brower, Shau Wing Chan, Nobutaka Ike (on leave 1964–65), Edward G. Seidensticker, Jr., Kurt Steiner
Associate Professors: Patrick D. Hanan, David S. Nivison
Assistant Professors: David Y. Chen, Albert E. Dien, William H. McCullough
Instructors: Hiroshi Miyaji, Francis T. Motofuji
Lecturers: Kung-yi Kao, Eric S. Liu

OFFERINGS

The Department of Asian Languages offers courses in the languages and literatures of China and Japan. The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts, and Doctor of Philosophy. It also gives a minor in Chinese or Japanese language and literature for the degree of Doctor of Philosophy.

PROGRAMS OF STUDY

Bachelor of Arts

The degree of Bachelor of Arts is granted both in Chinese and in Japanese. The following courses must be completed:

A. Concentration in Chinese:
C103, C151, C152, C153
B. Concentration in Japanese:
J103, J151, J152, J153

These requirements are in addition to the University's basic requirements for the Bachelor's degree.

**ADMISSION TO GRADUATE STUDY**

All students contemplating application for admission to graduate study must have a creditable undergraduate record at Stanford or elsewhere. Undergraduate work need not necessarily have been in Chinese or Japanese, or in an East Asian area of specialization. For admission, an applicant must, however, satisfy the Department that he has an aptitude for language work, and that he has a command of English written style adequate for the pursuit of graduate study. While it is possible for an applicant to be admitted to graduate study in the Department with no previous knowledge of an East Asian language, such an applicant is warned that he will not be able to complete the requirements for the A.M. in the minimum time of one year, or the requirements for the Ph.D. in the minimum time of three years.

**Master of Arts**

The degree of Master of Arts is granted both in Chinese and in Japanese. The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this *Bulletin*. The following are Departmental requirements:

The candidate must:

A. Meet the Department's requirements for the degree of Bachelor of Arts in Chinese (or Japanese) or their equivalent;
B. complete C221 (or J221), C222 (or J222), C299 (or J299). 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 or, under special circumstances, a paper approved by the Graduate Adviser.

**Doctor of Philosophy**

The Doctor of Philosophy degree is granted in Chinese and in Japanese. Candidates for the degree are expected to acquire a thorough familiarity with Chinese or Japanese literature, an adequate command of both languages, and a comprehensive knowledge of East Asian history, social institutions, and thought. University requirements for the doctorate are given in the section "Degrees" in this *Bulletin*. The following are Departmental requirements:

I. Admission to candidacy: A student who has been admitted to graduate study in the Department must meet the following requirements before being certified for admission to candidacy.

A. He must demonstrate a reading knowledge of French or German by passing a written examination administered by the Department. All students presenting themselves for candidacy are strongly urged to acquire a reading knowledge of both these languages.
B. He must complete all of the requirements for the Master of Arts degree in this department or the equivalent courses at another university.
II. Further requirements:
A. The candidate must complete at least 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.

III. Preparation for University oral examination: General regulations governing the oral examination will be found in the section "Degrees" in this Bulletin. In addition, the Department of Asian Languages expects a candidate to be prepared in the following fields.
A. The general field of Chinese or Japanese literature and literary studies;
B. East Asian history and culture;
C. An outside field, to be selected in consultation with the Graduate Adviser. For most candidates this will be a Western literary field and will give attention to modern methods of literary analysis and criticism. Under special circumstances, a candidate may be permitted to substitute a field of Western history, philosophy, comparative religion, or some other appropriate subject.

IV. Dissertation: The candidate will write a dissertation demonstrating his ability to undertake original research based on primary materials in Chinese or Japanese. He will not receive final approval of the dissertation topic until he has passed the University oral examination.

Minor for the Degree of Doctor of Philosophy—A student taking a minor in Asian languages shall complete at least 30 units of work within the Department to be chosen in consultation with a Departmental adviser. He must elect either C221 or J221 unless he satisfies the Department that work done elsewhere has given him similar training. He must also pass a written examination in the Chinese or Japanese language.

Special Programs for the Degree of Doctor of Philosophy

Properly qualified students may plan special interdepartmental programs in the Asian field for the degree of Doctor of Philosophy. See the section "Graduate Division Special Programs" in this Bulletin.

Special Opportunities for Study Abroad

Attention is called to the 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.
COURSES NOT REQUIRING A KNOWLEDGE OF AN ASIAN LANGUAGE

#C151. Ancient Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, autumn, (Chan), MWF 10

#C152. Medieval Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, winter, (Chan), MWF 10

#C153. Modern Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, spring, (Chan), MWF 10

#J151. Early Japanese Literature in Translation—From the primitive period to the end of the twelfth century. (Freshmen and sophomores may be admitted by permission of instructor.)
4 units, autumn, (Seidensticker), MWF 11

#J152. Medieval Japanese Literature in Translation—From the thirteenth to the end of the seventeenth century. (Freshmen and sophomores may be admitted by permission of instructor.)
4 units, winter, (Seidensticker), MWF 11

#J153. Modern Japanese Literature in Translation—From the eighteenth century to the present. (Freshmen and sophomores may be admitted by permission of instructor.)
4 units, spring, (Seidensticker), MWF 11

See also Senior Colloquia.

I. COURSES IN CHINESE

#C1, C2, C3. First-Year Modern Chinese—Conversation, grammar, reading, elementary composition.
C1. 5 units, autumn, (Liu), MTWThF 9
C2. 5 units, winter, (Liu), MTWThF 9
C3. 5 units, spring, (Liu), 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, (Chen), MTWThF 9
C22. 5 units, winter, (Chen), MTWThF 9
C23. 5 units, spring, (Chen, Hanan), MTWThF 9

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, (Kao), TTh 11
C32. 2 units, winter, (Kao) TTh 11
C33. 2 units, spring, (Kao), 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, Liu), MTWThF 9 and 1:15
C42. 10 units, winter, (Kao, Liu), MTWThF 9 and 1:15
C43. 10 units, spring, (Kao, Liu, Hanan), MTWThF 9 and 1:15
ASIAN LANGUAGES

ADVANCED

C101, C102, C103. Introduction to Classical Chinese—Reading, syntax, composition. Prerequisite: C23 or equivalent.
C101. 5 units, autumn, (Nivison), MTWThF 9
C102. 5 units, winter, (Nivison), MTWThF 9
C103. 5 units, spring, (Dien), MTWThF 9

C105. Intensive Introduction to Classical Chinese—Equivalent to C101, C102, C103 combined. Prerequisite: C23 or equivalent. Consent of instructor necessary.
15 units, summer, ( ), MTWThF 8-12

C121, C122, C123. Advanced Conversation—Prerequisite: C33 or equivalent.
C121. 2 units, autumn, (Liu), TTh 11
C122. 2 units, winter, (Liu), TTh 11
C123. 2 units, spring, (Liu), 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

C162. History of Chinese Literature: Ancient to T'ang Period—Lectures and discussion. Prerequisite: C23 or equivalent.
3 units, winter, (Chen), 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

C171, C172, C173. Composition—Prerequisite: C23 or equivalent.
C171. 3 units, autumn, (Chen), MWF 1:15
C172. 3 units, winter, (Chen), MWF 1:15
C173. 3 units, spring, (Chen), MWF 1:15

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), by arrangement
C252. 4 units, spring, (Nivison), WF 2:15-4:05

C254, 255. Chinese Historical Texts.
C254. 4 units, autumn, (Dien), WF 2:15-4:05
C255. 4 units, winter, (Dien), WF 2:15-4:05

C257. Fiction and Essays in Classical Chinese.
4 units, spring, (Chen), TTh 2:15-4:05

C261, C262. Chinese Poetry.
C261. 4 units, autumn, (Chen), WF 2:15-4:05
C262. 4 units, winter, (Chen), by arrangement

C271. 4 units, winter, (Hanan), TTh 2:15-4:05
C272. 4 units, spring, (Hanan), TTh 2:15-4:05

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, (Hanan), by arrangement
C291. History of the Chinese Language—Lectures and discussion. Prerequisite: C103 or equivalent.
4 units, winter (Dien), to be given in 1965-66
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, spring (Dien), M 2:15-4:05
C361. Seminar in Chinese Literary Criticism—May be repeated for credit.
5 units, autumn, (Hanan), T 2:15-4:05
By arrangement, (Staff)

II. COURSES IN JAPANESE

#J1, J2, J3. First-Year Modern Japanese—Conversation, grammar, reading, elementary composition.
J1. 5 units, autumn, (Miyaji), MTWThF 9
J2. 5 units, winter, (Miyaji), MTWThF 9
J3. 5 units, spring, (Miyaji), 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, (Miyaji), MTWThF 1:15
J22. 5 units, winter, (Miyaji), MTWThF 1:15
J23. 5 units, spring, (Miyaji), 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, (Motofuji), TTh 11
J32. 2 units, winter, (Motofuji), TTh 11
J33. 2 units, spring, (Motofuji), TTh 11

J41, J42, J43. Intensive Modern Japanese—Intensive study in grammar, reading, conversation, and composition, the equivalent of first-year and second-year Modern Japanese combined. The successful completion of this course will qualify the student to take J101.
J41. 10 units, autumn, (Motofuji), MTWThF 9 and 1:15
J42. 10 units, winter, (Motofuji), MTWThF 9 and 1:15
J43. 10 units, spring, (Motofuji), MTWThF 9 and 1:15

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, (Miyaji), T 2:15-4:05  
J122. 2 units, winter, (Miyaji), T 2:15-4:05  
J123. 2 units, spring, (Miyaji), 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, (Brower), MWF 9  
J133. 3 units, spring, (Seidensticker), MWF 9  

J171, J172, J173. Composition—Prerequisite: J23 or equivalent.  
J171. 3 units, autumn, (Miyaji), MWF 2:15  
J172. 3 units, winter, (Miyaji), MWF 2:15  
J173. 3 units, spring, (Miyaji), MWF 2:15  

Graduate  

J200. Directed Reading in Japanese—Prerequisite; J103 or equivalent.  
1 to 3 units, any quarter, (Staff), by arrangement  

J221, J222. Proseminar—Research Methods in Japanese Studies. Prerequisite: J103 or equivalent.  
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  

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, autumn, (———), by arrangement, to be given in 1965-66  

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, winter, (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, Geography, Graduate Division Special Programs, History, Hoover Institution, Humanities (Special Programs), Philosophy, Political Science, Senior Colloquia, Social Sciences (Special Program).
BEHAVIORAL SCIENCES (HONORS PROGRAM in QUANTITATIVE METHODS)

Committee in Charge: Patrick Suppes (Chairman), Kenneth J. Arrow, Gordon Bower, James E. Brinton, Bernard P. Cohen, Herbert Solomon

GENERAL STATEMENT OF PURPOSE

The Honors Program in Quantitative Methods is designed to supplement the curricula of able students in the behavioral sciences with an integrated program of quantitatively oriented work. It is intended that students participating in the Program will acquire a firm mastery of certain mathematical tools and also become familiar with substantive theoretical developments in the behavioral sciences which require mathematical methods.

ADMISSION TO THE PROGRAM

A University average of B is required for admission to, and continuation in, the Program. Because many of the courses require specific mathematical background, candidates are urged to apply for admission not later than their sophomore year. Any member of the Committee may be consulted on admission. Information may also be obtained from the Program secretary in Ventura Hall.

REQUIREMENTS OF THE PROGRAM

1. The Honors Program supplements rather than replaces a regular departmental major. Consequently a major in one of the following seven participating departments is required: Communication, 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.</td>
<td>Differential and integral calculus</td>
<td>5, 5, 5</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.</td>
<td>Introduction to Logic</td>
<td>5</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.</td>
<td>Partial derivatives, multiple integrals, infinite series</td>
<td>3</td>
</tr>
<tr>
<td>Course in Matrix Theory</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Statistics 50, Psychology 60, or Economics 7</td>
<td></td>
<td>5</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.</td>
<td>Theory of Probability</td>
<td>4</td>
</tr>
<tr>
<td>Statistics 119.</td>
<td>Statistical Inference</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 206, 207.</td>
<td>Mathematical models in the Behavioral Sciences</td>
<td>6</td>
</tr>
</tbody>
</table>
FOURTH YEAR

Economics 199, Psychology 104, or
Behavioral Sciences 199. Senior Thesis in Quantitative Methods ..... 5
Three of the following: ................................................................. 9
  Economics 272. Statistical Inference in Economics
  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 advisor. It may properly be concerned with empirical or experimental problems whose investigation requires use of mathematical techniques. The Thesis may be written as part of a Departmental Honors Program.

4. Each student will be required to take three courses designated by the department in which he is majoring. In general these three courses will exemplify the application of mathematics to the student’s major subject.

COURSE

199. Senior Thesis in Quantitative Methods.
1 to 5 units, each quarter, (Staff), by arrangement

BIOLOGICAL SCIENCES


Executive Head: Clifford Grobstein
Professors: Donald Putnam Abbott, Lawrence Rogers Blinks, Rolf Ling Bolin, Arthur Charles Giese, Clifford Grobstein, Joshua Lederberg, George Sprague Myers, Joseph Frederick Oliphant, Robert Meredith Page, David Dexter Perkins, David Cook Regnery, Victor Chandler Twitty, Donald Eugene Wohlenschlag, Charles Yanofsky, By Courtesy: Jens Christian Clausen, Charles Stacey French, William McKinley Hiesey
Assistant Professors: Peter Hamilton Raven, Norman Keith Wessells, Dow Woodward
Instructor: Charles Harold Baxter
Lecturers: Walter C. Brown, Laurence Monroe Klauber, Alan Edward Leviton, Oswald Hope Robertson, Oscar Elton Sette, John Hunter Thomas
Research Biologists: Isabella A. Abbott, Dorothy Newmeyer, Virginia M. Page
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 Bachelor of Arts degree must complete: (1) a group of specified core courses in biology, or their equivalents; (2) a group of specified courses in cognate fields; and (3) 10 units of elective courses in the biological sciences or closely related fields. Elective courses may be selected from the offerings in the Department of Biological Sciences or from a list of courses in other departments which may be obtained from advisers. 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 “3” must be completed with an average grade of not less than C.

**Required Courses in Biology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 10. Fundamentals of Biology</td>
<td>5</td>
</tr>
<tr>
<td>Biology 11. Plants as Organisms</td>
<td>5</td>
</tr>
<tr>
<td>Biology 12. Animals as Organisms</td>
<td>5</td>
</tr>
<tr>
<td>Biology 13. Molecular Biology</td>
<td>3 or 5</td>
</tr>
<tr>
<td>Biology 14. Cell Physiology</td>
<td>5</td>
</tr>
<tr>
<td>Biology 15. Population Biology</td>
<td>5</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. Should the number of units taken in core courses not equal 30, students must make up the difference in elective course units. Biology 1, 2, and 3 may be substituted for Biology 10 as prerequisite for the core. Students may receive advanced placement credit for Biology 1, 2, and 3 upon receiving a satisfactory grade in the national examination.

**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 the 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.
Senior Honors Program

(See Biology 200 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 independence of thought and a more professional approach to biological problems. Emphasis will be placed on the importance of original ideas in research rather than on the mastery of established facts. Satisfactory completion of the program will lead to graduation "With Departmental Honors."

Premedical Students

It is recommended that premedical students who are not biology majors take at least the following courses in biology: 10, 11, 12, and 16. 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 Registrar’s 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 15 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 a period of approximately one year.

The Department of Biological Sciences makes the majority of the teaching assistantship awards on or before April 1 for the coming year, and for these awards, and for half-tuition scholarships to accompany them, application forms (Application for Fellowship, Scholarship, or Assistantship) should be submitted to the Office of Admissions not later than March 1. However, assistantships occasionally become vacant at other times of the year, and 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. Applications for scholarships or fellowships from candidates who are not applying for teaching assistantships must be received by the Office of Admissions not later than January 15.

**Predoctoral Fellowships**—Qualified applicants are urged to take the initiative in applying for predoctoral fellowships from the National Science Foundation and the U.S. Public Health Service (Forms and information: National Science Foundation Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D.C. Deadline: Early January. Research Fellowships Branch, Division of Research Grants, National Institutes of Health, Bethesda 14, Maryland. No deadline, but 3 to 4 months required between application and decision). These attractive awards provide full tuition and generous stipends. Application may be made by college seniors planning to work for a higher degree after graduation, as well as by students at any level of graduate work. Competition is with other applicants at the same level of advancement.

Application for these fellowships does not preclude application for a teaching assistantship at Stanford; if both are granted one may be declined in favor of the other.

**BIOLOGY SEMINAR**

The Biology Seminar meets on Monday afternoons at 4:15. Topics of current biological interest are presented by speakers from Stanford and from other institutions, and are announced in the weekly University calendar. Students are urged to attend.

**COURSES**

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.

2. 3 units, winter, (Kennedy, Regnery, Baxter), WF 11; lab. (I) T 9-12, (II) T 2:15-5:05, (III) W 2:15-5:05, (IV) Th 9-12, (V) Th 2:15-5:05.

**10. Fundamentals of Biology**—A concentrated introduction to biology for those intending to major in the subject and to take Biology 11-15. Emphasis on fundamental facts, concepts and questions which underlie later more detailed consideration in the core curriculum. Readings, lectures, and discussion-demonstrations. Prerequisites: Chemistry 1, 2, and 3, or equivalents.


**11. Plants as Organisms**—Structure and functions of plants at the organism level. Prerequisite: 10 or equivalent.

5 units, winter, (Page), MWF 8; lab. (I) TTh 9-12, (II) TTh 2:15-5:05, (III) WF 2:15-5:05.
12. Animals as Organisms—The basic function of organisms as carried on by animals. Prerequisite: 11 or equivalent.
   5 units, spring, (Oliphant), MWF 9; lab. (I) TTh 1:15-4:05, (II) WF 1:15-4:05
13a. Molecular Biology—The synthesis, function and interactions of the various molecular components of cells with emphasis on molecular genetics. Prerequisites: 10 or 1, 2, and 3, and Organic Chemistry.
   3 units, autumn, (Woodward), MWF 11
13b. Molecular Biology Laboratory—By permission.
   2 units, autumn, (Woodward), TTh 2:15-5:05
14. Cell Physiology—Structure and function of plant and animal cells. Prerequisites: 1, 2, 3, and 13, or 10, 11, 12, and 13, or their equivalents.
   5 units, winter, (Giesc), MWF 9; lab. (I) TTh 1:15-4:05, (II) WF 1:15-4:05
15. Population Biology—Introduction to the properties of aggregations of organisms. Prerequisites: 10, 11, 12, 13, and 14.
   5 units, spring, (Holm, Ehrlich, Raven), MWF 11; lab. WF 2:15-5:05
16. Biology of Vertebrates—Structure, function, development, and evolution of vertebrates. Prerequisites: 10, 11, and 12.
   5 units, autumn, (Wessells), MWF 9; lab. (I) TTh 9-12, (II) TTh 1:15-4:05
25. Genetics—Prerequisites: 1, 2, and 3, or equivalents. Students planning to take 13, 14, and 15 should not take 25.
   4 units, autumn, (———), MTWTh 10
28. Classification of Flowering Plants—Lectures, laboratory, field studies. Prerequisite: 11 or equivalent.
   4 units, spring, (Thomas), WF 2:15-5:05; field trips on alternate Saturdays, by arrangement
29. Fungi—Prerequisite: 11 or 1, 2, and 3, or equivalents.
   4 units, spring, (Page), TTh 9-12, and two hours by arrangement
30. The Plant Kingdom: Algae and Fungi—Structure, development, evolutionary relationships of algae, fungi. Lectures, laboratory, field trips. Prerequisite: 11 or equivalent.
   4 units, autumn, (Page), TTh 1; lab. TTh 2:15-5:05
31. The Plant Kingdom: Mosses and Ferns—Structure, development, evolutionary relationships of liverworts, mosses, the seedless vascular plant. Lectures, laboratory, field trips. Prerequisite: 11 or equivalent.
   4 units, winter, (Briggs), TTh 11; lab. TTh 2:15-5:05
50. Evolution—A synthesis of current evolutionary thought with emphasis on processes. Prerequisites: 1, 2, and 3, or their equivalents. No credit will be given for 50 following 15.
   3 units, winter, (Ehrlich, Holm, Raven), MWF 11
55. General Ecology—Environmental-biological interrelationships. Concepts of populations, communities, energy levels, utilization and conservation of resources by man. Prerequisites: 11 and 12, or equivalents.
   3 units, winter, (Wohlschlag), MWF 8
60. Advanced Population Biology—Interactions of individuals and populations. Prerequisite: 15.
   3 units, autumn, (Raven, Ehrlich, Holm), MWF 11
100h. Marine Algae—Lectures, laboratory, field work on various classes of algae. Open to elementary students.
   5 units, summer (first term), (———), MWF
101h. Natural History of Marine Animals—Lectures, laboratory, field work stressing adaptive adjustments of marine animals. Prerequisite: general biology or zoology (or concurrent registration in 111h).
   5 units, summer (first term), (———), TThS
103. Comparative Histology—Microscopic structure of animal tissues; special reference to vertebrates. Prerequisite: 12 or equivalent.
   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 1964-65

111h. Marine Invertebrates—Structure, classification, biology, and phylogeny of lower marine invertebrates, echinoderms, protochordates. Prerequisite: an elementary zoology course.

5 units, summer (first term), (Abbott), MWF

112h. Marine Invertebrates—Continuation of 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), MWF

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

136h. General Ichthyology—Fishes, including elements of morphology, taxonomy, embryology, natural history. Prerequisite: 12 or equivalent.

5 units, summer (second term), (———), TThS

139. Herpetology I—Lecture, laboratory and field survey of living amphibians, with a synoptic history of herpetology. By permission.

3 units, winter, (Leviton, Myers), TTh 11; lab. W 1:15-4:05

140. Herpetology II—Lecture, laboratory and field survey of living reptiles. By permission.

3 units, spring, (Leviton), TTh 11; lab. W 1:15-4:05

141. Cytodifferentiation—Lectures and class discussion of the nature, criteria and mechanisms of differentiation at the cell level. Prerequisites: 14, 16, and 142, or equivalents.

3 units, winter, (Grobstein), TTh 10, alternate years, to be given in 1964-65

142. Experimental Embryology—Lectures on experimental analysis of embryonic development by microsurgical methods, related techniques. Prerequisites: 14 and 16.

3 units, autumn, (Twitty), MWF 10

143. Analysis of Development—Lectures and class discussion of the experimental analysis of development, with emphasis on the behavior of cells and tissues and its integration in the development of the whole organism. Prerequisites: 14, 16, and 142, or equivalents.

3 units, winter, (Grobstein), TTh 10, alternate years, to be given in 1965-66

144. Plant Growth and Development—Morphological, physiological aspects of plant growth. Prerequisite: 156.

2 units, autumn, (Briggs), TTh 9

145. Laboratory Techniques in Embryology—Application of microsurgical, chemical, and tissue culture procedures to developmental problems. Prerequisites: 16 and permission of instructor.

3 units, winter, (Wessells), TTh 1:15-4:05

148a. Genetics of Microorganisms I—Genetic mechanisms in microorganisms other than bacteria and viruses. Prerequisite: 25.

3 units, winter, (Perkins), TTh 9, alternate years, to be given in 1964-65

148b. Genetics of Microorganisms II—Genetic mechanisms in bacteria and viruses. Prerequisite: 25.

3 units, spring, (Yanojsky), TTh, alternate years, to be given in 1965-66

151. Evolutionary Genetics—Application of genetics to study of evolution. Prerequisite: 25.

2 units, winter, (Regnery), TTh, alternate years, to be given in 1965-66


3 units, spring, (Yanojsky), TTh, alternate years, to be given in 1964-65

156. Introductory Plant Physiology—Principal functions of organs of higher
plants; growth, mineral nutrition, water relations, movement of materials, respiration, nitrogen relations, photosynthesis. Prerequisites: 11 or equivalent, and inorganic chemistry. Organic chemistry recommended.

5 units, spring; (Briggs), MWF 9; lab. WF 2:15-5:05

161h. Comparative Biochemistry of Marine Organisms—Prerequisites: elementary biology and organic chemistry.

5 units, summer (first term), (Phillips), MWF

162h. Comparative Biochemistry of Marine Organisms—Continuation of 161h.

5 units, summer (second term), (Phillips), MWF

164h. Physiology of Algae—Prerequisites: elementary physics, chemistry, biology.

5 units, summer (second term), (Blinks), TThS

166. Physiology of the Nervous System and Sense Organs—The generation of electrical activity in neurons and receptors; neural organization, and its relationship to behavior. Enrollment by permission.

4 units, autumn, (Kennedy), lec. and lab. WF 1:15-5:05

168. Comparative Animal Physiology—Response, nutrition, reproduction of animals; special emphasis on invertebrates. Laboratory work may be undertaken during summer at Hopkins Marine Station. Prerequisites: 11, 13, and 14, or their equivalents.

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

169h. Ecological Physiology—Physiological responses of animals to variation in environmental factors and to organisms. Most work will deal with marine invertebrates. Prerequisites: general zoology and elementary chemistry.

5 units, summer (first term), (Giese), TThS

170. Readings in Paleobotany—Structure, evolutionary relationships of fossil plants. Prerequisites: 11, and permission of instructor.

(Holm), by arrangement


2 units, spring, (Leviton, Myers), alternate years, to be given in 1965-66

175h. Problems in Marine Biology—Field studies, laboratory, lectures, and individual problems in marine biology. Designed primarily for undergraduates. Students will be in residence at the Hopkins Marine Station during the entire quarter. Prerequisites: 1, 2, and 3, or 11 and 12; and Chemistry 1, 2, and 3, and permission of the instructors.

15 units, spring, (Abbott, Blinks, Phillips), MTWThF

176. Limnology—Ecology of fresh waters. Lectures, laboratories, field trips. Prerequisite: 55.

4 units, spring, (Wohlschlag), TTh 9; lab. WF 2:15-5:05, alternate years, to be given in 1964-65

184. Problems in Entomology—Independent study of the morphology, physiology, ecology, behavior, and taxonomy of insects. By permission. Prerequisite: 16.

4 units, autumn, (Ehrlich), by arrangement

185. Problems in Autecology—Field studies of some aspects of the ecology of a single organism. By permission.

3 units, spring, (Ehrlich), by arrangement

189. Quantitative Methods in Biology—Design, analysis, interpretation of biological experiments. Rationale, application of techniques of analysis of variance, regression and correlation, covariance; techniques utilizing chi-square, binomial, and Poisson distributions. 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

199. Special Problems.

(Staff), by arrangement
199h. Special Problems.  
(Hopkins Marine Station Staff) by arrangement

200. Senior Honors Program—Readings or research in some phase of biology of especial interest to the individual. Satisfactory completion leads to Departmental recommendation for graduation with honors in biology. Open only to seniors (or students in the last quarter of their junior year) who have maintained an 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

212. Evolution of the Flowering Plants—Phylogenetic relationships of angiosperm families. Prerequisite: 28 or equivalent, and permission of instructor.  
3 units, winter, (Raven), by arrangement

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

222h. Biological Oceanography—Intensive lecture, field and laboratory course dealing with marine organisms and their environment. The work is done on board ship in oceanic regions that vary from quarter to quarter. Open only to graduate students by arrangement with the Chief Scientist through correspondence.  
15 units, autumn, winter, summer, (Bolin, ———), by arrangement

230. Advanced Systematic Ichthyology I—Intensive lecture, laboratory course extending through two quarters. Open only to especially qualified advanced students upon permission of instructor.  
4 units, autumn, (Myers), by arrangement, alternate years, to be given in 1965-66

231. Advanced Systematic Ichthyology II—Continuation of 230.  
4 units, winter, (Myers), by arrangement, alternate years, to be given in 1965-66

247. Advanced Cellular and Comparative Physiology—Discussion of a selected topic. Prerequisite: 14 or equivalent. By permission. May be repeated for credit.  
2 units, autumn, (Giese), M 1:15-3:05

260. Topics in Population Biology—Readings and discussions on research of current or special interest. Prerequisites: 15 and 60 and permission of instructors. May be repeated for credit.  
1 unit, (Ehrlich, Raven, Holm), by arrangement

300. Research.  
(Staff), by arrangement

300h. Research.  
(Hopkins Marine Station Staff), by arrangement

350. Graduate Seminars.  
(Staff), by arrangement

See also Senior Colloquia.

DIVISION OF MARINE BIOLOGY AND OCEANOGRAPHY  
HOPKINS MARINE STATION

Emeritus: Cornelis B. van Niel (Professor)

Director: Lawrence Rogers Blinks  
Associate Director: Rolf Ling Bolin  
Assistant Director: Donald Putnam Abbott  
Professors: Donald Putnam Abbott, Lawrence Rogers Blinks, Rolf Ling Bolin, Arthur Charles Giese  
Associate Professor: John Howell Phillips, Jr.  
Research Associate: Isabella Aiona Abbott

The Hopkins Marine Station is situated at Pacific Grove, on the south side of Monterey Bay, 90 miles from the main University campus at Palo Alto. The ground
area comprises seven and a half acres, consisting of the main portion of Cabrillo Point, with complete control of the coast line of the Point and including a sheltered landing place and storage for small boats. Buildings include the "Marinostat," the Alexander Agassiz Laboratory and the Jacques Loeb Laboratory. The library is especially endowed, and subscribes to about fifty journals. Its collections are particularly good in marine biology, oceanography, and microbiology.

The Station is open during the entire year and maintains a permanent staff of resident investigators and technical assistants; this staff is increased by visiting faculty members, especially during the summer. There are facilities for visiting investigators and for elementary and advanced instruction in biology. For further information, see the \textit{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. \textbf{Problems in Marine Biology.}\n15 units, spring, (Abbott, Blinks, Phillips), TWThFS

199h. \textbf{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. \textbf{Biological Oceanography.}\n15 units, autumn, winter, summer, (Bolin, ————), by advance arrangement only

300h. \textbf{Research}—Problems involving original work may be undertaken with members of the staff in the following fields:

- **Marine Zoology**—Problems connected with anatomy, taxonomy, natural history of oceanic invertebrates. Invertebrate ecology.
  (Abbott)

- **Physiology**—Problems of general and cellular physiology, especially of marine plants. Permeability, photosynthesis, bio-electric phenomena emphasized.
  (Blinks)

- **Marine Fishes**—Morphology, taxonomy, embryology, ecology of marine fishes.
  (Bolin)

- **Physiology**—Problems on physiology of invertebrate animals; photobiology, especially effects of ultraviolet light.
  (Giese)

- **Comparative Biochemistry and Immunology**—As exemplified in marine animals.
  (Phillips)

**Summer Quarter Courses**

The summer quarter is divided into two terms of five weeks each. Those courses requiring the lower tides of early summer are scheduled in the first term. It is possible to register for either term, or for the full quarter.

The regular five-unit laboratory courses are scheduled for three alternate days.
per week, an average of 20 hours per week being required. It is possible to obtain
ten units in each term, but registration for more than fifteen units in the full quarter
is not ordinarily advisable, owing to the intensive schedule.

For detailed descriptions of courses, see listings above under Biological Sciences; also the Hopkins Marine Station Bulletin (issued in March).

First Term

100h. Marine Algae.
5 units, (———), TThS

101h. Natural History of Marine Animals.
5 units, (———), MWF

111h. Marine Invertebrates.
5 units, (Abbott), TThS

161h. Comparative Biochemistry of Marine Organisms.
5 units, (Phillips), MWF

169h. Ecological Physiology.
5 units, (Giese), TThS

199h. Special Problems—(See autumn, winter, spring quarters, above.)
(Staff), by arrangement

222h. Biological Oceanography—(See above.)

Second Term

112h. Marine Invertebrates—Continuation of 111h.
5 units, (Abbott), TThS

136h. General Ichthyology.
5 units, (———), MWF

162h. Comparative Biochemistry of Marine Organisms (continued).
5 units, (Phillips), MWF

164h. Physiology of Algae.
5 units, (Blinks), TThS

199h. Special Problems—(See under First Term.)
(Staff), by arrangement

222h. Biological Oceanography—(See above.)

300h. Research—(See under First Term.)
(Staff), by arrangement

DIVISION OF SYSTEMATIC BIOLOGY

Emeriti: Roxana Stinchfield Ferris (Curator), Willis Horton Rich, Ira Loren Wiggins (Professors)

Director: Richard William Holm
Professor: George Sprague Myers
Associate Professors: Paul Ralph Ehrlich, Richard William Holm
Assistant Professor: Peter Hamilton Raven
Lecturers: Laurence Monroe Klauber, Alan Edward Leviton, John Hunter Thomas
Curators: Paul Ralph Ehrlich (Entomological Collections), George Sprague Myers
(Zoological Collections), John Hunter Thomas (Dudley Herbarium)
Research Associates: Samuel Stillman Berry (Malacology), Walter Creighton Brown (Herpetology), Warren Curtis Freihofer (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. The collection of marine invertebrates is rich in echinoderms, crustaceans, and cephalopods, and contains good working nuclei in other groups. The series of deep-sea forms is especially good.
CHEMISTRY*

Emeriti: Philip Albert Leighton, John Pearce Mitchell, George Sutton Parks (Professors)

Executive Head: William Summer Johnson
Associate Executive Head: Douglas Arvid Skoog

Associate Professor: Frank Ephraim Harris
Assistant Professors: John Brauman, Victor William Laurie
Lecturers: Frank R. Mayo, Pierre Van Rysselberge
Laboratory Director and Research Associate: Boris Weinstein

ENTRANCE PREPARATION

Students who intend to major in chemistry are expected to offer entrance credit in the preparatory subjects of chemistry, physics, and mathematics (including trigonometry and solid geometry). Those who do not have entrance credit or equivalent training in the foregoing subjects, particularly mathematics, may experience some difficulty in meeting the Department requirements for graduation in four years, especially if they expect to pursue a program leading to professional certification to the American Chemical Society or to the B.S. degree with Honors.

Students who have taken the College Board Advanced Placement Examinations in chemistry may petition the Department to waive the requirement of Chemistry 1, 2, and 3. The Department, however, does not allow unit credit toward graduation nor unit credit for meeting the University requirement in science for courses from which the student has been excused.

PROGRAMS OF STUDY

Minimum Requirements for the 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, 123, 124, 125, 171, 173, 175, 176. 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, 180, and at least three units from one of the following: Chemistry 138, 139; 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.

* The curriculum leading to the B.S. degree in Chemical Engineering is described elsewhere in this Bulletin.
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 3.50 in courses in chemistry, physics, and mathematics. In addition to the minimum requirements for the B.S. degree, the student must complete nine units of Chemistry 190 to be taken three units per quarter for three quarters; seven units from Chemistry 126, 180, 212, 216, 221, 223, 225, 233, 235, 246, 247, 271, 273, 275, 289a, 289b, 289c; and nine additional units of courses from the above list or from Biochemistry 101, 102, Mathematics 130, 131, 132, physics lecture courses numbered 100 and higher, or other advanced courses approved by the student's adviser and by the supervisor of his work in Chemistry 190.

Students who wish to be admitted to the Honors Program but who do not meet all of the above formal requirements, may petition the Department for admission.

Typical Schedule for Four-Year Minimum Program

First Year

<table>
<thead>
<tr>
<th>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>
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</tr>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>3</td>
<td>3</td>
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<tr>
<td>German G1, G2, G3. First-Year German</td>
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<td>4</td>
<td>4</td>
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<tr>
<td>Math. 10, 11, 21. Analytic Geometry and Calculus</td>
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<td>3</td>
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<tr>
<td>Group Activities</td>
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<td><strong>Totals</strong></td>
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<td><strong>14</strong></td>
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Second Year

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<tr>
<td>Chem. 121, 123, 125. Organic Chemistry</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Chem. 122, 124. Organic Preparations</td>
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<tr>
<td>German G22, G23. Second-Year Reading</td>
<td>3</td>
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<tr>
<td>Math. 22, 23. Analytic Geometry and Calculus</td>
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<td>3</td>
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<tr>
<td>Physics 51, 52, 53, 54. Mechanics, Sound, Electricity</td>
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<tr>
<td>Social Science</td>
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<tr>
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Third Year

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<tr>
<td>Chem. 112, 113. Quantitative Analysis</td>
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<td>Chem. 116. Instrumental Analysis</td>
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<td>Chem. 171, 173, 175. Physical Chemistry</td>
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<td>Chem. 176. Physical Chemistry Laboratory</td>
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<tr>
<td>Physics 55, 56, 57. Light, Heat, Atomic Physics</td>
<td>5</td>
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<tr>
<td>Social Science</td>
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Course No. Subject

Fourth Year

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</tbody>
</table>

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, 130, 150; Economics 1; English 102; Mathematics 24, 130, 131, 132; Physics 61, 110, 111, 140; Statistics 110; Geology 1, 25, 123; Engr. 50; Min.E. 105; Mat.Sci. 107; Microbiology 101; Biology 11, 12, 16, 25; Biochem. 101, 102.

Teaching Credentials

The requirements for certification to teach chemistry in the secondary schools and junior colleges of California may be ascertained by consulting the section on credentials under “School of Education” in this Bulletin and the Credential Secretary of the School of Education.

Advanced Degrees in Chemistry

General Requirements

Qualifying examinations are given during the first week of the autumn quarter. Each new graduate student must take these examinations on entrance. Satisfactory performance is required for permission to continue work for an advanced degree. Students who fail to pass these examinations in the autumn may be permitted to repeat them during the first week of the winter quarter. Students who do not complete the remaining requirements for an advanced degree within six years after entrance as a graduate student must repeat and pass the qualifying examinations and must meet any other requirements established by the faculty before the degree will be granted.

Graduate students must begin their course work with Chemistry 221 if majoring in organic chemistry, with Chemistry 271 if majoring in chemical physics, or in analytical, inorganic, or physical chemistry, or with either course if majoring in biochemistry. Candidates for advanced degrees must have a minimum grade point average of 3.00 for all chemistry lecture courses as well as for all courses taken during graduate study. All students are expected to give full time to their graduate work once they have begun research. During the period in which a thesis is being read by members of the staff, candidates must be available for personal consultation until the thesis has had final Departmental approval. In addition to Departmental requirements, candidates for advanced degrees must meet the general University regulations as stated in the section “Degrees” in this Bulletin.

Qualifying Examinations

For all students other than those majoring in chemical physics, these examinations will consist of four written examinations of two hours duration each in the fields of analytical, inorganic, organic, and physical chemistry, and will cover such material as ordinarily is given in a rigorous one-year undergraduate course in each of these subjects. Students majoring in chemical physics are required to take two of the four examinations, namely that in physical chemistry and either that in inorganic or that in organic chemistry, and in addition thereto, a four-hour written examination in chemical physics. The examinations will be given during the period September 30—
October 3, 1964, and all examinations must be taken at this time. For those students who fail to pass one or more of the examinations and are permitted to repeat them, the examinations will be held again during the period January 5–8 in 1965.

Master of Science

All applicants for the degree of Master of Science in Chemistry are required to complete, in addition to the requirements for the Bachelor's degree, a minimum of 39 units of work. Of the 39 units approximately two-thirds must be in the Department and must include at least 12 units of advanced course work in chemistry exclusive of the thesis. Of the 12 units, at least three units must be from Chemistry 221, 223, 225, 271, 273, or 275.

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. However, proposals to substitute for French or Russian another language or a program of course work will be considered by the Department on petition of the candidate. The Department requires that the foreign language requirement or the approved substitute program be fulfilled completely before the candidate may apply for admission to candidacy. Candidates for the Ph.D. degree are required to participate continually in the Department seminar (Chemistry 300), and in the division seminar of the major subject.

All students majoring in inorganic chemistry are required to take (1) Chemistry 271 and 180; (2) Chemistry 273 or 275; and (3) Chemistry 233 or 235. Requirements (1) and either (2) or (3) must be completed during the first year irrespective of background; those who fail to make a grade point average of 3.00 in the three courses may not become candidates for the Ph.D. degree in inorganic chemistry. In addition they are required to complete (4) three units of Chemistry 221, 223, or 225, and (5) six additional units of advanced lecture courses of which at most three may be chosen from physical or inorganic chemistry.

All students majoring in organic chemistry are required to take (1) basic training in certain spectroscopic and chromatographic techniques, and a proficiency test in qualitative organic analysis; those failing to pass the test will be required to take Chemistry 126; (2) Chemistry 221, 223, and 225 during the first year, irrespective of background; those who fail to make a grade point average of at least 3.00 in these three courses may not become candidates for the Ph.D. degree in organic chemistry; (3) three units of Chemistry 227; (4) nine units of advanced lecture courses outside of the field of organic chemistry of which at least three units must be from Chemistry 271, 273, or 275. Beginning with the second year of graduate work at Stanford, organic majors are required to participate in a series of advanced problem sessions.

All students majoring in physical chemistry are required to take (1) Chemistry
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SCHOOL OF HUMANITIES AND SCIENCES

271, 273, and 275 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) three additional units of advanced analytical, physical or inorganic chemistry; (3) nine units of advanced lecture courses outside of the fields of analytical, physical, and inorganic chemistry of which at least three units must be from Chemistry 221, 223, or 225.

Students majoring in biochemistry must complete (1) a course in general biochemistry such as Biochemistry 101 and 102 (7 units or equivalent); (2) the advanced organic chemistry series, Chemistry 221, 223, and 225, or the advanced physical chemistry series, Chemistry 271, 273, and 275; and (3) five units of advanced courses in biochemistry such as Chemistry 246, Chemistry 247, Biochemistry 211, or allied courses in Medical Microbiology, Biology, or Physiology as approved by the Department of Chemistry.

In 1963 the Department 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, 271, 273, or 275.

FELLOWSHIPS AND SCHOLARSHIPS

In addition to the University fellowships and scholarships that are open to properly qualified students, there are at present numerous Departmental fellowships in chemistry. The Allied Chemical Corporation Fellowship, Continental Oil Company Fellowship, Dow Chemical Company Fellowship, Edward Curtis Franklin Fellowship, James W. McBain Memorial Fellowship, Stauffer Chemical Company Fellowship, and Frederick P. Whitaker Fellowship are granted only to graduate students. The William H. Nichols Scholarships, David L. and Lavinia E. Sloan Memorial Scholarship, John Maxon Stillman Scholarship, and Ephraim and Amelia Weiss Scholarships are open to graduates and undergraduates; the Robert M. and Katherine F. Loeser Scholarship and the Frank 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

#1. General Chemistry—Prerequisite: high school algebra or Mathematics A.
4 units, autumn, (Staff), lec. (I) MWF 8, (II) MWF 9, (III) TThS 9; lab. (I) T 9-12, (II) T 2:15-5:05, (III) W 2:15-5:05, (IV) Th 9-12, (V) Th 2:15-5:05, (VI) F 2:15-5:05

#2. General Chemistry—Continuation of 1.
4 units, winter, (Staff), lec. and lab. sections same as under Chemistry 1.

#3. General Chemistry—Continuation of 2.
5 units, spring, (Staff), lec. (I) MWF 8, (II) MWF 9; lab. (I) TTh 9-12, (II) TTh 2:15-5:05, (III) W 2:15-5:05

110. Elementary Quantitative Analysis—For other than Chemistry or Chemical Engineering majors. Concurrent registration in 111 required. Prerequisite: 3.
2 units, spring, (Loring), TTh 11

111. Elementary Quantitative Analysis Laboratory—Concurrent registration in 110 required.
3 units, spring, (Loring), MWF 1:15-4:05

112. Quantitative Analysis—For Chemistry or Chemical Engineering majors. Concurrent registration in 113 required. Prerequisite: 3.
3 units, autumn, (Skoog), MWF 10

113. Quantitative Analysis Laboratory—Concurrent registration in 112 required.
2 units, autumn, (Skoog), MW 1:15-4:05 or TTh 1:15-4:05

116. Instrumental Analysis—Techniques and instrumentation theory of electro-metric titrations, polarography, spectrophotometry, chromatography, and refractometry. Prerequisites: 112, 113, 171, and previous or concurrent enrollment in both 173 and Physics 29 or 57.
4 units, winter, (Laurie), lec. TTh 10; lab. TTh 1:15-4:05 or W 1:15-4:05

120. Organic Chemistry—Aliphatic, aromatic compounds. For students other than Chemistry, or Chemical Engineering majors. Prerequisite: 3.
5 units, summer, (Staff), MTWThFS 9

121. Organic Chemistry—Carbon compounds. Prerequisite: 3.
3 units, autumn, (Mosher), MWF 11

122. Organic Preparations—Laboratory course. Prerequisite: 120, or previous or concurrent enrollment in 123.
3 units, winter, (Noller), MT 1:15-5:05 or WTh 1:15-5:05

123. Organic Chemistry—Continuation of 121.
3 units, winter, (Mosher), MWF 11

124. Organic Preparations—Continuation of 122.
3 units, spring, (Noller), MWF 1:15-4:05

125. Organic Chemistry—Continuation of 123.
3 units, spring, (Mosher), 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, radioactive analysis, and their applications. Prerequisites: 3, Mathematics 23, and Physics 57, or equivalent.
3 units, autumn, (Kruger), TTh 9
139. **Radiochemistry Laboratory**—Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisite: 138 or consent of instructor.

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

171. **Physical Chemistry**—Introduction to chemical thermodynamics. The properties of gases, liquids and solutions. The phase rule and some applications. Prerequisites: 3; Mathematics 10, 11, 21 (or equivalent); Physics 51, 52, 53, 54, and previous or concurrent registration in Physics 55 and 56 (or Physics 21, 23, 29 on petition).

3 units, autumn, (Hutchinson), MWF 8

173. **Physical Chemistry**—Electrochemistry, including conductance phenomena and galvanic cells. Chemical kinetics, colloid and surface chemistry. Prerequisite: 171.

3 units, winter, (Hutchinson), MWF 8

175. **Physical Chemistry**—Atomic and molecular spectra. The solid state. Statistical mechanics. Prerequisite: 173.

3 units, spring, (Hutchinson), MWF 8

176. **Physical Chemistry Laboratory**—Vacuum, temperature control, electronic, and optical techniques used in the measurement of enthalpy changes, viscosity, surface tension, vapor pressure, electronic and vibration-rotation molecular spectra, optical rotation, solution conductance, reaction rates, and x-ray crystal scattering. Prerequisites: 116 and previous or concurrent enrollment in Chemistry 175.

3 units, spring, (Brauman), lec. T 10; lab. TTh 1:15-4:05 or WF 1:15-4:05

180. **Inorganic Chemistry**—A systematic discussion of the chemistry of some of the nonmetallic elements, emphasizing the application of equilibrium, rate, and structural principles. Prerequisite: 171.

3 units, winter, (Taube), MWF 10

**GRADUATE COURSES**

Undergraduates may register for chemistry courses numbered 200 and above only if admitted to the Honors Program or if special permission has been granted by the instructor in the course.

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 1964–65

   2 units, autumn, (Loring), TTh 9, alternate years, to be given in 1965–66

271. Advanced Physical Chemistry—Quantum Mechanics. Prerequisite: 175 or its equivalent.
   3 units, autumn, (Harris), MWF 11

273. Advanced Physical Chemistry—Molecular Structure. Prerequisite: 271, or permission of the instructor.
   3 units, winter, (Laurie), MWF 11

275. Advanced Physical Chemistry—Statistical Mechanics. Prerequisite: 271 or permission of the instructor.
   3 units, spring, (Flory), MWF 11

276. Electrochemical Concepts and Conventions—A survey of the fundamentals of electrochemistry. Prerequisite: 175.
   1 unit, winter, (Van Rysselberghe), by arrangement, alternate years, to be given in 1965–66

277a. Electrochemical Thermodynamics and Kinetics—Thermodynamic treatment of reversible cells, electrodes; irreversible phenomena in electrochemical systems, kinetics of electrode processes, polarization and overvoltage, Tafel law, electrochemical procedures in physical, analytical chemistry. Prerequisite: 175.
   2 units, winter, (Van Rysselberghe), TTh 9, alternate years, to be given in 1964–65

277b. Electrochemical Thermodynamics and Kinetics—Continuation of Chemistry 277a. Prerequisite: 276 or 277a.
   2 units, spring, (Van Rysselberghe), TTh 9, alternate years, to be given in 1964–65

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 10, 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 10, 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 10, alternate years, to be given in 1965–66

289a. Chemical Thermodynamics—Systematic exposition of thermodynamics from the Gibbsian point of view. Principal topics are: fundamental concepts, Gibbsian equations, general conditions for chemical equilibrium, phase rule, systematic deduction of thermodynamic formulas, monovariant systems, azeotropic systems, perfect gases, absolute temperature, imperfect gases, ideal solutions, law of mass action. Lectures, problems.
   3 units, autumn, (Flory), T 8 and Th 8–10, alternate years, to be given in 1964–65

289b. Chemical Thermodynamics—Continuation of 289a. Nonideal solutions, systematic deduction of the thermodynamic solution laws, chemical affinity and standard free energy, charged components, electrochemical potential, electric potential, electromotive force, galvanic cells, without liquid junction.
   3 units, winter, (Flory), T 8 and Th 8–10, alternate years, to be given in 1964–65
289c. Chemical Thermodynamics—Continuation of 289b. Galvanic cells with liquid junction, $\text{pH}$, gravitational field, radiation, irreversible processes.

3 units, spring, (Koenig), T 8 and Th 8-10, 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, Antony E. Raubitschek

Associate Professors: Edwin Joseph Doyle, Edwin Marshall Good (Religion and Hebrew)

Assistant Professors: Charles R. Beye, Andrew Thomas Cole

Instructor: Michael Wigodsky

The Department of Classics offers work in the Greek, Latin, and Hebrew languages and literatures, in Greek and Roman History and in Classical Archaeology. It aims to develop in the student three things: a competence in the classical languages, an appreciation, comprehension, and enjoyment of classical literature, and an understanding of the history and culture of the ancient world. The Department is interested both in students who wish to do their major work in Classics and in students who wish to relate classics to work in such other departments as English, Philosophy, History, and the Modern Languages. Study of the classics as a Major subject equips students for teaching Latin and Greek in high school and college and is also an essential part of a liberal education.

ADMISSION TO THE DEPARTMENT

Students should enroll as majors in the Department as early as possible, since they must complete the second-year courses in Latin and Greek (L23, G23) or have reached an equivalent standard through work done in high school before they can be admitted to courses on the 100 level. Students interested in Greek should start at
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 A: Classics (Latin and Greek), or B: Latin or Greek.

A student's program of study should be prepared in advance after consultation with his Departmental adviser. Major students must register each quarter for at least one course in the Major subject. A student interested in obtaining certification for teaching Latin in the State of California should consult the Head of the Department or his adviser.

A. Major in Classics: Latin and Greek. 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 (L170-172; G170-172). This major is especially designed for students who are interested in Graduate work in Classics or in related fields such as Ancient History, Medieval History, Ancient and Medieval Philosophy, etc.

B. Major in Classics: Latin or Greek.

1. There are two types of Latin Major: the Latin Major, and the Latin Major with a related minor.

   a) The Latin Major: 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 (L170-172); two courses in Roman history (H102, 103); Humanities 61 or some work in Greek history or ancient art or some study of Greek.

   b) The Latin Major with a Related Minor: the above program for the Latin Major plus a minor of 20-21 units in either Greek, French, German, Italian, Philosophy, English, or History.

2. There are two types of Greek Major: the Greek Major and the Greek Major with a related minor.

   a) The Greek Major: 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 (G170-172); two courses in Greek history (H100, 101); Humanities 61 or some work in Roman history or ancient art or some study of Latin.

   b) The Greek Major with a Related Minor: the above program for the Greek Major plus a minor of 20-21 units in either Latin, French, German, Italian, Philosophy, English, or History.

Combined Majors

Students may with the consent of the Heads of departments concerned offer for the degree of Bachelor of Arts a combined major in Classics (Latin and/or Greek)
SCHOOL OF HUMANITIES AND SCIENCES

and English, Classics and Philosophy, Classics and Modern European Languages. Students interested in such a major should consult the Heads of each of the departments concerned.

Minors

The Department recommends for an undergraduate minor in Classics (Latin or Greek) the following: 18 to 19 units of Latin or Greek of which at least 12 shall be on the 100 level or above, and 4 units in related courses (Greek or Roman History, Ancient Art).

Honors Program in Humanities

For acceptable majors in Classics an Honors Program in Humanities is offered, a description of which will be found under “Humanities (Special Programs).”

Advanced Degrees

Master of Arts

Students may be accepted as candidates for the degree of Master of Arts who have completed an undergraduate major in Classics (Latin and/or Greek) or its equivalent. The other requirements for the degree are:

1. Satisfactory demonstration of competence in Greek and/or Latin composition.
2. Attainment of a standard of scholarship such as would normally be reached by three quarters of study in the Department after fulfilling the requirements for an undergraduate major in the Department. This would normally mean the completion of at least 18 units of graduate courses and 18 units of work at the 150 or 170 levels.
3. The satisfactory completion of one Greek course at the 100 level (if his undergraduate major has been Latin) or one Latin course at the 100 level (if his undergraduate major has been Greek).
4. The passing of an examination testing the candidate's ability to translate into English from a selected list of Greek or Latin authors.
5. The writing of a thesis or essay.
6. Passing of an oral examination testing his general knowledge of the Classical field. A reading knowledge of French or German is required.

Second-year students, and in some cases first-year students, who are candidates for the Ph.D. degree may also (on the recommendation of the Department) become candidates for the A.M. degree. In their case the thesis requirement above will be waived provided that they have completed some work beyond the course requirements listed under 2 and 3 above.

Master of Arts (Three-Year Program)

In addition to the regular major programs, the Department of Classics offers, with the support of the Ford Foundation, a three-year Master of Arts program, which is especially designed to prepare college teachers of Classics (Latin or Greek) and Classical civilization. Highly qualified students begin this program at the beginning of their junior year and continue for eleven consecutive quarters. One of these quarters is spent abroad in Italy and Greece. For information regarding eligibility, admission to the program, and special scholarships write to Professor Daniel D. McCluney, Jr., Program Director, Three-Year Master's Degree Program, Office of the Dean, Graduate Division, Stanford University, Stanford, California.

Doctor of Philosophy

University regulations regarding admission and application for candidacy are discussed in the section “Degrees” of this Bulletin.
All candidates for the Ph.D. degree in Classics must fulfill the following requirements:

1. They must complete at least three years (nine quarters) of full-time work, or equivalent, in study beyond the Bachelor's degree. At least 72 approved units of graduate courses or seminars must be completed in addition to the doctoral dissertation. At least three consecutive quarters of graduate work and the final units of credit in the program must be taken at Stanford.

2. Candidates will be required to pass examinations as follows:
   a) A reading examination in French and German. Candidates should prepare themselves to take this examination by the end of their first year of graduate study if possible.
   b) An examination in translation into English from Latin and Greek authors included in an approved list (drawn up by the Department and obtainable from the Department secretary). This examination will be set in each autumn quarter, and is expected to be taken after one full year of graduate study.
   c) An examination in Latin and Greek composition to be taken in the candidate's second year or earlier.
   d) An examination in four classical authors (two Latin, two Greek), selected by the Department each year. (The authors for 1964-65 will be: Tacitus, Virgil, Demosthenes, Sophocles.) This examination will be set each spring quarter and candidates are expected to be prepared for it in their second year of study unless special arrangements are made to take it later.
   e) An oral examination on ancient literature and history, his dissertation and one or more special topics (approved by the Department) such as selected periods of Greek or Roman History, Archaeology, Philosophy, Epigraphy, or Palaeography. Candidates should be ready for the examination in the spring quarter of their third year.

3. Each candidate (not later than the end of the quarter in which he takes his Examination in the Four Authors) must submit to the Executive Head of the Department a statement of his dissertation topic as approved by his dissertation committee. This committee will normally be appointed (for each candidate) by the Executive Head of the Department at least one quarter before his dissertation topic is due to be submitted. At the same time or earlier a senior member of the Department will be appointed as the candidate's adviser who will thereafter supervise the candidate's writing of the dissertation. An acceptable dissertation must be a genuine contribution to classical scholarship 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 LI71–173 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 G1a, 1b which is intended to cover approxi-
mately the same ground at a faster pace. For the second year two alternate series are offered: G22, G23, G100 (two quarters of Homer and one of Attic prose) or G27, G28, G109 (two quarters of Attic prose and one of Homer). In both series one meeting in each week will be regularly devoted to grammar and composition exercises.

The General Studies languages requirement can be fulfilled by successful completion of either G23 or G28.

The following table shows the sequence of courses offered each year:

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<th>Autumn</th>
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<th>Spring</th>
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<td>G2a</td>
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#G1. First-Year Greek—For beginners.
4 units, autumn, (Doyle), TWThF 10

#G2. First-Year Greek—Continuation of G1.
4 units, winter, (Doyle), TWThF 10

#G3. First-Year Greek—Continuation of G2.
4 units, spring, (Doyle), TWThF 10

#G2a. First-Year Greek.
5 units, winter, ( ), MTWThF 1:15

#G1b. First-Year Greek—Continuation of G2a.
5 units, spring, ( ), MTWThF 1:15

4 units, autumn, (Pearson), TWThF 10

4 units, winter, (Otis), TWThF 10

#G27. Second-Year Greek—Attic Prose: Xenophon or Plato.
3 to 4 units, autumn, ( ), by arrangement

3 to 4 units, winter, ( ), by arrangement

1 to 2 units, by arrangement

3 to 4 units, spring, (Otis), MTWF 10

3 to 4 units, spring, ( ), by arrangement

**Third- and Fourth-Year Courses**

#G101. Tragedy—One play of Euripides.
3 to 4 units, autumn, ( ), MWF 9 or by arrangement

#G102. Tragedy—One play of Sophocles.
3 to 4 units, winter, ( ), MWF 9 or by arrangement

#G103. Plato: *Phaedo.*
3 to 4 units, spring, ( ), MWF 9 or by arrangement

#G104. Tragedy—One play of Aeschylus.
3 to 4 units, spring, ( ), MWF 9 or by arrangement

G105. Composition, Elementary.
2 units, autumn, ( ), by arrangement

G151. Plato: *Symposium.*
3 to 4 units, autumn, ( ), by arrangement

G152. Plato: *the Republic.*
3 to 4 units, winter, ( ), by arrangement
3 to 4 units, spring, (——), by arrangement

G155. Composition, Advanced.
2 units, winter, spring, (——), by arrangement

G156. Aristophanes.
3 to 4 units, autumn, (——), by arrangement

3 to 4 units, winter, (Raubitschek), by arrangement

G158. Thucydides.
3 to 4 units, spring, (Raubitschek), 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)

G172. History of Greek Literature: Comedy, Tragedy.
4 units, winter, (——)

4 units, spring, (——)

See also Classical Courses (Latin and Greek) listed after Hebrew (III)

Graduate Courses

G202. The Hellenistic Epic.
3 units, winter, (Otis), by arrangement

G204. Fifth Century Sophists.
3 units, winter, (Cole), by arrangement

G205. Composition for Graduates.
By arrangement

G208. Sophocles.
3 to 4 units, autumn

G213. Individual Work.
By arrangement

3 units, autumn, (Pearson), by arrangement

G216, G217. Seminar—Subject to be announced.
G216. 3 to 4 units, autumn, (——), by arrangement
G217. 3 to 4 units, winter, (——), by arrangement


II. Courses in Latin
First- and Second-Year Courses

The General Studies language requirement may be fulfilled by successful completion of either L23 or L28. The following table shows the sequence of courses offered each year:

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Descriptions of these courses will be found below. A placement test will be set for entering freshmen (and for others by arrangement), 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.
2. 6 units required—L27 and L28 or L22 and L23. In exceptional cases students in this category will be permitted to complete their requirements by taking one 3-unit course, provided that they obtain a grade of B or higher.
3. 9 units required—L21, L22, L23.

#L1. First-Year Latin—For beginners (see also L5).
4 units, autumn, ( ), TWThF 8

#L2. First-Year Latin—Continuation of L1.
4 units, winter, ( ), TWThF 8

#L3. First-Year Latin—Continuation of L2 or equivalent.
4 units, spring, ( ), TWThF 8 or by arrangement

L5. Accelerated Course in Elementary Latin—Intended especially for graduate students in other departments or juniors and seniors with consent of instructor.
5 units, autumn, ( ), MTWThF 1:15

L6. Accelerated Course in Elementary Latin—Continuation of L5.
5 units, winter, ( ), MTWThF 1:15

5 units, spring, ( ), MTWThF 1

#L21. Second-Year Latin—For students with two years of high school Latin or equivalent preparation. Reading in Latin prose.
3 units, autumn, ( ), MWF 1:15

3 units, winter, ( ), MWF 1:15

3 units, spring, ( ), MWF 1:15

L25. Grammar and Elementary Composition, Second Year.
2 units, autumn, ( ), by arrangement

2 units, winter, ( ), by arrangement

#L27. Latin poetry: Virgil, Aeneid VII–XII or Ovid.
3 units, autumn, ( ), by arrangement

#L28. Latin Prose: Livy or Pliny the Younger.
3 units, winter, ( ), by arrangement

L109. Christian Latin Authors.
3 units, spring, ( ), by arrangement

**Third-Year Courses**

Students will be recommended to take one or more of the following series. Series A (L101, 102, 103) will be given in 1964–65, Series B (L106, 107, 108) in 1965–66, and the Translation and Composition series will be given every year.

L101, L102, L103. The Crisis of the Roman Republic: Cicero, Sallust, Caesar, Catullus.
101. 3 to 4 units, autumn, (Staff), by arrangement
102. 3 to 4 units, winter, (Staff), by arrangement
103. 3 to 4 units, spring, (Staff), by arrangement

106. 3 to 4 units, autumn, (Staff), by arrangement
107. 3 to 4 units, winter, (Staff), by arrangement
108. 3 to 4 units, spring, (Staff), by arrangement
  L105. 2 units, autumn, (Staff), by arrangement
  L115. 2 units, winter, (Staff), by arrangement
  L155. 2 units, spring, (Staff), by arrangement
#L151. Lucretius.
  3 to 4 units, autumn, (———), by arrangement
L152. Virgil, Eclogues.
  3 to 4 units, autumn, (———) MWF 11 or by arrangement
L153. Virgil, Georgics.
  3 to 4 units, winter, (———) MWF 11 or by arrangement
L154. Virgil, Aeneid.
  3 to 4 units, spring, (———), MWF 11 or by arrangement
L155. Composition, Advanced.
  2 units, winter, spring, (———), by arrangement
L156. Satire.
  3 to 4 units, spring, (———)
  3 to 4 units, winter, spring, (———), by arrangement
L160. Individual Work.
  By arrangement
L170. Teachers' Course.
  3 units, by arrangement

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

  4 units, autumn, (———), by arrangement
  4 units, winter, (———), by arrangement
  4 units, spring, (———), by arrangement

GRADUATE COURSES

  3 units, autumn, (Wigodsky), by arrangement
L205. Latin—Prose composition for graduates.
  3 units, autumn, (———), by arrangement
L213. Individual Work.
  By arrangement
L214. Tacitus.
  3 units, spring, (Otis)
L216, L217. Seminar—Subject to be announced.
  L216. winter, (Otis), by arrangement
  L217. spring, (Otis), by arrangement

III. COURSES IN HEBREW

#HE1. First-Year Hebrew—Introduction to classical Hebrew language, emphasizing reading ability in various styles as found in the Hebrew Bible.
  4 units, autumn, (Good), TWThF 11
#HE2. First-Year Hebrew—Continuation of HE1
  3 units, winter, (Good), MWF 11
#HE3. First-Year Hebrew—Continuation of HE2.
  3 units, spring, (Good), MWF 11
#HE22. Second-Year Hebrew—Advanced reading in the Hebrew Bible, with particular attention to poetry and poetic structure, critical analysis, and methods of interpretation.
4 units, autumn, (Staff), by arrangement

4 units, winter, (Staff), by arrangement

4 units, spring, (Good), by arrangement

IV. COURSES IN GREEK AND ROMAN AUTHORS IN TRANSLATION

#T160. The Classical Epic (in Translation)—A study of the epic in respect to structure, character, theme, and imagery.
3 units, spring, (——), MWF 2:15

#T170. Tragedy (in Translation).
3 units, spring, (——), MWF 2:15

See also Senior Colloquia.

V. COURSES IN ANCIENT HISTORY

The following courses form a sequence, as a general survey of the Greek and Roman world, but they may be taken separately. Prerequisite: History 1, or equivalent.

H100. Greek History: The City States.
4 to 5 units, autumn, (Doyle), MTWTh 2:15

H101. Greek History—Continuation of H100.
4 to 5 units, winter, (Doyle), MTWTh 2:15

H102. The Roman Republic.
4 units, autumn, (Pearson), MTWTh 2:15, to be given in 1965–66

H103. The Roman Empire.
4 units, winter, (Pearson), MTWTh 2:15, to be given in 1965–66

4 to 5 units, spring, (——), MTWTh 2:15

For more advanced students—especially majors and graduate students in Classics or History—work will be offered on an individual basis:

H200. Independent Reading in Greek History.
3 or more units, spring, (——), by arrangement

H205. Independent Reading in Roman History.
3 or more units, spring, (Pearson), by arrangement, to be given in 1965–66

VI. COURSES IN GREEK ARCHAEOLOGY

These will be announced in autumn, 1964.

VII. COURSES IN CLASSICS

C101. Reading course for Three-Year Master of Arts Candidates.
3 units, spring, (——), by arrangement

C201. Introduction to Classical Scholarship.
3 units, autumn, (Doyle), by arrangement
COMMUNICATION

Emeritus: Chilton R. Bush (Professor)

Executive Head: Clifford Francis Weigle
Associate Executive Head, Broadcasting and Film: Stanley T. Donner
Director, Institute for Communication Research: Wilbur Schramm
Professors: Stanley T. Donner, Nathan Maccoby, Wilbur Schramm, Clifford Francis Weigle. Consulting: Grant Fairbanks
Assistant Professors: Richard F. Carter, Richard Rees Fagen. Acting: John David Lewis
Instructor: Henry S. Breitrose
Lecturers: Lyle M. Nelson, Templeton Peck

The Department of Communication engages in research in communication and offers a curriculum which prepares its students for careers in journalism, broadcasting, film, and communication research.

The main objectives of the curriculum are to equip the student with an adequate set of professional values; to provide a broad program in the social and humanistic studies; and to present courses in the processes and effects of communication.

A secondary objective is to provide that amount of training in skills and techniques that will sustain the student's interest in his chosen profession while he is in college and will assist him in beginning his career.

The technical courses provide not only practice but a content that is an application of some of the principles of the behavioral sciences and humanities. The technical curriculum in this sense is like the curricula of the Schools of Medicine and Engineering which apply the principles of the biological and physical sciences.

ADMISSION

Undergraduate students who have been admitted by the University are accepted as majors provisionally for one quarter. Thereafter, the student's record is reviewed quarterly by the Department.

Students who wish an undergraduate minor in the Department may arrange for a suitable sequence of preprofessional courses.

Prospective 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 available, one in the Journalism Division and one in the Broadcasting and Film Division. Requirements are as follows:
1. Two courses in general or English literature; Psychology 1; Sociology 1 or Anthropology 1. In addition, Journalism Division students are required to take Economics 1 and Political Science 1 and 10 or 20.

2a. Broadcasting and Film Division: Communication 1, 100a, b, and c, 105a, b, and c, and 110a or b or c, 113, 114, 141 or 142, 180.

2b. 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 109, 169 and 175; the student preparing for advertising work will take Communication 115 and 116; the student interested primarily in writing for consumer magazines and industrial publication will take Communication 109, 150 and 169.

3. A unified program totaling not less than 20 units of courses numbered 100 or higher shall be arranged, with the approval of the adviser, from one or two other departments such as Anthropology, Art, Economics, English, History, Music, Philosophy, Political Science, Psychology, Sociology, or Speech and Drama.

While the Department offers no courses in such subjects as science reporting, technical writing, or public relations, appropriate programs of study can be arranged for interested students. For example, a prospective science writer could be permitted to substitute a unified program of courses in the physical sciences in lieu of requirement "3" above.

Majors in Communication may elect one of the following interdisciplinary honors programs:

- Behavioral Sciences (Honors Program in Quantitative Methods)
- Humanities Undergraduate Honors Program.
- Social Sciences (Honors Program in Social Thought and Institutions)

Communication Honors Program

In addition to the regular undergraduate programs in communication, a Communication Honors Program is designed for those exceptionally able students who wish, in their major, to pursue an intensive and somewhat independent study of communication. This program is directed toward the integration of a substantial body of theoretical and factual information and the development of both communication skills and creative scholarly skills by independent study, tutorial guidance, small seminars, and research experience. Particular emphasis is placed on the planning of an individual program for the student that will combine his specialized interests with a body of basic knowledge about communication processes. The plan will be aimed at helping the student prepare for a comprehensive examination to be taken in the final quarter of his senior year, over his entire area of communication study. The plan will include arrangements for continuous supervised work in communications skills or in communication research. A report of the work done under this plan will be submitted as an undergraduate thesis at the end of the next to final quarter of the student's senior year. It is possible for a student to elect both the Communication Honors Program and one of the three interdisciplinary honors programs listed above.

Master of Arts

The Master of Arts degree is awarded by the Department in the fields of Journalism, Broadcasting and Film, or Communication Research. Requirements are as follows:

1. The candidate must earn 45 units in graduate residence at Stanford; he must earn an average grade of B on his entire program of study. An independent project under the direction of a major professor must be undertaken. Three to six hours of credit in independent study may be applied to this requirement. A report of the project must be made to the professor directing the independent study. A candidate
may petition the Department by the end of the second week of the second quarter for permission to submit the report as a thesis.

2. A unified program of advanced course work is to be arranged with the approval of the adviser. This includes appropriate grounding in research methodology and communication theory; it includes training in one or more communication media; and, it includes the equivalent of a minor in a related field—or a cohesive group of courses in several fields.

3. Students 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. Psychology 150a, 150b.

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 his 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, 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.

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 expected to complete the equivalent of the Communication course requirements for an A.M. in Communication, 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.

The following is an example of a typical Ph.D. program:

1. Communication Theory
   Comm. 211. Theory of Communication I—Mass Communication
   Comm. 212. Theory of Communication II—Communication Processes
   Comm. 213. Theory of Communication III—Groups and Networks

2. Methodology
   Comm. 217. Research Methods I—Introduction to Scientific Method
   Comm. 218. Research Methods II—Data Collection
   Comm. 219. Research Methods III—Design and Analysis

3. Statistics
   Psych. 150a. Advanced Statistical Methods, Correlation
   Psych. 150b. Advanced Statistical Methods, Statistical Inference
   Psych. 250. Advanced Statistical Methods, Multivariate Analysis

4. Experimental Psychology (at least two of the following; order may be altered from year to year)
   Psych. 103a. Experimental Psychology—Cognition
   Psych. 103b. Experimental Psychology—Perception
   Psych. 103c. Experimental Psychology—Learning

5. Social Psychology and Personality
   Psych. 112. Social Psychology
   Psych. 135. Intermediate Social Psychology
   Psych. 212. Advanced Social Psychology
   (at least one of the following)
   Psych. 160. Abnormal Psychology
   Psych. 195. Personality
   Psych. 197. Dynamic Psychology

6. Sociology (at least two of the following)
   Sociol. 61. Introduction to Small Groups
   Sociol. 62. Introduction to Formal Organization
   Sociol. 108. Social Stratification

Preparation for examinations and for the dissertation should include selected courses from among the following:

Comm. 220. Mass Communications in Society
Comm. 255. International Communication
Comm. 230. Advertising and Media Research
Comm. 260. Content Analysis
Comm. 275. Attitude Measurement
Psych. 209. Advanced Perception
Psych. 213. Organizational Processes
Psych. 214. Motivation
Psych. 261. Seminar in Social Psychology
Psych. 198. Trends in Cognitive Theory
Psych. 267. Seminar in Interpersonal Processes
Phil. 157a, b. Logic
Phil. 164. Philosophy of Science
Anthr. 176. Language and Culture
Anthr. 164. Culture and Personality
Pol.Sci. 162. Advanced Study of Political Behavior
Pol.Sci. 262. Seminar in Political Behavior: Modes of Analysis
Sociol. 280. Research Seminar on Influence Processes
C.S. 136. Use of Automatic Digital Computers

Other courses and special advanced reading courses may be selected in conference with the adviser.

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

#1. Communication and Society—An introductory survey of the structure, functions, philosophy, process, and effects of mass and interpersonal communication in modern society. Taught from a behavioral science perspective. Open to nonmajors.
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 nonmajors. Prerequisite: Psychology 60 or equivalent.
3 units, spring, (Maccoby), M 2:15-4:05

156. Media Management—Principles of business operation of newspapers, magazines, radio-TV; emphasis on revenue factors. Nonmajor students require consent of instructor.
3 units, spring, (Brinton), by arrangement

199. Individual Work—Major students with high academic standing are permitted to undertake individual work.
1 to 2 units, any quarter, (Staff), by arrangement

II. JOURNALISM

50. Editorial Techniques I—Theory and techniques of news communication for newspapers and radio-TV; analysis of journalist's audience; representative media; journalistic vocations. To be taken concurrently with Communication 51. Open to nonmajors.
3 units, autumn, spring, (Rivers), MWF 9

51. Editorial Techniques I Laboratory—Practice in news writing. Weekly conferences, laboratory, outside assignments. To be taken concurrently with Communication 50. Open to nonmajors. Prerequisite: typing skill of 35 words per minute (may be met by taking Typing 1).
1 unit, autumn, spring, (Rivers), by arrangement

3 units, winter, (Brinton), TTh 9; lab. by arrangement
3 units, winter, (Weigle), MW 9; lab. by arrangement

109. Editorial Techniques III—Advanced news writing for newspapers, radio-TV. Conducted in cooperation with the Palo Alto Times. Prerequisites: 50 and 51, junior standing. Majors only.
2 units, spring, (Brinton), by arrangement

115. Advertising I—Fundamentals of marketing, consumer research, media, copy, layout. Open to nonmajors.
3 units, autumn, (Brinton), MWF 11

3 units, winter, (Brinton), MWF 11

140. History of Anglo-American Journalism—Open to nonmajors.
3 units, autumn, (Weigle), TTh 9
4 units, summer, (——), by arrangement

150. Forms of Journalistic Writing—Practice in writing magazine articles, with emphasis on marketing manuscripts. Conferences. Prerequisites: senior standing and 50 and 51 or consent of instructor.
3 units, autumn, (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, spring, (Rivers), by arrangement

169. Legal Aspects of Journalism—Libel, contempt, constitutional guarantees, privacy, copyright, inspection of public records.
3 units, winter, (Fagen), TTh 9

175. Reporting of Public Affairs—Local, state, federal courts; municipal, state, federal administration in the local community. Open only to major students with senior standing.
4 units, winter, (Rivers), MWF 10

Practice Courses

121. Advanced Practice—Practice work in executive positions on editorial or business staff of The Stanford Daily; weekly conferences. Open to undergraduate students who qualify by election or appointment; not open to graduate students. Students limited to total of 7 units credit. Credit may not be offered in fulfillment of Communication unit requirements for degrees in communication.
1 to 2 units, each quarter, (Staff), by arrangement

183. San Francisco Newspaper Practice—Majors who have made a high record in their entire program, and especially in 175, are permitted to work in San Francisco in the senior year, by arrangement with San Francisco newspapers. Work is under supervision of specially appointed San Francisco newspapermen and faculty of the Department.
5 units, spring, (Weigle), by arrangement


III. Broadcasting and Film

100. Theory of Broadcasting and Film—Approaches to radio, television, and film as media of communication, art, and commerce. Background and nature of the organization and processes of broadcasting and film.
100a. Broadcasting I.
3 units, winter, (Lewis), MWF 9

100b. Broadcasting II.
3 units, spring, (Lewis), MWF 10

100c. Film.
4 units, autumn, (Breitrose), MWF 9

105. Practice in Broadcasting and Film—Actual production and direction of various forms in radio, television, and film, respectively. Complete production facilities are used in each medium.

105a. Radio.
4 units, autumn, (Lewis), TTh 1:15-3:05

105b. Television.
4 units, winter, (Lewis), TTh 1:15-3:05

105c. Film.
4 units, autumn, (Breitrose), 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, (Lewis), T 10-11 and Th 10-12

110b. Television.
3 units, spring, (Lewis), T 1:15 and Th 1:15-3:05

110c. Film.
3 units, winter, (Breitrose), T 10-11 and Th 10-12

113. Writing for Broadcasting—Writing of nondramatic forms for broadcast, including news, educational programs, music continuity, and documentary. To be taken concurrently with Communication 114.

2 units, autumn, (Lewis), MWF 11

114. Broadcast Journalism Laboratory—Procedures of the broadcast newsroom. Use of radio and film techniques for features and documentaries. Practice in KZSU newsroom. To be taken concurrently with Communication 113.

1 unit, autumn, (Lewis), by arrangement

123. Advanced Writing for Broadcasting—Study and analysis of dramatic, documentary, and informational programs for television. Practice and criticism in the writing of these forms.

4 units, spring, (Lewis), MW 2:15-4:05

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 to be announced in class.

4 units, spring, (Breitrose), MWF 9; lab. by arrangement

142. History of Broadcasting—Studies in the development of broadcasting as communication.

4 units, winter, (Donner), TTh 9

180. Broadcasting and Film Criticism—The techniques and role of criticism based upon the objectives and potential of these media. For advanced students. 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 non-commercial 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. Special study of 1964 convention and election coverage on network and local levels. 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

COURSES PRIMARILY FOR GRADUATES

211. Theory of Communication I—Theory, structure, and effects of mass communication. Analysis of the literature.

5 units, autumn, (Schramm), M 2:15-4:05 and additional meetings by arrangement


5 units, winter, (Maccoby), MW 2:15-4:05

213. Theory of Communication III—Theory of communication in groups and
communication networks. The theory of information and meaning. Analysis of the literature.

215. **Behavioral Science in Broadcasting and Film**—A comprehensive survey of the contribution of behavioral science theory and research to radio, television, and film. Methods and findings of behavioral science research on effects of forms and contents of audio-visual communication on audience learning of skills, information, and attitudes. For A.M. candidates primarily.

3 to 5 units, autumn, (Maccoby, Donner), Th 7-10 p.m.

217. **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, (Maccoby, Parker), TTh 2:15-4:05

218. **Communication Research Methods II**—Continuation of 217.

4 units, winter, (Maccoby), TTh 2:15-4:05

219. **Communication Research Methods III**—Continuation of 218.

4 units, spring, (Maccoby, Parker), TTh 2:15-4:05

220. **Mass Communications in Society**—A survey lecture course on the nature and social responsibilities of the media, the structure of the industry, problems of regulation, management, educational and commercial interests, and social effects of the mass media.

5 units, autumn, (Donner, Parker), MTW 10 and section
4 units, summer, (Staff), by arrangement

230. **Advertising and Media Research**—Procedures for advertising and media research, audience measurement, and consumer analysis. Prerequisite: consent of instructor.

3 units, spring, (Brinton), F 2:15-4:05

255. **International Communication**—Chief patterns of mass communications throughout the world; philosophies behind them; economic, social, political reasons why a given kind of pattern develops where it does; channels by which nations, cultures communicate with each other; kinds of barrier which intervene in those channels; manipulative communication between nations which is characteristic of the "cold war."

4 units, spring, (Schramm, Fagen), M 2:15-4:05

260. **Content Analysis**—The method of frequency, contingency, and qualitative analysis of texts.

3 units, autumn, (Carter), W 2:15-4:05


4 units, spring, (Fairbanks), by arrangement

275. **Attitude Measurement.**

3 units, winter, (Carter), by arrangement

299. **Advanced Individual Work**—Graduate majors may supplement certain courses with individual projects of distinctly advanced order.

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

300. **Thesis.**

(Staff), by arrangement

309. **Directed Graduate Research**—Research in connection with a staff project, in lieu of Master's thesis.

(Staff), by arrangement

310. **Proseminar in Broadcasting and Film**—Introduction to various types of bibliographical research and research methods in radio, television, and film, through
study of selected problems. Required of all graduate students in broadcasting and film.

311. Seminar in Broadcasting and Film—Directed studies in areas of bibliography, audience research, program analysis, production problems, and effects of these media on society. Required of all graduate students in broadcasting and film.

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.

ECONOMICS


Executive Head: Moses Abramovitz
Directors: Paul Hartman (Undergraduate Study), Marc Nerlove (Graduate Study)
Assistant Professors: Richard Eugene Attiyeh, Paul Allan David, Paul Theodore Hartman, Paul Hohenberg, Ronald Ian McKinnon, 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, S. Daniel Neumark (Food Research Institute)
Assistant Professor: Charles O. Meiburg (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 sound judgment in evaluating public policy. There is training for the general student as well as for those who plan careers as economists in civil service, private enterprise, teaching, or research. 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 the curriculum of the Food Research Institute.
   a) Economics 1, 5, 10, 111 and 120 or their equivalent shall be included in the 45 units. All of these should be completed by the end of the junior year except for Economics 120.
   b) Economics courses taken at other universities may be included in the 45 units. The Director of Undergraduate Study for the Department will establish the amount of credit to be granted toward completion of the Departmental requirements. However, if the elementary course is repeated at Stanford, credit will not also be given for the elementary course taken at another institution toward the required 45 units, and in any case no more than 5 units credit will be given for such a course.
   c) A minimum of 25 units of courses numbered 100 or above, of which 20 must be taken at Stanford, shall be included in the 45 units.

2. An average grade of C or better shall have been received for all course units completed at Stanford in economics and the curriculum of the Food Research Institute, and an average grade of C or better shall have been received for Economics 1, 5, and 10.

3. Completion of a program, approved by the student’s adviser, of at least 25 units of courses numbered 100 and above (in history, courses numbered 20 or above) in not more than two of the following subjects: cultural anthropology, history, industrial engineering, mathematics (including courses in differential and integral calculus numbered below 100 for which partial credit is given) and statistics, philosophy, political science, psychology, and sociology.

The Undergraduate Honors Program—All economics majors who qualify are urged to complete the requirements for a degree with honors. The purpose of this program is to encourage the study of economics beyond the ordinary requirements for the degree of Bachelor of Arts. The Bachelor of Arts degree with honors in economics will be granted upon application to all of those who have met the following requirements in addition to those listed above:

1. The student must have received a grade point average of at least 3.00 in all courses at the University, excluding the last quarter.

2. The student must have received a grade point average of at least 3.00 in all economics courses at Stanford.

3. The student must present a minimum of 55 units in economics and the curriculum of the Food Research Institute, including three Honors Seminars.
4. Candidates for admission to the Honors Program should apply to the Director of Undergraduate Study during the first or second quarter of their junior year. In any case, such application must be made by the beginning of the third quarter of the junior year. (In exceptional cases, the Director of Undergraduate Study for the Economics Department may admit students to the Honors Program at the beginning of the senior year.)

*Quantitative Methods*—Students who are preparing for professional careers as economists, statisticians, or accountants are advised to register for courses in mathematics through elementary differential and integral calculus. Among the courses of instruction which make use of mathematics are Economics 6, 9, 108, and 172, and Statistics 116 and 119 (which may be taken for economics credit).

Qualified students may enter the Honors Program in Quantitative Methods in the Behavioral Sciences, the details of which are given elsewhere in this *Bulletin*, under the heading Behavioral Sciences (Honors Program). Among the requirements are three courses designated by the Economics Department; these are 6, 9, and 108. Completion of this Honors Program automatically implies satisfaction of the degree requirements of 25 units in two outside fields.

A student may, of course, qualify for both Departmental honors and honors in Quantitative Methods in the Behavioral Sciences.

**ADVANCED DEGREES**

**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 comprehensive written examinations, given at the close of spring quarter, covering the subject matter of Economics 202, 203, 204 and Economics 210, 211, 212.

2. The student must have completed the University foreign language requirement for the degree by:
   a) Passing satisfactorily, during either undergraduate or graduate training, a second-year reading course equivalent to French 23, German 23, etc., or by
   b) Passing a special reading examination to be scheduled once annually by the Department of Economics.

The student's selection of a foreign language must be approved by the Departmental Director of Graduate Study. The minimum language requirement may be increased for students whose Ph.D. dissertations are concerned with foreign economic systems or involve a familiarity with literature in a foreign language.

3. The student must have completed a course in the calculus equivalent to Mathematics 63, with grade of C or better.

Recommendation for the Degree—Before being recommended for the degree of Doctor of Philosophy in economics, the student must have completed the following stages of preparation:

1. Qualification in six fields of study (if no minor subject is offered) or in three fields of study (with a minor subject). In either case, Price and Allocation Theory (covering the subject matter of 202, 203, 204) and Money, Income, and Employment (covering the subject matter of 210, 211, 212) will constitute two of the fields. The remaining fields will be chosen according to the following options:

Option A—Without a minor subject
   a) Economic Development and Comparative Systems (215, 216, 217) is required.
   b) Three other fields of economics are to be chosen from the following: Economic History, Public Finance, Labor Problems, Economics of Industry, International Economics, Economic Statistics, Econometrics, and any two of the fields in Food Research. The preparation required will be determined by the professor in charge of each field and will consist of two courses at the 200 level or their equivalent. (In case of scheduling difficulties, a reading course may be substituted for one of the courses.) An approved program of 20 units in subjects other than economics may be substituted for one field.

Option B—With a minor subject
   b) A minor subject, the requirements for which are determined by the department concerned.

For students who elect either option, there will be comprehensive Departmental written examinations in all elected fields of study in economics. The examinations for Price and Allocation Theory (202, 203, 204) and Money, Income and Employment (210, 211, 212) will be given at the close of spring quarter in each academic year. During the spring quarter, dates will be announced for comprehensive
examinations during the succeeding academic year for all other fields in economics. Normally the comprehensive examination in any field will be offered once annually. The examination will be based on the sequence of courses, at the 200 level, that is specified for the field. The standard of qualification in each field will be minimally a grade of B in the comprehensive examination.

2. Qualification in background subjects:
   a) Economic Statistics and Quantitative Analysis equivalent to 170 and 171 (for those who do not elect Economic Statistics as a field).
   b) The History of Economic Thought (201), except for students electing Option B.
   c) Accountancy (equivalent to 290).
   Each of these requirements may be satisfied by passing, with minimal grade of B, the final examination in each course cited above.

3. Training in independent research. Participation in three one-quarter seminars, or in one two-quarter and one one-quarter seminar, and preparation of satisfactory papers in each. The seminars must be at the 300 level and in at least two fields. For this purpose Economics 319a and 319b may be considered to be in a field separate from Economic Development.

4. Satisfactory performance in the University oral examination. Except in special cases, the first three stages of preparation must be completed before the student is admitted to the University oral examination. This examination is held for each student after his Departmental dissertation committee has certified to the Director of Graduate Study in Economics that the dissertation is complete in at least rough-draft form. The examination is based on the dissertation and on the field or fields of economics within which it lies.

5. Completion of the dissertation in form satisfactory both to the Departmental committee and to a committee appointed by the University. Students are urged to complete the first three stages of preparation in a maximum of two years, with no comprehensive examinations scheduled later than the first quarter of the third year, so that the dissertation may be virtually finished during graduate residence.

Minor for the Degree of Doctor of Philosophy—To be recommended for the degree of Doctor of Philosophy with economics as a minor subject, the student is required to qualify in three fields of economics, one of which must be either Price and Allocation Theory or Money, Income, and Employment. Qualification in these fields is tested in the Departmental comprehensive written examinations that are given once annually. The standard of achievement in these examinations is the same for minor as for major candidates.

FELLOWSHIPS AND ASSISTANTSHIPS

The attention of prospective graduate students is directed to the fact that the Department awards a number of fellowships for graduate study in economics. These grants range in their amounts from about $1200 to $3000. Completed application forms for graduate fellowships should be filed before January 15 at the Office of Financial Aids, 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 to competent graduate students. The salary scale for half-time employment depends upon the student's experience and ability.

Qualified graduate students who wish to combine their studies with part-time teaching may apply for teaching assistantships which carry a stipend of $2,100 for three quarters of half-time teaching and a tuition scholarship covering up to half-time tuition and fees. Graduate students may apply for a teaching assistantship without
a tuition scholarship if they are not subject to tuition charges or if they do not require scholarship aid.

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.

COURSES

Note—Food Research Institute courses which count as economics are shown below. For details see the section on the Institute.

Courses: 103, 105, 160, 170, 203, 205, 212, 250, 275
Seminars: 260, 261, 270, 303, 305, 350
Directed Reading and Research: 371, 372, 373, 374
Advanced Directed Reading and Research: 401, 402, 403, 404

It is not possible at the date this announcement goes to press to schedule courses accurately for the year. Application should be made to the secretary of the Department after March for information about the exact times at which courses will be given in 1964-65.

#1. Elementary Economics—Introduction to economics. Prerequisite: sophomore standing, or third-quarter freshmen with B average.
5 units, autumn, winter, spring, (Staff), MTWThF 9
4 units, summer, (Staff), MTWThF 9

5. Price Theory and Policy—Function of price system; determination of prices, outputs in different market structures; public policy. (May be taken as 105 by graduate students.) Prerequisite: 1 or equivalent.
5 units, autumn, winter, (Staff), MTWThF 9
4 units, summer, (Staff), MTWThF 9

6. Price Theory and Policy—Content same as Economics 5 but use will be made of mathematical tools in presentation. (May be taken as 106 by graduate students.) Prerequisites: 1 or equivalent and Mathematics 62 or equivalent.
5 units, spring, (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, (Solomon), MTWThF 1:15

9. Income and Employment—Content same as Economics 10 but use will be made of mathematical tools in presentation. (May be taken as 109 by graduate students.) Prerequisites: 1 or equivalent and Mathematics 41 or equivalent.
5 units, winter, (Staff), MTWThF 11

10. Income and Employment—National income accounts; the determination of income, employment, prices. (May be taken as 110 by graduate students.) Prerequisite: 1 or equivalent.
5 units, autumn, spring, (Staff), MTWThF 11

100. Early Economic Doctrine—The development of early economic thought, with particular attention to English classical economics, and its counterpart in other Western countries, in the period 1776-1850. (Same as 200.) Prerequisites: 5 and 10.
5 units, (——-), MTWThF

102. Price and Allocation Theory I—(Same as 202.) Open to advanced undergraduates with consent of instructor.

5 units, (Staff), MTWThF

111. Income, Employment, and Money—National income analysis; emphasis on role of financial institutions. Prerequisites: 5 and 10.
   5 units, autumn, winter, (Staff), MTWThF

   5 units, (Staff), MTWThF

115. Economic History of Europe—Forces involved in emergence of modern capitalism. General economic development of Europe from sixteenth century to present. Prerequisite: 1 or equivalent.
   5 units, (Staff), MTWThF

117. Economic History of the United States—Economic development of United States in nineteenth, twentieth centuries. Prerequisite: 1 or equivalent.
   5 units, (Staff), MTWThF

   5 units, (Staff), MTWThF

119. Economic History and Development Problems of Modern Japan—A survey of the economic history of Japan since the Meiji restoration. Problems in the modernization and industrialization of the Japanese economy. Prerequisite: 1 or equivalent.
   5 units, (Staff)

120. Comparative Economic Systems—Working principles, institutions of different capitalist, noncapitalist national economies. (It is recommended that majors take this course in their senior year.) Prerequisites: 5 and 10 or consent of instructor.
   5 units, winter, spring, (Staff), MTWThF

122. Socialist Economics—Survey of origins, development of socialist thought; particular reference to early French, British socialists; Marx and followers; Fabians. (It is recommended that majors take this course in their senior year.) Prerequisites: 5 and 10 or consent of instructor.
   5 units, (Staff), MTWThF

   5 units, (Staff), MTWThF

141. Public Finance—Effects of government expenditure, borrowing, taxation upon allocation of resources, levels of national income, employment, prices. Prerequisites: 5 and 10.
   5 units, (Staff), MTWThF

142. Taxation—Further study of taxation; particular reference to ethical aspects of taxation, concepts of taxable income, shifting and incidence of taxation. Prerequisite: 141.
   5 units, (Staff), MTWThF

145. Labor Economics—Analysis, description of labor force, labor markets. Impact of legislative measures, productivity changes, labor organizations upon wages, distribution of income. Prerequisite: 1 or equivalent.
   5 units, (Staff), MTWThF

147. Collective Bargaining—Discussion of collective bargaining; legislation curbing collective bargaining practices; unions as social organizations; strikes and the control thereof; schemes for increasing labor participation in management.
   5 units, (Staff), MTWThF

154. Dynamic Processes in the Firm—Mathematical analysis of the dynamic effects of investment in facilities, inventories, research, and advertising in the firm. Applications to specific problems concerning the optimal operation of the firm. Prerequisites: 6 and a knowledge of differential equations.
   5 units, (Murphy), MTWThF
157. Economics of Industry—Factors determining structure, economic behavior of plants, firms, industries. Prerequisite: 1 or equivalent, or consent of instructor.
5 units, (Staff), MTWThF

158. Social Control of Industry—Effects of various types of business behavior and various types of market structures; attempts to preserve competition through the enforcement of anti-trust laws; public regulation of noncompetitive sectors of the economy. Prerequisite: 5, or consent of the instructor.
5 units, (Staff), MTWThF

159. Economics of Public Works—Particular emphasis on the criteria for investment and pricing decisions in public expenditure programs for natural resource development (e.g., water), public facilities (e.g., highways), and national defense. Course will include a survey of those parts of economic theory of special relevance and review some of the important attempts to apply economic analysis to particular problems in the above areas. May be taken by advanced undergraduates and graduate students.
3 to 5 units, (———), MWF

5 units, autumn, spring (Staff), MTWThF

5 units, (Staff), MTWThF

171. Introduction to Quantitative Analysis—Major problems of quantitative research in economics; relevant sources of statistical information, including national economic accounting, input-output analysis, cost and demand studies, family budget surveys. Prerequisite: 170.
5 units, (Staff), MTWThF

172. Statistical Inference in Economics—(Same as 272.) Prerequisite: Statistics 119.

190. Introduction to Accounting—An introduction to the principles and concepts underlying financial reports such as the income statement, statement of financial position, and the “funds” statement, and to the uses of such reports. No prior accounting is assumed. Students who have taken or are now taking a college-level accounting course may not enroll.
5 units, autumn, winter, (Staff), MTWThF

191. Introduction to Cost Accounting—The use of internal financial data for managerial decision making. Students who have had or are now taking a college-level cost accounting course other than 190 may not enroll. Prerequisite: 190 or equivalent.
5 units, winter, spring, (Staff), MTWThF

199. Honors Seminar in Economics—(Required of all Honors students.) Prerequisites: major in economics, completion of 25 units of economics including 1, 5, 10 and 111, Stanford grade average of at least 3.00 or grade average of 2.50 and consent of instructor.
5 units, autumn, winter, spring, (Staff), MTWThF

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.
A. Price and Allocation Theory
[Professors Arrow, McKinnon, Nerlove, Reder]

200. Early Economic Doctrine—The development of early economic thought, with particular attention to English classical economics, and its counterpart in other Western countries.
5 units, (—)

201. 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, (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)

205. Advanced Topics in Price and Allocation Theory—Reading and discussion of recent work in economic theory with special attention to periodical literature. Recommended for Ph.D. candidates. Prerequisites: 204 and Statistics 63 (or equivalent).
5 units, (—)

*301a, *301b. Seminar in Price and Allocation Theory—Prerequisites: 204 and consent of instructor.
301a. 5 units, (Staff), by arrangement
301b. 5 units, (Staff), by arrangement

B. Money, Income and Employment
[Professors Abramovitz, Attiyeh, Gurley, Shaw, Tarshis]

*210, *211, *212. The Theory of Income and Economic Fluctuations—Theory of money, employment, income considered from points of view of comparative statics, causes of instability and long-term change. 210 is prerequisite for 211; 210, 211 are prerequisites for 212.
210. 5 units, autumn, (—)
211. 5 units, winter, (—)
212. 5 units, spring, (—)

*310a, *310b. Seminar in Money, Income and Employment—Prerequisites: 212 and consent of instructor.
310a. 5 units, (Staff), by arrangement
310b. 5 units, (Staff), by arrangement

C. Economic Development and Comparative Systems
[Professors Abramovitz, David, Despres, Hohenberg]

*215. Economic Development I—Outline of origins and development of modern capitalism. Historical study of the growth of advanced economies. Prerequisite: 10 or consent of instructor.
5 units, autumn, (Staff)
216. **Economic Development II**—Comparative analysis of presently underdeveloped economies, the process of development, alternative theories of growth.

*5 units, winter, (Staff)*


*5 units, spring, (Staff)*

218. **Underdeveloped Economies: Structure and Policy**—Same as Economics 118, with additional reading and written paper. Designed for graduate students who are not Ph.D. candidates in economics.

219. **Underdeveloped Economies: Case Studies**—Same as Economics 119, with additional reading and written paper. Designed for graduate students who are not Ph.D. candidates in economics.

218. **Seminar in Economic Growth of Modern Japan**—Prerequisite: consent of instructor.

*5 units, (Staff)*

320a, *320b. Seminar in Economic Development**—Prerequisites: 215, 216, 217 or equivalent and consent of instructor.

**D. Economic History**

[Professors Abramovitz, David, Hohenberg]

225. **Economic Problems in Economic History**—Analytical examination of selected economic questions treated in the literature of economic history. Aspects of historical experience bearing on stagnation and growth in pre-industrial economies, demographic and economic interaction, integration of economic activities into a market framework, the impact of monetary phenomena on economic development, the implications of conditions in agriculture for industrialization, economic "dualism," and other problems. A topical introduction to the field rather than a survey of the economic history of particular peoples or regions.

*5 units, autumn, (David, Hohenberg)*

226. **Problems in American Economic History**—Discussion and analysis of broad trends and selected aspects of American economic history as they appear in the light of recent quantitative and non-quantitative research. Reappraisal of the literature dealing with the significance of the frontier, the economics of slavery, the timing of industrialization, the impact of the railroads, foreign lending, governmental participation, the choice of techniques, and other problems.

*5 units, winter, (David)*

325. **Research Seminar in Economic History**—Prerequisites: 225 or 226 and consent of instructor.

*5 units, spring, (David, Hohenberg)*

**E. Public Finance**

[Professors Arrow, Gurley, Margolis, 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. Credit will be given only for completion of both 241 and 242. Prerequisites: 204 and 212.

241. *5 units, (*)

242. *5 units, (*)

341. **Seminar in Public Finance**—Prerequisite: 241 or consent of instructor.

*5 units, (*)
F. Economics of Labor

[Professors Reder, Hartman]

*245. History of the American Labor Movement—Analytical topics from historical viewpoint. Special attention to growth patterns of specific unions, changes in leadership, and objectives of American labor. Prerequisite: consent of instructor.

5 units, (———), MTWThF

*246. Comparative Labor Movements—Labor forces, labor markets, trade union restrictions of Western European countries, British Commonwealth. Political behavior of unions. Prerequisite: consent of instructor.

5 units, (———)

248. Wages and Income Distribution—Wage levels, structure; income distribution, effects of education on earnings, special reference to empirical data. Prerequisite: consent of instructor.

5 units, (———)

345. Seminar in Wage Theory—Prerequisite: consent of instructor.

5 units, (———)

G. Economics of Industry

[Professors Maddala, Manne, Margolis, Murphy, Thompson]

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: 106 and a knowledge of differential equations.

5 units, (Murphy), MTWThF


255. 5 units, (Staff)
256. 5 units, (Staff)

257. Economics of Industry—Factors determining structure, economic behavior of plants, firms, industries. Prerequisite: 1 or equivalent, or consent of instructor.

5 units, (Staff)

258. Social Control of Industry—Effects of various types of business behavior and various types of market structures; attempts to preserve competition through the enforcement of anti-trust laws; public regulation of noncompetitive sectors of the economy. Prerequisite: consent of the instructor.

5 units, (Staff)

355. Seminar in Economics of Industry—Prerequisite: consent of instructor.

5 units, (Staff), by arrangement

H. International Economics

[Professors Despres, McKinnon, Tarshis]

*265, *266. International Economics—Factors that underlie trade, policies for regulating it. Significance of international transactions for the national income; related questions.

265. 5 units, (Staff)
266. 5 units, (Staff)
365. Seminar in International Trade and Resource Allocation — Prerequisite: consent of instructor.
5 units

I. Economic Statistics
[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, (Parzen), MTWThF 11; (———), MTWF 2:15
winter, (Stein), MTWF 11
spring, (———), MTWF 11
summer, (———), MTWThF 1:15

*271. Elementary Statistical Inference — Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. (Same as Statistics 219.) Prerequisite: 270.
3 units, winter, (Olkin), MWF 9

*272. Statistical Inference in Economics — Multiple correlation, special emphasis on economic applications; correlation of time series; introduction to simultaneous equations estimation. Prerequisites: 271 and Statistics 64.
5 units, (Staff), MWTh

J. Econometrics
[Professors Arrow, Maddala, Manne, Nerlove]

205. Advanced Topics in Price and Allocation Theory — See "A. Price and Allocation Theory."

*280. Quantitative Analysis in Economics — Economic interdependence in relation to statistical analysis; problems of aggregation, use of cross-section data. Prerequisites: 5, 10, and 272.
5 units, (———)

284. Nonlinear Programming and Welfare Economics — Necessary and sufficient conditions for optima under inequality constraints. Methods of solution. Applications to optimization in economics at the levels of the firm and of the economy. Prerequisite: working knowledge of differential calculus.
5 units, (Staff)

285. Special Topics in Mathematical Economics — The topics for 1964–65 will be announced. May be repeated for credit. Prerequisites: consent of instructor and working knowledge of differential calculus are required.
5 units, (———)

286. Linear Programming — Fundamentals Theorems; variations of the simplex methods; parametric programming; standard model formulations; quadratic programming; discussion of current developments. (Same as Statistics 255.)
380. Seminar in Econometrics — Prerequisite: consent of instructor.
5 units, (———)

K. Accountancy

290. The Role of Accounting in Economic Analysis — Topics include: recording history of economic events, reporting, significance of data, impact of price-level changes, relationship to decision-making, impact of new quantitative techniques. A minimum of attention will be given to accounting techniques. Students who have had no previous accounting should attain a basic familiarization with such techniques. Prerequisite: consent of instructor.
5 units, (Staff)
ENGLISH

Emeriti: Hardin Craig, Richard Foster Jones, (Professors); Margaret Dille Hudson (Instructor)

Executive Head: Thomas C. Moser
Associate Executive Head: To be announced
Associate Professors: Charles N. Fifer, W. Wesley Trimpi, Jr.
Assistant Professors: Alfred Appel, Jr., Walter Bliss Carnochan, J. Martin Evans, Verdel A. Kolve, Robert M. Polhemus, Fred Colson Robinson, Lucio P. Ruotolo
Instructors: S. Dale Harris, Ronald A. Rebholz
Lecturers: Blair Fuller, 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.

I. Prospective English majors may profitably elect one or more of the following courses: English 25 and 76; Humanities 61.

II. All students majoring in English are required to take the following Departmental courses:

   English 102. Introduction to the English Language.
   English 141. Chaucer.
   English 143. Shakespeare.
   English 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

The student should take a course in English history, such as History 105, before the end of his junior year.
1. One course from each of the following groups:
   a) English 142, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 155.
   b) English 100, 237, 238, 241, 242, 251.

2. One of the following seniors seminars: English 192, 193, 194, 195.

B. American Literature

The undergraduate major in American Literature should plan to take English 177 and 178 in sequence during the junior year, and he should not register for any American Literature course numbered in the 200's until he has studied the corresponding period in English 177 or 178.

1. English 177. American Literature to 1855.
2. English 178. American Literature, 1855 to the present.
3. Two additional courses from the following list: English 155, 172, 196, 255, 264, 265, 266, 267, 268, 269, 270; Speech and Drama 292.

C. Creative Writing

All students wishing to major in creative writing must have maintained at least a B record in preliminary writing courses.

1. One course from each of the following groups:
   a) English 142, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 155.
   b) English 171, 172, 173, 265, 266, 269, 270; Speech and Drama 292.

2. Completion of at least 12 units of work in one of the programs listed below:
   a) Fiction—English 255, The Development of the Short Story; plus eight units of English 133, Directed Writing, or a more advanced course, with grades of B or better.
   b) Poetry—English 251, The English Lyric, and English 201, The Writing of Poetry, which may be repeated for a total of 8 units of credit.

III. In addition to the English major requirements, courses totaling not less than 16 units of college work must be taken in one of the following minor fields:

One foreign language and literature.
Philosophy and/or History.
Philosophy and Religion (junior and senior courses listed under Special Programs in Humanities: Religion).
Speech and Drama.
Music or Art (advanced courses).
Unified program to be arranged with the approval of the adviser and the Department.

Humanities Honors Program. (The entire Honors Program must be taken to fulfill the minor requirement.)

Honors Program in English

Students with at least a B average in their university work and unusual interest in literary studies may apply for admission to the Honors Program in English literature, preferably by the start of their sophomore year and not later than the start of their junior year. Admission is selective.

The Program offers the chance for more intensive and more independent work in the field. Course requirements are as follows: English 102, 141, 143, 182, 183, and 184, and a single author or genre course, and one of the following options:

American Emphasis: English 177, 178, and one advanced elective in American literature.

English Emphasis: One course in American literature, and two elective advanced
courses in English literature. With the approval of the adviser, three advanced
courses in the appropriate period may be substituted for 177, 178, 182, 183, or 184.
Not more than two such substitutions will be permitted.

Honors students will be placed in special seminar sections of English 182, 183,
and 184. They will take a comprehensive examination early in the fall of their senior
year, and those who pass with at least a B will write a senior essay of 10,000-15,000
words. In the autumn quarter of the senior year honors students will normally be
free of course obligations; they will take instead a program of directed reading as
background for the senior essay. In this quarter they will meet weekly as a group
to discuss major works outside English and American literature.

Since admission to the Creative Writing Program is limited to students having a
special aptitude for writing, it is regarded as itself a kind of honors program.

**Combined Major in Classics and English**

Students may with the consent of the Heads of departments concerned offer for
the degree of Bachelor of Arts a combined Major in Classics (Latin and/or Greek)
and English. Students interested in such a major should consult the Heads of each
of the departments concerned.

**Honors Program in Humanities**

An Honors Program in Humanities is offered for majors of this Department
who wish to supplement their Departmental major by a related and carefully guided
program of studies. See the section "Humanities (Special Programs)" for a descrip-
tion of the Honors Program.

**Teachers' Credentials**

Students wishing to obtain the Standard Teaching Credential (Secondary) enti-
titing them to teach in grades 7-14 in the public schools of California, or a Junior
College Credential for grades 13 and 14, should consult the statement on credentials
under "School of Education" in this Bulletin and the Credential Secretary of the
School of Education for the requirements.

A. General Secondary Credential

Candidates for the Stanford General Secondary Credential with a teaching major
in English are required to take the following Departmental courses or their equiva-
lents:

**Teaching Major**

<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>4</td>
</tr>
<tr>
<td>Speech and Drama 120a. Exposition</td>
<td>3</td>
</tr>
<tr>
<td>Speech and Drama 164a. Principles of Directing or 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><strong>Total</strong></td>
<td><strong>71</strong></td>
</tr>
</tbody>
</table>
5. A minimum of 36 units in the history, thought and literature of one period, in two or more languages, one of which must be English and one European. As much as 24 units of this requirement may be satisfied through courses in Reading and Research;

6. A knowledge, tested by a written or oral examination, of the period. This examination will be based on a reading list established by the candidate in consultation with his adviser;

7. A minimum of four seminars, of which at least three must be in the English Department and no more than two of which may be in the same genre or period.

Language Requirements—All candidates for the Ph.D. degree (except those in English and comparative literature) must demonstrate a reading knowledge of Latin, German, and French by passing the examinations in these languages, which will be given by the Department on the following dates: July 31, 1964; November 20, 1964; February 26, 1965; May 21, 1965; July 30, 1965; November 19, 1965; February 25, 1966; May 20, 1966; July 29, 1966; November 18, 1966; February 24, 1967; May 26, 1967; August 4, 1967. Another foreign language may be substituted for German or French if it is required for the student's projected research. Italian may be substituted for either language if the candidate's dissertation is concerned with the English Renaissance.

The following schedule for meeting foreign language requirements will apply to all candidates, whether for the A.M. or the Ph.D. degree:

No graduate student will be allowed to register for his third quarter of work until one foreign language examination has been passed. No Ph.D. candidate will be allowed to register for the fifth quarter of work until a second foreign language examination has been passed. No Ph.D. candidate will be allowed to take the written comprehensive until all language requirements (two modern and Latin) have been satisfied.

Examination—In addition to the foreign language examinations, a Ph.D. candidate must take the comprehensive written examination at least one year before he anticipates receiving the degree. This examination will be given September 21–26, 1964; March 22–27, 1965; September 20–25, 1965; March 21–26, 1966; September 19–24, 1966; March 27–April 1, 1967. Candidates will also take an oral examination, shortly after the written, on the period of the dissertation, the minor, and the dissertation itself.

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 candidate will then submit to this committee a brief statement of his dissertation project and meet with the committee to confer about his program of study and preparation for the dissertation. A copy of the statement, revised if necessary, and bearing signatures of the three committee members in approval of the topic, will become a part of the Department records. It must be transmitted to the Department not later than the quarter before the candidate takes his written comprehensives. N.B. The candidate should take this crucial step as early in his graduate career as possible, and the deadline stated is to be regarded as the last possible, not the normal or desirable, time. The committee may well advise extra preparation within or outside the Department, and time should be allowed for such work.

The dissertation must be submitted to the adviser in rough draft but in substantially final form at least four weeks before the University deadline in the quarter during which the candidate expects to receive his Ph.D. degree. N.B. Dissertations may not be submitted to the adviser or committee during the summer quarter.

Immediately after passing the oral examination, the candidate will be expected to file a formal application for candidacy as prescribed by the University. Ph.D. dis-
sertations must be completed and approved within five years from the date of that application. A candidate taking more than five years will be required to reinstate his candidacy by passing the written comprehensives once again.

GRADUATE PROGRAM IN HUMANITIES

The Department of English participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in English and Humanities. Candidates for this degree may omit English 311 or 312 from their requirements, but must offer a reading knowledge in the three foreign languages (Latin, French, German) required by the Department of English. For a description of the Humanities program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)."

FRESHMAN AND SOPHOMORE COURSES

The Department does not offer a prescribed course in remedial English. Students with special problems are offered tutorial help by instructors in regular Freshman classes, or by special instructors, according to individual needs.

#1, 2, 3. Freshman English — Expository writing, emphasizing the control of meaning through critical thinking and mastery of style; introduction to the forms of literature.

1. A course in writing, reading, and thinking designed to help the student to write lucid, orderly and logical prose.
   3 units, autumn, (Staff)

2. Continuation of 1; emphasis on elements of style; introduction to research, introduction to short story and the novel. Prerequisite: 1.
   3 units, winter, (Staff)

3. Continuation of 2; emphasis on introduction to drama and poetry; the writing of literary criticism. Prerequisite: 2.
   3 units, spring, (Staff)

1F, 2F. Freshman English — For foreign students.

1F. A specially designed course in expository writing which undergraduate foreign students may substitute for 1.
   3 units, winter, (Staff)

2F. Continuation of 1F.
   3 units, spring, (Staff)

#1S, 2S, 3S. Freshman English (Special) — Sections of 1, 2, and 3 for students of exceptionally high aptitude and achievement, paralleling the regular sections but offering more advanced readings and more rigorous training. Open only to students selected by the Department.

1S. A course in advanced composition with study of expository prose.
   3 units, autumn, (Staff)

2S. Continuation of 1S with emphasis on prose fiction.
   3 units, winter, (Staff)

3S. Continuation of 2S with emphasis on poetry and drama.
   3 units, spring, (Staff)

5. Narration — Basic problems of narrative and imaginative writing. Prerequisite: 3.
   3 units, autumn, (———), (I) MWF 1:15; (———), (II) MWF 1:15
   winter, (Fuller), (I) MWF 1:15; (———), (II) 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, spring, (Watt), MTWTh 10

#9. Masterpieces of American Literature — Intensive study of a few masterpieces of American literature, including poetry, drama, the essay, the novel.
   4 units, autumn, (Appel), MWThF
#25. Shakespeare—Rapid reading of about half the plays and poems in chronological sequence.

4 units, winter, (Ford), MTWF 10
   summer, (Rebholz), MTWThF 9

73. Modern British Humorists—Detailed study of Oscar Wilde, Max Beerbohm, G. B. Shaw, G. K. Chesterton, Aldous Huxley; inquiry into the nature, and brief history, of humor, wit, comedy.

3 units, winter, (Irvine), MWF 11

#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, autumn, (Harris), MWF 10

76. Introduction to Poetry—Prosody, poetic forms and types, critical theories regarding poetry. Masterpieces of English poetry will be studied in the light of these theories.

4 units, winter, (Rebholz), MTWF 10
   summer, (Trimpi), MTWThF 11

77. Introduction to the Drama—Principal dramatic forms; development of dramatic art; masterpieces of the theater from various periods, countries.

4 units, spring, (Kolve), MTWF 10

England—See History 105.


JUNIOR AND SENIOR COURSES

The following courses (100-184) are open to juniors and seniors of all departments. Well-prepared sophomores may be admitted, but only by special permission of the instructor. Freshmen and sophomores who do not have such permission may be refused admission to the courses. Students in other departments may be especially interested in the following introductory courses: 100, The English Bible as Literature; 102, Introduction to the English Language; 177-9, an introductory survey of American literature; and 182-4, an introductory survey of English literature.

100. The English Bible as Literature—Readings in Old and New Testaments and selected books of the Apocrypha, with some attention to the history of the English Bible and use made of Biblical themes in English literature.

4 units, autumn, (Ford), MTWF 11

102. Introduction to the English Language—Designed to give the student a knowledge of fundamental matters about the English language; to familiarize him with terminology, classification of language; to enable him to form standards of judgment about good English.

4 units, winter, (Meritt), TWTThF 11
   spring, (Robinson), TWTThF 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, (———), (I) MW 2:15-4:05; (Fuller), (II) TTh 2:15-4:05
winter, (Scowcroft), (I) TTh 2:15-4:05; (Guerard), (II) TTh 4:15-6:05
spring, (———), (I) TTh 2:15-4:05; (Fuller), (II) MW 2:15-4:05
summer, (Fuller), MW 2:15-4:05

134. Directed Writing: Poetry—Intermediate course in writing various types of verse. May be repeated for credit.

4 units, spring, (———) MW 2:15-4:05

141. Chaucer.

4 units, autumn, (Kolvo), MTWF 8
winter, (Ryan), MTWTh 8

142. Spenser.

4 units, to be given in 1965-66

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, autumn, (Sensabaugh), TWThF 9

145. Donne and Jonson.

4 units, to be given in 1965-66

146. Swift and Pope.

4 units, spring, (Carnochan), MTWF 11

147. Johnson and His Circle.

4 units, to be given in 1965-66


4 units, to be given in 1965-66

149. Byron, Shelley, and Keats.

4 units, autumn, (Ford), MTWF 9

150. Dickens and Trollope.

4 units, winter, (Polhemus), MTWF 9

151. Matthew Arnold.

4 units, to be given in 1965-66

152. Browning and Tennyson.

4 units, to be given in 1965-66

153. George Bernard Shaw.

4 units, autumn, (Irvine), TWThF 10


4 units, spring, (Moser), TWThF 11

#171. Contemporary Drama—Ibsen, subsequent dramatists—English, Continental, American. Lectures, discussions; critical papers.

4 units, to be given in 1965-66

#172. Forms of the Modern Novel—Studies in major English, American, and Continental novelists from 1850 to the present.

4 units, autumn, (Guerard), MTWTh 10

173. Twentieth Century English Fiction.

4 units, autumn, (Scowcroft), MTWTh 1:15

177. American Literature to 1885.

4 units, winter, (———), TWThF 9

178. American Literature, 1885 to the Present.

4 units, spring, (Simpson), MTWTh 9

181. Medieval Literature—A survey of the literature of medieval England. Attention is centered on several important works in Old and Middle English and also in Latin and Old French.

4 units, to be given in 1965-66

182, 183, 184. English Literature—A basis 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, (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.

190. Tutorial Work, Department Honors Program.
Any quarter, by arrangement

English 192, 193, 194, 195, and 196 are open only to seniors and Honors students in the Department of English. They are strictly limited in enrollment. Each student must sign up for a senior seminar in the last quarter of his junior year during the preregistration period.

192. Senior Seminar: Selected Topics in Renaissance Literature—Prerequisite: 182.
4 units, autumn, (Evans), MW 2:15-4:05
winter, (Sensabaugh), TTh 2:15-4:05

193. Senior Seminar: Selected Topics in Eighteenth Century Literature—Prerequisite: 183.
4 units, winter, (Watt), TTh 4:15-6:05

194. Senior Seminar: Selected Topics in Nineteenth Century Literature—Prerequisite: 184.
4 units, winter, (Irvine), MW 2:15-4:05
spring, (Ford), TTh 4:15-6:05

195. Senior Seminar in Twentieth Century Literature—Prerequisite: 184.
4 units, spring, (Appel), MW 4:15-6:05

196. Senior Seminar in American Literature—Prerequisites: 177 and 178.
4 units, winter, (Grommon), MW 2:15-4:05
spring, (Stegner), TTh 2:15-4:05

199. Senior Essay, Department Honors Program.
Any quarter, by arrangement

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

[N.B.] Though these courses are designed primarily for English majors, graduate students in other departments who wish to broaden their programs will find many of them useful on the same basis as the Graduate Division Special Courses.

201. The Writing of Poetry—Primarily for students seriously interested in the composition of poetry. First- and second-year students may be admitted to this course and to 251 upon application. 251 must be taken simultaneously with 201 or before it. 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, (Scowcroft), TTh 2:15-4:05
winter, spring, (Stegner), MW 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), MWF1:15

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, (Robinson), TWThF 11

209. **Principles of Standard English**—Phonetics, syntax, derivation, etymology, meanings; consideration of recent developments in study of language.

4 units, summer, (Meritt), MTWThF 9

237. **The English Drama to 1642.**

4 units, spring, (Sensabaugh), TWThF 11

238. **Drama of the Restoration and Eighteenth Century.**

4 units, winter, (Loftis), TWThF 11

241. **The English Novel through the Eighteenth Century**—Study of the most significant novels, with emphasis on development of the form.

4 units, winter, (Scowcroft), MTWTh 1:15

242. **The English Novel in the Nineteenth Century**—Study of the most significant novels, with emphasis on development of the form.

4 units, spring, (———), TWThF 9

244. **The Impressionist and Experimental Novel**—Prerequisite: 172 or graduate standing.

4 units, winter, (Guerard), MTWTh 10

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, autumn, (Guerard), MTWTh 1:15

255. **The Development of the Short Story.**

4 units, winter, (Stegner), MTWTh 11

264. **Varieties of American Romanticism.**

4 units, spring, (Simpson), MTWTh 10

265. **Hawthorne and Melville.**

4 units, to be given in 1965-66

266. **Chief American Poets, from 1630 to the Present.**

4 units, winter, (Winters), TWThF 11

267. **Emerson and Thoreau.**

4 units, to be given in 1965-66

268. **Narrative Prose in America**—A study of most significant nonfictional narrative works, with emphasis on history and biography, including autobiography.

4 units, to be given in 1965-66

269. **Twain, Howells, and James.**

4 units, autumn, (Simpson), TWThF 9


4 units, autumn, (———), TWThF 1:15

278. **Popular Ballad and Folksong.**

4 units, autumn, (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, (Evans, Kocher, Rebholz, Sensabaugh), 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, to be given in 1965-66

304. Seminar in Modern Literary Criticism—The use of literary criticism in graduate study and in teaching.
   
   4 units, winter, (Guerard), MW 4:15-6:05

305. Seminar in the History of Literary Theory. To be given in 1965-66.

   
   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, spring, (Scowcroft), TTh 2:15-4:05

310. Old English—Elements of Old English grammar; reading exercises.
   
   4 units, autumn, (Meritt), (I) TWThF 9; (Robinson), (II) TWThF 10

311. Beowulf—Prerequisite: 310 or equivalent.
   
   4 units, winter, (Meritt), TWThF 9

312. Middle English—History, dialects of Middle English; readings of representative selections from the literature. Prerequisite: 310 or equivalent.
   
   4 units, spring, (Ackerman), TWThF 11

   
   4 units, to be given in 1965-66

316. Seminar in Elizabethan Language—Vocabulary, pronunciation, grammar, orthography of the period. Prerequisite: 312 or equivalent.
   
   4 units, autumn, (Meritt), TWThF 4:15

318. Seminar in Middle English Literature—Prerequisite: 312 or equivalent.
   
   4 units, winter, (Ackerman), MW 2:15-4:05

320. Seminar in Chaucer—Troilus and Criseyde in some years, selected short poems in others; structure, history of the works, their literary significance. Prerequisite: 141 or equivalent.
   
   4 units, alternate years, to be given in 1965-66

322. Seminar in Medieval Drama.
   
   4 units, to be given in 1965-66

325. Shakespeare Seminar—Prerequisites: The equivalent of 25 or 143, 182 or 330, and 237.
   
   4 units, winter, (Whitaker), TTh 4:15-6:05

330. Proseminar: English Literature of the Sixteenth Century—Special arrangements will be made to accommodate students who need this proseminar in 182.
   
   4 units, spring, (Ryan), TTh 4:15-6:05

331. Seminar in Literary Problems of the English Renaissance—Prerequisite: 182 or 330, or equivalent.
   
   331a. Jacobean Drama—Additional prerequisite: 237 or equivalent.
   
   4 units, to be given in 1965-66

331b. Seminar in Marlowe.
   
   4 units, to be given in 1965-66

331c. Natural and Moral Philosophy: Bacon.
   
   4 units, to be given in 1965-66
331e. English Drama before Shakespeare.
4 units, autumn, (Kocher), TTh 4:15–6:05

334. The Age of Milton.
4 units, autumn, (Sensabaugh), TWThF 10
334b. Seminar: Problems in Seventeenth Century Literature—Prerequisite: 330 or 334a, or equivalent.
4 units, winter, (Sensabaugh), MW 2:15–4:05

4 units, autumn, (Watt), 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 4:15–6:05
4 units, to be given in 1965–66
341c. Johnson and His Circle.
4 units, autumn, (Fifer), MW 2:15–4:05

4 units, winter, (Ford), MW 2:15–4:05

351. Literary Problems of the Romantic Period—Prerequisite: 184 or 350, or equivalent treatment of Romantic period.
351c. Nineteenth Century Poetry.
4 units, spring, (Ford), MW 4:15–6:05

354. Victorian Prose: Carlyle and Arnold.
4 units, to be given in 1965–66

358. Seminar: Literary Problems of the Nineteenth Century—Prerequisite: 184 or 350, or equivalent.
358a. Impressionism in English Poetry and Prose.
4 units, autumn, (Irvine), TTh 2:15–4:05
358b. Browning.
4 units, spring, (Irvine), TTh 4:15–6:05
358d. The Bloomsbury Group.
4 units, to be given in 1965–66

361. Seminar in American Critics—Prerequisite: 266 or equivalent.
4 units, to be given in 1965–66

4 units, winter, (Stegner), TTh 2:15–4:05

371. Seminar in American Historians as Men of Letters—Prerequisite: 268 or equivalent.
4 units, to be given in 1965–66

4 units, to be given in 1965–66

377. Seminar in American Literature of the Colonial Period—Prerequisite: 177 or equivalent.
4 units, to be given in 1965–66

381. Seminar in Problems in American Literature of the Nineteenth Century.
4 units, autumn, (Moser), MW 4:15–6:05
381b. Studies in Realism and Naturalism.
4 units, winter, (Simpson), MW 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
Seminar in the Teaching of Composition—Open only by permission of the Director of Freshman English.
2 units, spring, (Ackerman), 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, Stanley Astredo Smith (Professors); Earl Kendall Carter, Jessie E Smith (Assistant Professors)

Executive Head: John Clarke Lapp
Professors: Robert G. Cohn, Raymond Giraud, Alphonse Georges Juilland, John Clarke Lapp, Robert Louis Politzer (Education and Romance Linguistics), Roberto B. Sangiorgi
Associate Professors: Alexander E. A. Naughton, Pauline Newman-Gordon, Leo Weinstein
Assistant Professors: William C. Calin, Ralph M. Hester, Vincenzo Paolo Traversa
Instructors: John George Barson, Cosimo Donaldo Corsano, Henri Diament, Carla Federici, Jean Raymond Gosselin
Lecturers: Clio P. Dorr, Ellen G. Naniche

The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts, and Doctor of Philosophy in French and for certification as high school and junior college teachers. Special consideration is given to the needs of those who intend to make teaching their profession.

PROGRAMS OF STUDY

Bachelor of Arts in French
Candidates must have completed the first- and second-year courses in reading, composition, and conversation (or their equivalent) offered in French.
Candidates are expected to complete a minimum of 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 18 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, Room 43, 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.

Master of Arts: French
Applicants must have an undergraduate major in French with an average grade of B (or the equivalent) in that language and a high level of speaking proficiency, to
be demonstrated through an interview or by a tape recording forwarded to the Department.

They must have a minimum of two years of high school Latin or the equivalent.

1. Language requirements—A reading knowledge of one other Romance language, preferably Italian, to be demonstrated by passing an examination not later than the second quarter of residence.

2. Course requirements
   a) Advanced composition Fr201  
   b) History of the French Language Fr225  
   c) Three graduate courses in literature, to include one seminar  
   d) Electives, chosen with approval of the graduate adviser (students majoring in Linguistics should take the appropriate graduate courses in that subject as electives)  
   e) Thesis  

   Total  

   Units

   4  
   3  
   12-13  
   13-14  
   6  

   38-40

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**

**Candidacy**

Candidates should read carefully the general regulations governing the conferring of this degree, as described in the section “Degrees” in this Bulletin. For specific Departmental requirements and recommendations, the student should consult with his adviser. Candidates must have completed the equivalent of the course requirements for the Master of Arts degree in French.

**General Requirements**

All candidates, regardless of their field of specialization, are expected to fulfill these requirements:

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 examination**
   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.**

**Specialization**

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 also participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in French and Humanities. For a description of that program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)."

**Intensive Language Work in European Study Centers**

Each student accepted by the Committee on General Studies for work at a Stanford center in France or Italy will complete twelve units of Intensive French or Italian during the six months of his residence abroad. The intensive work is oriented to the development of the student’s individual ability to understand, speak, write, and read French or Italian. All courses regardless of the level at which the work is completed bear the designation Fr, or It80, with the successive levels, the lowest 2 and the highest 6, indicated as second digit. Assignment to a particular level is made by the director of each center.

**COURSES OPEN TO ALL STUDENTS**

The courses in this section do not require a knowledge of any language other than English. Students desiring French or Italian language credit for these courses must secure the permission of the Department and do the assigned readings in French or Italian.

**A. GENERAL COURSE**

A101. Science of Language—Introduction to the fundamentals of language, its nature and function; phonological, grammatical, and lexical structure of natural languages and their development; outline of the descriptive, comparative, and historical study of language.

3 units, autumn, (Juillard), MWF 1

A1. FRENCH

#AF160. Molière—Representative comedies of Molière in English translation.

3 units, (Weinstein), to be given in 1965-66

#AF170. Modern French Novels in Translation.

3 units, autumn, (Naughton), MWF 11

AF171. Contemporary French Novelists—Significant authors of contemporary France: Proust, Gide, Malraux. Lectures, readings in English.

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

A1. ITALIAN

#AI75. Dante in English—Reading, interpretation of *Vita Nuova* and *The Divine Comedy* in translation.

3 units, autumn, (Corsano), MWF 10

A180. The High Renaissance—Given only at Stanford in Italy.

2 units, autumn, (____)

#AI140. The Contemporary Italian Novel in Translation—Reading, discussion of significant novels of such authors as Silone, Berto, Moravia, Verga, Pratolini.

3 units, spring, (Traversa), MWF 10

**FR. FRENCH COURSES**

**FIRST- AND SECOND-YEAR**

[Under the direction of 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.
#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

Fr10. Elementary French—Accelerated course for beginners, particularly for those seeking to fulfill the University requirement of a reading knowledge for the Ph.D. degree. Open to seniors and graduate students only.
4 units, autumn, winter, spring, (Staff), MTWTh 8 summer, (Staff), MTWThF 8

#Fr22. Second-Year French—Prerequisite Fr3.
3 units, autumn, winter, spring, (Staff), MTWTh

#Fr23. Second-Year French—Continuation of Fr22.
3 units, autumn, winter, spring, (Staff), MTWTh

Fr24. Second-Year French—Continuation of Fr23.
3 units, autumn, winter, spring, (Staff), MTWTh

Fr30. Conversation française—Prerequisite Fr2 or equivalent.
3 units, autumn, winter, spring, (Staff), TTh 8

#Fr54. Intensive French—Satisfies General Studies requirement under “C.” Prerequisite: F24 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. French Phonetics—Prerequisite: Fr24 or equivalent.
3 units, autumn, winter, (Hester), MWF 11

Fr111. Third-Year French Grammar and Composition—Prerequisite: Fr24 or equivalent.
3 units, autumn, (———), TThS 9; (Diament), MWF 10

Fr112. Third-Year French Grammar and Composition—Continuation of Fr111.
3 units, winter, (———), TThS 9; (Diament), MWF 10

Fr113. Third-Year Grammar and Composition—Continuation of Fr112.
3 units, spring, (———), TThS 9; (Diament), MWF 10

Fr121. Advanced French Composition and Grammar—Prerequisite: Fr54 or equivalent.
4 units, autumn, (———), 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, (———), (I) MWF 8; (Giraud), (II) MWF 11; (———), (III) MWF 1:15

#Fr131. Introduction à la littérature française—17ème et 18ème siècles. Continuation of Fr130.
3 to 4 units, winter, (———), (I) MWF 8; (Newman-Gordon), (II) MWF 11; (———), (III) MWF 1:15
**#Fr132. Introduction à la littérature française—19ème et 20ème siècles.** Continuation of Fr131.
3 to 4 units, spring, (——), (I) MWF 8; (Newman-Gordon), (II) MWF 11; (Hester), (III) MWF 1:15

*Note—Prerequisites for the following courses are Fr130, Fr131, and Fr132, or equivalent.*

**#Fr140. Littérature de la Renaissance I—Rabelais, les poètes lyonnais, les poètes de la Pléiade.**
3 units, autumn, (Hester), MTTh 11

**#Fr141. Littérature de la Renaissance II—Montaigne, les poètes baroques; le théâtre.**
3 units, winter, (Hester), MTTh 11

**#Fr150. Le XVIIème siècle I—Poésie et roman.**
3 units, autumn, (Lapp), MWF 1:15

**#Fr151. Le XVIIème siècle II—La tragédie; Racine et Corneille.**
3 units, winter, (Naughton), MWF 1:15

**#Fr152. Le XVIIème siècle III—La comédie; Molière. Les moralistes.**
3 units, spring, (——), MWF 1:15

**#Fr160. Le XVIIIème siècle I—L’esprit philosophique et la littérature.**
3 units, winter, (——), MTTh 12

**#Fr161. Le XVIIIème siècle II—Roman et théâtre.**
3 units, spring, (——), MTTh 12

3 units, autumn, (Giraud), MWF 10

**#Fr171. Le XIXème siècle II—Le Roman au dix-neuvième siècle. Lectures principales: Constant, Stendhal, Balzac, Flaubert, Zola.**
3 units, winter, (Giraud), MWF 10

**#Fr172. Le XIXème siècle III—La Poésie post-romantique. Lectures principales: Gautier, Nerval, Leconte de Lisle, Baudelaire.**
3 units, spring, (Giraud), MWF 10

**#Fr180. Le XXème siècle I—Poésie.**
3 units, autumn, (Newman-Gordon), MWF 9

**#Fr181. Le XXème siècle II—Roman et théâtre.**
3 units, winter, (Newman-Gordon), MWF 9

**#Fr190. French Poetry—French lyrical poetry, Villon to Valéry.**
3 units, winter, (Naughton), MWF 11

**Fr199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor. Open only to majors in French. May be repeated for credit.**
1 to 3 units, each quarter, (Staff), by arrangement

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**Advanced Undergraduate and Graduate Courses**

**Fr201. Advanced Composition and Grammar—Prerequisite: Fr121 or equivalent.**
4 units, autumn, (Naughton), MWF 10

**Fr204. Etudes de style.**
4 units, spring, (Juilland), MWF 3:15

**Fr205. Modern French—Phonology, morphology, and syntax.**
3 units, autumn, (——), MWF 2:15

**Fr225. History of the French Language.**
3 units, autumn, (Colin), MWF 2:15
Fr263. Le Théâtre classique français—Corneille, Molière, Racine.
   4 units, autumn, (Lapp), TTh 2:15
Fr273. Le Roman au XVIIIe siècle—Rousseau, Prévost, Laclos, and others.
   4 units, (——), to be given in 1965–66
Fr275. La “grande génération”—Proust, Gide, Péguy, Claudel, Romain Rolland, Valéry.
   3 units, spring, (Newman-Gordon), Th 2:15–4:05
   4 units, (Weinstein), to be given in 1965–66
Fr288. Baudelaire.
   4 units, winter, (Cohn), MWF 10
Fr289. The Symbolist Poets—Baudelaire, Verlaine, Rimbaud, Mallarmé, Laforgue, etc.
   4 units, spring, (Cohn), MWF 12

GRADUATE COURSES IN FRENCH AND FRENCH LITERATURE

Fr310. French Historical Grammar—Elements of phonology and morphology. Prerequisite: L203 or equivalent.
   3 units, winter, (Juilland), MWF 3:15
Fr311. Old French Texts—Reading and philological interpretation of selected Old French Texts. Prerequisite: Fr225.
   3 units, autumn, (Calin), MWF 3:15
Fr325. Cours de méthode—Méthode critique et bibliographique, préparation de thèses.
   2 units, winter, (Lapp), TTh 2:15
Fr320. Old and Middle French Literature—An introduction to Medieval scholarship. Prerequisite: Fr225.
   4 units, spring, (Calin), MWF 2:15
Fr350. Graduate Seminar.
   Corneille.
   4 units, spring, (Lapp), T 2:15–4:05
   Montaigne.
   4 units, winter, (Lapp), W 2:15–4:05
   Mallarmé.
   4 units, autumn, (Cohn), W 2:15–4:05
   Flaubert.
   4 units, spring, (Giraud), Th 2:15–4:05
Fr352. La Renaissance en France—Rabelais et Montaigne; les poètes de la Pléiade et les poètes baroques de la fin du XVIe siècle.
   4 units, winter, (Lapp), to be given in 1965–66
Fr353. Montaigne—Lectures in French.
   3 units, spring, (Lapp), to be given in 1965–66
Fr363. Pascal—Lectures in French.
   3 units, autumn, (Naughton), MWF 9
Fr364. Racine—Lectures in French.
   3 units, spring, (Naughton), to be given in 1965–66
Fr372. Diderot—Lectures in French.
   4 units, spring, (——), TTh 4:15
Fr384. La Critique littéraire au XIXe siècle—Sainte-Beuve, Taine, Brunetière, and others. Lectures in French.
   3 units, (Weinstein), to be given in 1965–66
   3 units, autumn, (Newman-Gordon), Th 2:15–4:05
Fr390. Proust—Lectures in French.
3 units, spring, (Cohn), to be given in 1965–66
Fr391. Gide—Lectures in French.
3 units, spring, (Giraud), to be given in 1965–66
Fr392. Le Théâtre contemporain.
4 units, (Giraud)
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.

#It1. 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
It10. Basic Italian—Accelerated course for beginners, particularly for those seeking to fulfill University requirements of reading knowledge for the Ph.D. degree. Open to senior and graduate students only.
4 units, autumn, spring, (Staff), MTWTh 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
It111. Italian Composition and Conversation.
3 units, autumn, (Traversa), MTTh 10
It112. Italian Composition and Conversation—Continuation of It111.
3 units, winter, (Sangiorgi), MTTh 10
It113. Composition, Grammar and Conversation—Continuation of It112.
3 units, spring, (Sangiorgi), MTTh 10
#It131. Introduzione allo studio della letteratura italiana I—Dalle origini alla fine del Quattrocento. Prerequisite: It23 or equivalent.
3 units, autumn, (Traversa), MWF 1:15
#It132. Introduzione allo studio della letteratura italiana II—Dal Cinquecento al tardo Settecento. A continuation of It131, but may be taken independently. Prerequisite: It23 or equivalent.
3 units, winter, (Traversa), MWF 1:15
#It133. Introduzione allo studio della letteratura italiana III—Dal tardo Settecento al Novecento. A continuation of It132, but may be taken independently. Prerequisite: It23 or equivalent.
3 units, spring, (Traversa), MWF 1:15
#It151. Dante, La Divina Commedia—Studio e interpretazione.
4 units, winter, (Sangiorgi), MW 4:15–6:05
#It152. Dante, La Divina Commedia—Studio e interpretazione.
4 units, spring, (Sangiorgi), MW 4:15–6:05
It161. Letteratura Italiana del Medioevo—Il corso non include lo studio de La Divina Commedia. Conferenze, letture e saggi.
3 units, autumn, (Sangiorgi), TTh 3:00–4:30
SCHOOL OF HUMANITIES AND SCIENCES

#It162. Umanesimo e Rinascimento—Storia della letteratura e della cultura italiana nel Quattrocento e nel Cinquecento. Conferenze, letture e saggi.
3 units, winter, (Sangiorgi), TTh 3:00-4:30

3 units, winter, (Sangiorgi), TTh 4:15-6:05

#It165. Il dramma italiano moderno—Studio delle opere drammatiche più significative da Goldoni a Pirandello.
3 units, spring, (Sangiorgi), TTh 3:00-4:30

#It166. 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), MWF 10

#It199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit.
1 to 3 units, each quarter, (Staff), by arrangement

L. LINGUISTICS AND PHILOLOGY COURSES

L203. Vulgar Latin—Phonology, morphology, syntax of Vulgar Latin, as compared to Classical Latin and as established from subsequent Romance developments. Reading of selected texts. Prerequisite: working knowledge of Classical Latin.
3 units, winter, (Juilland), MWF 4:15

L204. Introduction to Romance Linguistics—Development of Romance languages from Vulgar Latin; phonology, morphology, syntax. Prerequisite: working knowledge of Latin.
3 units, winter, (Juilland), MWF 2:15

L250. Seminar in Romance Linguistics—Prerequisite: L204 or equivalent.
2 units, spring (Juilland), TTh 2

L270. Topics in Structural Linguistics.
2 units, autumn, winter, (Juilland), to be given in 1965-66

ROU. ROUMANIAN COURSES

Rou221. Intensive Roumanian—For first-year students.
5 units, autumn, (———), MTWThF 11

Rou222. Intensive Roumanian—Continuation of Rou221.
5 units, winter, (———), MTWThF 11

Rou223. Intensive Roumanian—Continuation of Rou222.
5 units, spring, (———), MTWThF 11

3 units, autumn, (———), MWF 10

Rou232. Advanced Roumanian Grammar and Composition, and Literature Survey II—Continuation of Rou231.
3 units, winter, (———), MWF 10

3 units, spring, (———), MWF 10

Rou241. Structure of Roumanian I—Phonology.
2 to 3 units, (Juilland), by arrangement

Rou242. Structure of Roumanian II—Morphology.
2 to 3 units, (Juilland), by arrangement

2 to 3 units, (Juilland), by arrangement
T. TEACHER TRAINING COURSES

TF288. Methods of Teaching French—(Same as Education 288.)
3 units, winter, (Politzer), M 4:15-6:05

See also Senior Colloquia.

GEOGRAPHY

Emeriti: C. Langdon White, Joseph E. Williams (Professors)

Lecturer: Joseph E. Terry (Lieutenant Colonel, USAF)

Courses in Geography are offered by the School of Humanities and Sciences to students who wish to supplement their work in other fields. Geography may not be selected as a major or minor subject.

COURSES

5 units, autumn, (White), spring, (Terry), summer, (White), MTWThF 8

4. Economic Geography—Relation from the world point of view, of man's industries—agriculture, lumbering, mining and quarrying, fishing, manufacturing, transportation, commerce—to the natural environment.
5 units, winter, (Terry), MTWThF 9

175. Individual Study in Geography—This course may be taken to do reading and work in Geography. Prerequisite: 1 or 4. Geography 175 may not be repeated.
2 to 5 units, by arrangement

191. Political Geography—Geographical pattern of major nations, territorial structure, resources, industry, communications, national aspirations, special consideration to role of the United States in the world. Establishment of base for analyzing current international trends.
4 to 5 units, winter, (Terry), MTWTh F 8

HISPANIC AMERICAN and LUSO-BRAZILIAN STUDIES

Director: Ronald Hilton
Assistant to the Director: To be announced
Instructor: Laura Tarquinio
Lecturers: Luis Bertonasco, Burnett Bolloten, William Kemnitzer, Sir Harold Mitchell, James L. Taylor

The program of the Institute of Hispanic American and Luso-Brazilian Studies is an area or regional program in that it concerns itself with a definite area, namely Spain, Portugal, and Latin America; this is a cultural and linguistic rather than a geographical region. Luso-Brazilian means simply Portuguese-Brazilian, Lusitania being the ancient name of Portugal. There is in the Institute a Luso-Brazilian Center which coordinates teaching and research in the Portuguese and Brazilian fields.
The program emphasizes the use of the Spanish and Portuguese languages; the study of a foreign area without a mastery of the language of that area is comparable to engineering without mathematics. Authorities from Spain and Latin America regularly address in Spanish or Portuguese the core seminar (250) which prepares the Hispanic American Report (see below) and engage in discussion with members of the Institute on a wide range of subjects. The Hispanic American Studies program strives to bridge the dangerous gap between the humanities and the social sciences.

Every program must have a focus, depending on the idiosyncrasies of the civilization studied and on the peculiar interests which have developed at any given institution. The predominant obsession of the Hispanic world today is politics—not the abstract variety which flourishes in more metaphysical lands, but a peculiarly personalistic brand, involving a day-to-day struggle in which revolution and unrest are often accompanied in a paradoxical way by economic and social growth. This focus of the Stanford program is the Hispanic American Report, a monthly publication founded in 1948, which has as its theme the political, social and economic development of the area. The Report is prepared by the core seminar (250) which provides a continuing thread through the advanced student's work, while the basic area analyses are taught in the Introductory courses 171-177. The Institute awards a certificate to those students who have done superior work on the Hispanic American Report for at least three quarters.

The Institute of Hispanic American and Luso-Brazilian Studies cooperates closely with the Department of Modern European Languages. Other disciplines such as geography, political science, history, economics, sociology, and anthropology contribute to the symposium which constitutes Hispanic American Studies. The Schools of Education and Earth Sciences likewise cooperate with the program.

It is obvious that a stay in a Spanish or Portuguese speaking country is a desirable and in some ways an indispensable part of the training of a Hispanic Americanist. Undergraduate majors are encouraged to spend the equivalent of two quarters at an accredited institution in Latin America, Spain, or Portugal. The Institute has cordial relations with several such institutions and will counsel undergraduate majors who wish to study abroad as part of their program.

The Institute has its own building, Bolivar House; this is a sufficient mailing address. The work of the Institute is organized on a country by country basis, with an International section which performs a coordinating role. For each area there is a study room in Bolivar House or in the adjoining building, which also houses the Archives. These Archives consist of source materials about Latin American affairs collected in connection with the preparation of the Hispanic American Report. They constitute a laboratory for students working in the core seminar (250), and are open only to them. Students from other departments may apply for admission to this seminar.

PROGRAMS OF STUDY

The requirements for the Bachelor of Arts, Master of Arts, and Doctor of Philosophy are as follows:

**Bachelor of Arts**

*Language*—The sequence of reading and composition courses, terminating with Third-Year Spanish Grammar and Composition (Modern European Languages Sp113).

*Civilization*—Hispanic American Studies 171-177 .................. 10 units

*Literature*—Two courses of Spanish or Spanish American Literature ... 6 units

*History*—Two courses on Latin American History ................... 8 units

*Inter-American Relations*—Latin America and the United States (Political Science 138, 5 units), or one course on advice of director ... 5 units

*Anthropology or Economics*—One course on advice of director .......... 4 units
Students who wish to minor in any special field of interest may do so by completing 16 units of work in that field.

**Master of Arts**

The A.M. program takes three quarters of full-time course work. In the following quarter the student takes the final examinations (see below). Full registration is necessary in the fourth quarter only for those wanting additional units; others may register as terminal graduates in order to have library, health service, and housing privileges.

Students enter the A.M. program (and also the Ph.D. program) with a variety of academic backgrounds, especially political science, Spanish, history, and economics. Students who are deficient in their language training may be required to do remedial work. Part I of the Graduate Record Examination (the Aptitude Test) is strongly recommended, but not required, as a prerequisite for admission.

Candidates for the Master's degree must fulfill satisfactorily the following requirements:

1. An approved program of 45 units with a grade of A or B, including 9 units for the thesis. The student's program will stress the language, civilization, literature, geography, history, and political affairs of modern Spain and Latin America, with special reference to one of the following: Spain and Portugal, Mexico and Central America, the Caribbean Islands, Gran Colombia (Venezuela, Colombia, Ecuador), West Coast countries (Peru, Bolivia, Chile), River Plate countries (Argentina, Uruguay, Paraguay), Brazil, or International affairs. Students are assigned to the appropriate section of the *Hispanic American Report*.

2. A thesis on an approved subject. Nine units of additional course work may be substituted for the thesis with the permission of the Director.

3. A general examination in the field.

4. A language examination in Spanish and Portuguese. Spanish is the major language and Portuguese the minor language, although for those specializing in Luso-Brazilian Studies this is reversed. Students will be tested for their reading, writing, and oral knowledge of their major language, and for their reading knowledge of their minor language.

Students wishing to work exclusively in Spanish language and literature and Hispanic American Studies may also take an A.M. in Spanish with a specialization in Hispanic American Studies. See under Modern European Languages.

Students may begin their A.M. program in any quarter. Those planning to begin in the summer will receive special consideration, and those planning to begin in the autumn quarter should arrive if possible early in September to familiarize themselves with the operation of the Institute.

**Doctor of Philosophy**

There are two Ph.D. programs in Hispanic American Studies. The first is general in character, the courses being selected from the offering of various departments according to the aims and interests of the candidate. It is administered under Graduate Division Special Programs. There is a core program consisting of the Seminar on Contemporary Latin America, Spain, and Portugal (250), and the study of the Spanish and Portuguese languages. Students for the Ph.D. will study three of the areas listed under the A.M. program, it being permissible to count Brazil as two areas. Students specializing in Brazil will be expected to achieve a higher degree of competency in Portuguese than those specializing in the Spanish-speaking countries. A candidate for the Ph.D. will take two examinations, the one on the Departmental level covering his general field of study; it will normally be taken before he has made substantial progress on his dissertation. The University examination will consist of a defense of the completed dissertation.
Those planning to teach in a language department may obtain a Ph.D. in Spanish with a specialization in Hispanic American Studies. The Hispanic American Institute cooperates in this program with the Department of Modern European Languages, which has a number of teaching assistantships for prospective language teachers. In this program, all candidates for a Ph.D. in Spanish must take a program lasting about a year and consisting of equal parts of language and linguistics, literature, and Hispanic American Studies. They may then specialize in any of the three fields mentioned. (See under Modern European Languages.) Candidates who do not propose to specialize in Hispanic American Studies should consider the advisability of remaining in the seminar for at least three quarters in order to qualify for the certificate mentioned above. Students specializing in literature or linguistics are welcome to continue work in Hispanic American Studies if they wish to present this as an area of study on their final examination.

Teaching Credentials

The Hispanic American Studies program was developed with the assistance and encouragement of the School of Education, since the subject matter meets the professional needs of high school teachers among others. An A.B. in Hispanic American Studies is a logical point of departure for students who wish to obtain a teaching credential with a major in Spanish and a minor in Social Studies or one of the social sciences. Consult the Credential Secretary of the School of Education for further information. Students preparing for an A.M. in the Teaching of Spanish are also urged to consider the advisability of working in Hispanic American Studies.

INTRODUCTORY COURSES

Students wishing to take extra units in courses numbered below 200 should register under 199 at Bolivar House, where they will be given instructions.

171. Spain and Portugal.
   2 units, (Hilton), alternate years, to be given in 1965-66

172. Mexico and Central America.
   2 units, winter, (Hilton), alternate years, to be given in 1965-66

173. The Caribbean.
   2 units, spring, (Hilton), alternate years, to be given in 1965-66

174. The Pacific Coast Republics.
   2 units, autumn, (Hilton)

175. The River Plate Republics.
   2 units, winter, (Hilton), TTh 8

176. Brazil.
   2 units, spring, (Hilton), TTh 8

177. Problems of Spain, Latin America—May be repeated for credit.
   2 units, autumn, (Hilton), TTh 8, to be given in 1965-66

These courses given in English provide, with convenient regional subdivisions, a general picture of Spain, Portugal, and Latin America (geography, history, social organization, culture). These courses are the basic requirement for the Hispanic American and Luso-Brazilian major, and provide a valuable background for students of Spanish and Latin American literature. They are also intended to give nonspecialists basic information about the Spanish- and Portuguese-speaking world.

178. La Civilización de Hispanoamérica.
   3 units, autumn, winter, spring, (Hilton), MWF 8

179. Simón Bolívar y su época.
   3 units, autumn, winter, (Hilton), MWF 10

   3 units, spring, (Hilton), MWF 10
MODERN SPAIN AND PORTUGAL

    2 units, autumn, (Bolloten), Th 11–1

    2 units, winter, (Bolloten), Th 11–1

183. Spain Since the Civil War (1939 to date).
    2 units, spring, (Bolloten), Th 11–1

MODERN LATIN AMERICA

191. Area Analysis of Contemporary Latin America—A cooperative seminar with the participation of specialists from commercial, academic, and governmental organizations.
    2 units, (Kemnitser), by arrangement

192. Development in Latin America—With special reference to the development of resources in certain countries.
    2 units, summer, (Kemnitser), MWF 10

193. Development in Latin America: Mexico and the West Coast Countries of South America.
    2 units, autumn, (Mitchell), MW 10

    2 units, (Mitchell), to be given in 1965–66

195. Development in Latin America: Brazil and the River Plate Countries.
    2 units, (Mitchell), to be given in 1965–66

    3 units, each quarter, (Hilton), MWF 9

199. Directed Work (Undergraduate)—May be taken separately or in conjunction with any course numbered below 200. Training in the research methods used in the Institute and especially in the preparation of the Hispanic American Report. Students should preregister at Bolivar House for a maximum of five units each quarter.

200. Proseminar in Contemporary Latin America, Spain, and Portugal—For a description, see 250. Students work as junior contributors to the Hispanic American Report. Preregistration at Bolivar House.
    3 to 5 units, each quarter, (Hilton, Hispanic American Report Committee), TTh 10

COURSES IN PORTUGUESE AND LUSO-BRAZILIAN STUDIES

Note—For courses in elementary Portuguese, see under Modern European Languages.

111. Intermediate Portuguese—Prerequisite: P13 or equivalent.
    4 units, autumn, (Tarquinio), MTWTh 1:15

112. Intermediate Portuguese—Continuation of 111.
    4 units, winter, (Tarquinio), MTWTh 1:15

113. Intermediate Portuguese—Continuation of 112.
    4 units, spring, (Tarquinio), MTWTh 1:15

211. Advanced Portuguese—Prerequisite: P113 or equivalent.
    4 units, by arrangement

212. Advanced Portuguese—Continuation of 211.
    4 units, by arrangement

213. Advanced Portuguese—Continuation of 212.
    4 units, by arrangement

    2 to 3 units, autumn, (——), M 2:15–4:05
2 to 3 units, winter, (———), M 2:15-4:05

2 to 3 units, spring, (———) M 2:15-4:05

234. História Econômica do Brasil I.
2 to 3 units, autumn, (———), W 2:15-4:05

235. História Econômica do Brasil II.
2 to 3 units, winter, (———), W 2:15-4:05

236. História Econômica do Brasil III.
2 to 3 units, spring, (———), W 2:15-4:05

237. A Economia Brasileira.
2 to 3 units, summer, (———), by arrangement

238. Seminário Especial sobre Portugal e o Brasil.
2 to 3 units, each quarter, (Hilton, ————), M 8-10 p.m.

239. Social and Linguistic Developments in Brazil—A study of the expanding vocabulary of Brazilian Portuguese under the influence of social and technical developments. A seminar for students trained in Portuguese.
2 to 4 units, any quarter, (Taylor), by arrangement

THE HISPANIC AMERICAN REPORT

250. Seminar on Contemporary Latin America, Spain and Portugal—Special attention is paid to political, social, economic, and cultural developments. This seminar produces the monthly Hispanic American Report. Given on a continuing basis, it is the core of the HAS graduate program. Preregistration at Bolivar House.
3 to 5 units, each quarter, (Hilton, Hispanic American Report Committee), TTh 10

299. Directed Reading (Graduate).
Any quarter, by arrangement

300. Thesis.
Any quarter, by arrangement

For other courses relevant to Hispanic American and Luso-Brazilian Studies see below:

Anthropology

161. Peoples of Middle America.

History

176. Latin America to 1825.
177. Modern Latin America.
178. Latin America Since 1939.
179. Historical Evolution of Mexico.
184. Directed Reading in Latin American History.
185. Senior Research in Latin American History.

Modern European Languages

AS150. Unamuno and Ortega.
Sp100. Advanced Spanish Conversation.
Sp133. Masterworks of Spanish Literature III.
Sp134. Modern and Contemporary Spanish Literature I.
Sp135. Modern and Contemporary Spanish Literature II.
Sp142. The Spanish Novel of the Nineteenth Century.
Sp151. Masterworks of Spanish-American Literature I.
Sp152. Masterworks of Spanish-American Literature II.
Sp182. Teatro español contemporáneo.
Sp186. Literatura hispanoamericana I.
HISTORY

Emeriti: Carl Fremont Brand, Harold Henry Fisher, Ralph Haswell Lutz, Edgar Eugene Robinson, Payson Jackson Treat (Professors)

Executive Head: Gordon Wright
Associate Professors: Gavin I. Langmuir, James T. C. Liu, Rixford K. Snyder, Lewis W. Spitz (on leave winter and spring quarters 1964–65)
Assistant Professors: John Philip Dawson, Paul Seaver, Lyman P. Van Slyke.
Acting: Lancelot L. Farrar, Jr.
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, in consultation with his adviser, select a minor to consist of a coherent group of courses totaling at least 25 units, to fall within one of the following categories: (1) A social science minor of at least 15 units in one subject, plus 10 elective units. Of the 15 units in one subject, at least one (but preferably two) of the courses should be advanced courses. The subjects acceptable for a social science minor are anthropology, economics (except accounting), geography, political science, psychology (except courses primarily laboratory in nature), and sociology. (2) A minor in humanities of at least 15 units in one subject (including some advanced courses) plus 10 elective units. The subjects acceptable under this requirement are classics, literature (including foreign language courses above 23), philosophy, religion, the history of science, and the history of the visual arts and of music. (3) The Honors Program in Humanities.

The Cory and Riotte scholarships are available for undergraduate women students in the Department.

In order to provide for students with special interests, the course work, seminars, and directed reading taken in the Department, together with the minor and other work taken outside, may be devoted to the development of an integrated program to cover, for example: (1) an area, such as Central Europe, the Far East, Near East, or Latin America; (2) a period, such as Europe in the Middle Ages or in the nineteenth century; (3) a country, such as France, England, Russia, the United States, or Japan; (4) a civilization, such as American civilization or Chinese civilization.

Honors in History

For a limited number of students the Department will offer a special program leading to a Bachelor's degree with Honors in History. To be eligible a student must have at least a B average in History and normally the same standing in the University. The candidate must fulfill the basic seminar requirement, be sponsored by a member of the Department, and have Department approval for his program. Normally students will begin this work in the winter or spring quarter of the third year and after completion of the basic seminar. Students electing the Honors Program will (1) take a minimum of 60 units in history, (2) meet the usual requirements for distribution and a minor, (3) complete a course on Interpretations of History, (4) take an independent study program of 12 units extending over a period of three quarters, and (5) write a senior thesis. A comprehensive examination, mainly upon the independent study work, will be given upon the completion of this program. The Department will recommend that recipients of the James Birdsall Weter scholarships be selected from among Honors candidates and that special weight for University honors at graduation be given for the quality of work done under this Department program.

History in the Secondary Teacher's Credential

Applicants for the Stanford Secondary Teacher's Credential in the social studies may get details of the requirements by applying to the Credential Secretary, Room 43, School of Education.

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 pa-
pers. 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 and two secondary fields to be selected from the following: (1) Ancient History (the Greek and Roman world); (2) Europe, 300–1400; (3) Europe, 1400–1789; (4) Europe since 1700; (5) Russia and East Central Europe; (6) The Near and Middle East; (7) The Far East; (8) Britain and the British Empire since 1485; (9) Latin America; (10) The United States (including Colonial America). The candidate in consultation with his adviser will choose a dissertation field within the major field. The student and his adviser, together with the professors in the secondary fields concerned, may delimit a particular area of study within these fields for primary consideration.

A minor in another department or a supporting program of not fewer than thirty units of advanced and graduate courses, taken as a graduate student, at least fifteen units of which shall be in one discipline (e.g., American literature, economics, political science) may be substituted for one of the two secondary fields.

The candidate will include in his program a graduate course (History 300) in historiography, a graduate course (History 301) in American historiography if the thesis field is American history, and a graduate course (History 302) in methods of teaching at the college level.

The Department of History participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in History and Humanities. For a description of that program, and of fellowships offered in connection with it, see the section "Humanities (Special Programs)" in this Bulletin.

The Department has about fifteen student assistantships and three teaching assistantships which are customarily held by candidates for advanced degrees.

I. INTRODUCTORY COURSES

Required of all students. Opportunities for individual study are open to a small group of carefully selected students.

#1. History of Western Civilization—Western Civilization to circa A.D. 1000; prehistoric man; ancient Orient, Greece, Rome, early Middle Ages.

4 units, autumn, (Staff)
#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, 300-1300—Emphasis on transition from ancient Mediterranean to European civilization, development of medieval social, cultural institutions and ideas.
   5 units, autumn, (Bark)

30. Europe, 1600-1789—Economic, political, cultural survey of seventeenth, eighteenth centuries.
   5 units, autumn, (Harris)

   5 units, winter, (Harris)

32. Europe Since 1914—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)

40. England to 1603—English people, survey of their political, economic, social, cultural history.
   5 units, autumn, (Langmuir)

60. Interpretive Survey of United States History.
   3 to 5 units, spring, (Bailey)

65. American Social History—Emergence of American people; development, conflicts of social classes; impact of expansion, industrialization, urbanization upon society.
   5 units, autumn, (Knoles)

91. Far Eastern Civilizations: Traditional Period—The origin and development of the civilizations of China and Japan.
   5 units, autumn, (Liu)

92. Far Eastern Civilizations: Modern Period—The development of the civilizations of China and Japan in the period of Western impact since 1800.
   5 units, winter, (Smith), to be given in 1965-66

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 100-104 (Basic Seminars and Honors courses) are open only to juniors and seniors majoring in History. Lecture courses numbered 105-199 are open to juniors, seniors, and graduate students; sophomores may be admitted by permission of the instructor.

Courses in directed reading for undergraduates are designed not as a substitute for but as a supplement to lecture courses. Prerequisites: at least an average grade of B in the University; at least an introductory course in the field; third- or fourth-year standing; and permission of the instructor. In a few cases one or more of these prerequisites may be waived by special action of the Department.

Courses in senior research are intended primarily (though not exclusively) for Honors candidates engaged in writing senior theses.
A. Basic Seminars and Honors Courses

100a. Basic Seminar.  
5 units, winter, (Bark)

100b. Basic Seminar.  
5 units, autumn, (Langmuir)

100c. Basic Seminar.  
5 units, autumn, (Spitz)

100d. Basic Seminar.  
5 units, winter, (Craig)

100e. Basic Seminar.  
5 units, winter, (Harris)

100f. Basic Seminar.  
5 units, autumn, (Mazour)

100g. Basic Seminar.  
5 units, winter, (Vucinich)

100h. Basic Seminar.  
5 units, winter, (Wright)

100i. Basic Seminar.  
5 units, spring, (Van Slyke)

100j. Basic Seminar.  
5 units, autumn, (Bailey)

100k. Basic Seminar.  
5 units, spring, (Fehrenbacher)

100m. Basic Seminar.  
5 units, autumn, (Miller)

100n. Basic Seminar.  
5 units, winter, (Potter), to be given in 1965–66

100p. Basic Seminar.  
5 units, autumn, (Pease)

100q. Basic Seminar.  
5 units, spring, (Johnson), to be given in 1965–66

100r. Basic Seminar.  
5 units, winter, (Buss)

100s. Basic Seminar.  
5 units, spring, (Liu)

100t. Basic Seminar.  
5 units, autumn, (Smith), to be given in 1965–66

100u. Basic Seminar.  
5 units, winter, (Knoles)

104. Interpretations of History—Required of students enrolled in the undergraduate honors program in History.  
4 units, spring, (Harris)

B. The Ancient World

See Classics, Section V, Courses H100, H101, H102, H103, H104, H200, H205, all of which are accepted for credit toward a major in history.

C. Medieval and Renaissance Europe

105. The Emergence of Medieval Europe—Genesis of European civilization from end of Roman political unity through Carolingian period.  
3 units, winter, (Bark)

107. The High Middle Ages—Such aspects of European civilization in twelfth, thirteenth centuries as papacy and Holy Roman Empire, French and English mon-
architectural 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)


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), to be given in 1965-66.

114. Directed Reading in Medieval History.

3 to 5 units, (Bark, Langmuir), by arrangement

115. Senior Research in Medieval History.

1 to 5 units, (Bark, Langmuir), by arrangement

116. Directed Reading in Renaissance-Reformation History.

3 to 5 units, (Spitz), by arrangement

117. Senior Research in Renaissance-Reformation History.

1 to 5 units, (Spitz), by arrangement

D. MODERN EUROPE

120. Russia—Founding of first Russian state to collapse of Russian Empire, 1917.

5 units, autumn, (Masour)

121. The Russian Revolution—Revolutionary era from fall of Tsarist government to present-day Soviet Russia. Prerequisite: 31, 32, or 120.

5 units, winter, (Masour)

122. Soviet Foreign Policy—Foreign policy in the West, Near, Middle, and Far East, 1917 to present.

3 units, spring, (Masour)

124. Ottoman Empire—Origin, development, and decline of the Ottoman Empire. An appraisal of Ottoman institutions and civilization. International diplomacy and the emergence of the so-called Eastern Question.

5 units, autumn, (Vucinich)

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, winter, (Craig)

129. Germany in the Twentieth Century.

4 to 5 units, spring, (Craig)

131. The French Revolutionary Epoch in Europe.

3 to 4 units, autumn, (Dawson)

132. Modern France—Foundations of Third Republic to present.

3 to 4 units, (Wright), to be given in 1965-66

134. Intellectual History of Europe—Analysis of major currents of thought beginning with Natural Law.

4 units, spring, (Harris)
135. European Diplomacy Since 1815.
   4 to 5 units, autumn, (Craig)

138. Directed Reading in Modern European History.
   3 to 5 units, (Craig, Harris, Mazour, Vucinich, Wright), by arrangement

139. Senior Research in Modern European History.
   1 to 5 units, (Craig, Harris, Mazour, Vucinich, Wright), by arrangement

E. THE BRITISH COMMONWEALTH AND EMPIRE

140. English Constitutional History—Anglo-Saxon origins, Norman innovations; legal, administrative, parliamentary development under Angevins; limitation of royal power, rise of cabinet system, democratization of Constitution.
   5 units, winter, (Langmuir)

141. Britain, 1603-1832—Emphasis on domestic political, economic and social history, but foreign and imperial affairs will be included as they influenced the country's general development.
   4 to 5 units, winter, (Lyman)

142. Britain Since 1832—See description of 141 (above).
   4 to 5 units, spring, (Lyman)

145. Directed Reading in British History.
   3 to 5 units, (Langmuir, Lyman), by arrangement

146. Senior Research in British History.
   1 to 5 units, (Langmuir, Lyman), by arrangement

F. THE UNITED STATES

150. The Colonial Period.
   3 units, autumn, (Miller)

151. The Revolution, Confederation, and Constitution.
   5 units, winter, (Miller)

152. The Colonial Mind—Advanced study of Colonial period through biographical approach to representative figures in fields of politics, art, religion, literature, science, American response to currents of thought from Great Britain, Europe.
   3 units, spring, (Miller), to be given in 1965-66

154. American Diplomatic History to 1898.
   4 to 5 units, autumn, (Bailey)

155. American Diplomatic History since 1898.
   4 to 5 units, winter, (Bailey)

157. The West in American History to 1860—Colonial background and the influence of the Trans-Appalachian West upon American development before the Civil War.
   4 units, autumn, (Fehrenbacher), to be given in 1965-66

158. The Great West in American History—Exploration, settlement, and historical influence of the Trans-Mississippi West.
   4 units, winter, (Fehrenbacher)

159. History of California—From Spanish period to present, emphasis upon twentieth 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), to be given in 1965-66

161. The South in American History since Reconstruction—Factors of regional distinctiveness; conditions in the post-bellum South; the rise of tenancy; the legend of the "New South"; Bourbonism and the Populist revolt; disfranchisement;
the one-party system; the collapse of the cotton economy; the crisis of biracialism; industrialization, urbanization, and the passing of the traditional South.

5 units, winter, (Potter), to be given in 1965-66

162. The Civil War and Reconstruction, 1850-1877—Political, constitutional, economic, cultural, military aspects of conflict between North and South, emphasis on its lasting effects on American civilization.

4 units, spring, (Pease)

163. The Age of Big Business, 1877-1919—Government and the economy in the era of business capitalism; the industrial ethos and progressive reform.

4 units, autumn, (Pease)

164. The United States since 1920—Growth of political and economic power during prosperity, depression, and international conflict; accompanying transformation in American culture.

4 units, winter, (Pease)


4 to 5 units, winter, (Knoles)


4 to 5 units, spring, (Knoles)

170. Interpretations of the American Character—The concept of national character; problems and methods in the study of group character; some social science approaches; travelers' accounts and other historical materials; American social history as a source; historical forces, both traditional and recent, in the shaping of American character. Open to advanced students by permission of instructor.

4 units, spring, (Potter), to be given in 1965-66

174. Directed Reading in United States History.

3 to 5 units, (Bailey, Fehrenbacher, Knoles, Miller, Pease, Potter), by arrangement

175. Senior Research in United States History.

1 to 5 units, (Bailey, Fehrenbacher, Knoles, Miller, Pease, Potter), by arrangement

G. LATIN AMERICA

176. Latin America to 1825—Discovery, conquest, growth of political, social, economic institutions; Wars of Independence in Spanish, Portuguese America.

5 units, autumn, (Johnson), to be given in 1965-66

177. Modern Latin America—Political, social, economic institutions in leading republics since independence.

5 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), to be given in 1965-66

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)

184. Directed Reading in Latin American History.

3 to 5 units, (Johnson), by arrangement

185. Senior Research in Latin American History.

1 to 5 units, (Johnson), by arrangement

H. MIDDLE EAST


3 units, spring, (Rents), to be given in 1966-67
188. History of the Islamic World, 1258-1803—Expansion and contraction of the Islamic domains and internal changes from the fall of the Abbasid Caliphate to the first occupation of Mecca by the House of Sa'ud.
   3 units, spring, (Rents)

189. 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 1965-66

I. East Asia

190. Institutional History of China—Topical analysis of key institutions.
   3 units, winter, (Liu)

   3 units, winter, (Liu), alternate years, to be given in 1965-66

192. Modern China—1800 to the present, emphasis on rebellions, reforms, revolutions, and resistance to changes.
   3 units, spring, (Liu)

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)

194. History of Modern Japan—End of the "feudal" period; emergence of Japan as a modern state; evolution of new economic and social institutions; problems of cultural change.
   5 units, autumn, (———)

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), to be given in 1965-66

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, winter, (Buss), to be given in 1965-66

197. History of Southeast Asia.
   4 to 5 units, spring, (Buss)

198. Directed Reading in Far Eastern History.
   3 to 5 units, (Buss, Liu, Van Slyke), by arrangement

199. Senior Research in Far Eastern History.
   1 to 5 units, (Buss, Liu, 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, (Spitz), to be given in 1965-66

220. Graduate Seminar in Russian History.
   5 units, spring, (Masour)

   5 units, autumn, (Vucinich)

228. Graduate Seminar in Modern Germany.
   5 units, autumn, (Craig)

235. Graduate Seminar: Twentieth Century Europe.
   5 units, spring, (Wright)
240. Graduate Seminar in Medieval English History.
   3 to 5 units, winter, (Langmuir)
243. Graduate Seminar in Modern British History.
   5 units, autumn, (Lyman)
250. Graduate Seminar in American Colonial History.
   5 units, spring, (Miller), to be given in 1965-66
252. Graduate Seminar in Nineteenth Century United States History.
   5 units, winter, (Fehrenbacher)
253. Graduate Seminar in Twentieth Century United States History.
   5 units, winter, (Pease)
255. Graduate Seminar in American Diplomatic History.
   5 units, winter, (Bailey)
258. Graduate Seminar in American Social and Intellectual History—The
   Progressive Movement.
   5 units, spring, (Knoles)
260. Graduate Seminar in History of the South.
   5 units, autumn, (Potter), to be given in 1965-66
262. New Interpretations of United States History.
   5 units, spring, (Potter), to be given in 1965-66
280. Graduate Seminar in Latin American History.
   5 units, autumn, (Johnson)
290. Graduate Seminar in the History of China.
   5 units, autumn, (Liu)
292. Graduate Seminar in the History of Japan.
   5 units, spring, (Smith), to be given in 1965-66
295. Graduate Seminar in Diplomatic History of the Far East.
   5 units, autumn, (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)
310. Graduate Colloquium: The Fall of the Roman Empire.
   5 units, autumn, (Bark)
314. Directed Reading in Medieval History.
   Units by arrangement, (Bark, Langmuir)
315. Graduate Research in Medieval History.
   Units by arrangement, (Bark, Langmuir)
316. Directed Reading in Renaissance and Reformation.
   Units by arrangement, (Spitz)
317. Graduate Research in Renaissance and Reformation.
   Units by arrangement, (Spitz)
318. Graduate Colloquium: The Course of Christian Humanism.
   5 units, spring, (Spitz), to be given in 1965-66
319. Graduate Colloquium: Humanism and the Reformation.
   5 units, autumn, (Spitz)
5 units, spring, (Vucinich)

288. Graduate Colloquium: Topics in Modern European History.  
5 units, spring, (Craig)

335. Graduate Colloquium: Europe 1890–1950.  
5 units, winter, (Wright)

338. Directed Reading in Modern European History.  
Units by arrangement, (Craig, Harris, Masour, Vucinich, Wright)

339. Graduate Research in Modern European History.  
Units by arrangement, (Craig, Harris, Masour, Vucinich, Wright)

340. Graduate Colloquium: Topics in Modern British History.  
5 units, spring, (Lyman)

345. Directed Reading in British History.  
Units by arrangement, (Langmuir, Lyman)

346. Graduate Research in British History.  
Units by arrangement, (Langmuir, Lyman)

358. Graduate Colloquium: American Social and Intellectual History.  
5 units, autumn, (Knoles)

360. Graduate Colloquium: American Politics from Jackson to Lincoln.  
5 units, winter, (Fehrenbacher)

374. Directed Reading in United States History.  
Units by arrangement, (Bailey, Fehrenbacher, Knoles, Miller, Pease, Potter)

375. Graduate Research in United States History.  
Units by arrangement, (Bailey, Fehrenbacher, Knoles, Miller, Pease, Potter)

380. Graduate Colloquium in Latin American History.  
5 units, spring, (Johnson)

384. Directed Reading in Latin American History.  
Units by arrangement, (Johnson)

385. Graduate Research in Latin American History.  
Units by arrangement, (Johnson)

390. Graduate Colloquium: Topics in Chinese History.  
5 units, winter, (Liu)

398. Directed Reading in Far Eastern History.  
Units by arrangement, (Buss, Liu, Van Slyke)

399. Graduate Research in Far Eastern History.  
Units by arrangement, (Buss, Liu, Van Slyke)

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**HUMANITIES (SPECIAL PROGRAMS)**

*Acting Executive Head: Jeffery Smith*

*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). Visiting: Daniel J. O'Hanlon, S.J.*

*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), (on leave 1964-65), George Knoles, Kurt Mueller-Vollmer, Otis A. Pease, Lucio P. Ruotolo, George F. Sensabaugh, Jeffery Smith (Acting Chairman)

Freshmen and sophomores who are interested in the Honors Program described below should consult with the chairman of the Honors Committee (Room 51M). It is desirable that the student begin to plan his program as early as possible.

Purpose of the Program

The Honors Program aims to develop in its students a greater sense of the relatedness of various fields of knowledge and experience, and to increase their awareness of basic values—intellectual, aesthetic, social, and ethical. The Committee in charge, composed of representatives of several departments in the Humanities, will help each Honors student to plan a balanced and integrated program.

Admission to the Program

Students wishing to enroll in the program should apply to the Chairman of the Committee, and students planning to attend campuses abroad should confer with him as early as possible as to adjustments in scheduling courses, and possible substitutions where necessary.

A University average of at least B is required for admission to the program and for graduation with Honors in Humanities.

The program is open to qualified students majoring in any department of the University. All students will take the same basic humanities requirements. Additional requirements, however, vary with different groups. There are three such groupings.

1. If the student plans to major in one of the humanistic departments (Art and Architecture, Asian Languages, Classics, English, History, Modern European Languages, Music, Philosophy, Speech and Drama) the program supplements the regular departmental major. Thus the student will be graduated in the department of his choice plus "Honors in Humanities." In some cases the Honors Program serves as a departmental minor.

2. The student majoring in a social, biological, or physical science should plan, with the help and approval of his tutor, a group of courses of at least 12 units (in addition to the regular honors courses). These should be in one of the humanistic departments; some of them may be in individual work. Since the senior essay must relate to the humanities, the courses should be chosen to provide an appropriate and definite background for the essay.

3. In certain exceptional cases (for example, when the student is taking a pre-medical or education-credential curriculum) the student may enroll as a Humanities major.

Requirements of the Program

1. Requirements normally completed during the first two years:
   a) The "World Literature" sequence—Humanities 61, 62, 63—15 units.
   b) Philosophy, a minimum of 4 units, other than Logic.
   c) Fine arts (music, art and architecture, theater), a minimum of 8 units.

2. Requirements during the third year:
   Participation for three quarters (4 units each quarter) in the Humanities Seminar, 12 units.

3. Requirements during the fourth year:
   a) Participation, for two quarters, in the Senior Colloquia in Humanities, 4 units.
b) Senior essay—In his senior year each honors student will write a senior essay on a subject growing out of his departmental field, but not confined to it. A credit of 8 units is allowed for the essay. A grade of at least a B is required on the essay for graduation with Honors in Humanities.

c) Oral examination—Upon completion of his essay each student must take an oral examination centered in the field of the essay and testing the student’s critical abilities. The student’s performance will be considered by the Committee in determining the grade on the senior essay.

COURSES, FIRST AND SECOND YEAR

21, 22, 23. World Personalities—A study of the lives and personalities of a number of significant men and women, including such individuals as Jesus, Socrates, St. Francis, Leonardo da Vinci, Madame Curie, Gandhi, and Hitler.

   3 to 4 units, autumn, (Smith), MWF 10, to be given in 1965–66

22. World Personalities: Renaissance and Modern.
   3 to 4 units, winter, (Smith), MWF 10, to be given in 1965–66

23. World Personalities: Twentieth Century.
   3 to 4 units, spring, (Smith), MWF 10, to be given in 1965–66

#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, (Raubitschek, Staff), TWTh 11 and one hour by arrangement (two hours for Honors students)

#62. Medieval and Renaissance Literature—Medieval epics, Augustine, Aquinas, Dante, Marlowe, Thomas More, Cervantes, Erasmus, Calvin, Montaigne, Spenser, Molière, others.
   4 units (5 units for Honors students), winter, (Ryan, 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, (Watt, 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 in Humanities.

191. A study of the lives and personalities of certain significant individuals, such as Heloise, Rousseau, Nietzsche, Lincoln, Van Gogh, and Gandhi.
   4 units, autumn, (Ruotolo, Smith), by arrangement

192. The Arts as they relate to human experience and values, approached through case studies using works of art drawn from several fields, including literature, music, and the plastic arts.
   4 units, winter, (Smith, Rhinelander, Mueller-Vollmer), by arrangement
193. The concern of men as philosophers and historians to determine the possibilities of reason in the ordering of their societies.

4 units, spring, (Dawson, Mothershead, 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, (Brown, Smith), by arrangement

spring, (Schramm, Stegner), by arrangement

200. Senior Essay—An essay of about 15,000 words.

8 units, (Staff), by arrangement

See also Senior Colloquia.

GRADUATE PROGRAM

Committee in Charge: John W. Dodds (Chairman), Raymond D. Giraud, John D. Goheen, David Harris, 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.

Requirements

A. For entering the Program:

Candidates may apply to the Director for entrance to the Program upon qualifying for graduate study in one of the participating departments.

B. Within the Program:

1. Continued work in the candidate's major field in accordance with departmental requirements. For these requirements the prospective student should consult the departmental listings.

2. Participation in one course for each of six quarters in the "Western Traditions" series—reading, interpretation, and discussion of significant writers. This Western Traditions course is divided, according to the Stanford quarter system, as follows: The Classical and Patristic Periods (1st and 2d quarters); The Medieval Period (3d quarter); The Renaissance (4th quarter); The Eighteenth and Nineteenth Centuries (5th quarter); The Modern Period (6th quarter).

3. Participation in the Graduate Humanities Seminar. The Seminar discusses basic intellectual and educational problems of the present in the light of Western traditions. The themes of the first quarter may change from year to year. That of the last quarter is fixed. Topics treated in 1963-64 were: The Renaissance Mind, especially philosophical and scientific thought (2d quarter); The Functions of a University and the Meaning of Education (3d quarter).

4. Submission of a Ph.D. dissertation acceptable to both the Humanities Com-
mittee and the major department, as well as to the University Committee on the Graduate Division.

5. The passing of a reading examination in two foreign languages, one ancient and one modern. (Certain departments require a third language.) One of these examinations must be passed during the first two quarters of the candidate's second year of work beyond the A.B. degree.

6. The passing of a comprehensive written examination in Humanities and the University oral examination.

FELLOWSHIPS

The Program awards a number of fellowships which are available to properly qualified students. Detailed information concerning these may be obtained by addressing the Director of the Program.

GRADUATE COURSES

301, 302, 303. The Western Traditions.
301. The Classic Period: Greece.
4 units, autumn, (Rhinelander), MTWTh 9, alternate years, to be given in 1965-66
302. The Roman and Patristic Periods.
4 units, winter, (Otis, Strothmann), MTWTh 9, alternate years, to be given in 1965-66
303. The Middle Ages.
4 units, winter, (Staff), MTWTh 9, alternate years, to be given in 1965-66
304, 305, 306. The Western Traditions.
304. The Renaissance.
4 units, autumn, (Kocher, Ryan), MTWTh 9
305. The Eighteenth and Nineteenth Centuries.
4 units, winter, (Giraud), MTWTh 9
306. The Modern Period.
4 units, spring, (Mueller-Vollmer), MTWTh 9
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, Edwin M. Good, Robert M. Minto, Brooks Otis, Philip H. Rhinelander, Lawrence V. Ryan, Friedrich W. Strothmann, James T. Watkins IV.

The Curriculum in Religious Studies is designed to provide the essentials for an understanding of Biblical Religion and of the Christian inheritance in its basic documents, in its history and doctrine, in its relation to contemporary life and to alternative world-views. Certain of the offerings are listed in the General Studies Program Bulletin to which reference should be made.

COURSES

4 units, autumn, (Good), to be given in 1965-66
4 units, winter, (Good), TWThF 10, to be given in 1965-66

4 units, winter, (Good), TWThF 9, to be given in 1965-66

#R104. History of Christian Thought: to A.D. 1500—A study of the origin and development of Christian doctrine through the scholastic period, with particular focus on recurrent issues: faith and reason; incarnation and atonement; Church and culture.
4 units, autumn, ( ), TWThF 10

#R105. History of Christian Thought: Since A.D. 1500—Roman Catholic and Protestant developments during and after the century of the Reformation. Correlation of these developments with other cultural movements.
4 units, winter, ( ), TWThF 10

R113. Introduction to Christian Thought—Major areas of doctrine, in Protestant perspective. Particular attention to problem of revelation and reason, and Christian views of God, man, Christ, the church, providence and evil, death and resurrection.
4 units, autumn, ( ), TWThF 10

#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, winter, ( ), TWThF 10

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, ( ), TWThF 10

R120. Religion in America—Critical assessment of the “return to religion,” theological and sociological factors involved. Major attention to Protestantism, Roman Catholicism, and Judaism. Occasional guest lecturers to represent various traditions on the American scene.
4 units, spring, ( ), TWThF 10

#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

R155. The Prophets of Israel—One or more of the most significant prophets as poets and thinkers. Major motifs: Covenant, Sin, Judgment, Mercy, Future Hope.
4 units, autumn, (Good), TWThF 1, to be given in 1965-66

4 units, spring, (Good), MW 2-4, 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, ( ), TWThF 8

R190. Christianity and Culture—Seminar for juniors and seniors. Historical consideration of various types of relationship between Christianity and culture. Discussion of contemporary issues, such as nonreligious alternatives to Christian faith, impact on Christianity of social and political ideologies, relation of theology to other intellectual disciplines (e.g., science, philosophy). Admission by permission.
4 units, autumn, (Brown, Staff), TTh 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 Catholic-
ism. Particular attention will be given to the World Council of Churches, the Second Vatican Council, and the writings of ecumenical theologians. Admission by permission.

4 units, winter, (Brown, O'Hanlon), TTh 2:15-4:05
R199. Individual Work.
(Staff), by arrangement

For related courses see the departments of Anthropology, Classics, English, History, Modern European Languages, and Philosophy.

See also Senior Colloquia.

Hebrew Language: See Classics.

LINGUISTICS

Committee in Charge:
Chairman: Alphonse Juilland
Professors: Robert W. Ackerman, 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 estab-
lished 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 working knowledge of French and German, to be established by Committee examination or certification; a reading knowledge of a third language, such as Russian or Spanish, is strongly recommended.

b) Course (beyond the A.M.)

40 units of graduate work; selected among courses listed below, numbered 200 or above, and distributed approximately as follows:

1) 15 units in general linguistics (descriptive, comparative, historical linguistics; phonology, morphology, syntax, lexicology, dialectology, typology, etc.);
2) 15 units in a particular language or language family (graduate courses of a given language department);
3) 10 units in a related discipline (e.g., Anthropological Linguistics, Mathematical Linguistics, Psycholinguistics, Sociolinguistics, Statistical Linguistics, etc.).

c) Examination

Successful passing of a written Committee examination and of a University oral examination on:

1) the principles of general linguistics (descriptive, comparative, and historical);
2) the methods and techniques of the main linguistic disciplines (phonology, morphology, syntax; lexicology, dialectology, typology, etc.);
3) one related discipline (e.g., Anthropological Linguistics, or Mathematical Linguistics, or Psycholinguistics, or Sociolinguistics, or Statistical Linguistics, etc.);
4) the language of specialization (e.g., Latin Linguistics, French Linguistics, English Linguistics, Russian Linguistics, etc.), or the language family of specialization (e.g., Indo-European Linguistics, or Amerindian Linguistics, or African Linguistics, etc.; Romance Linguistics, or Germanic Linguistics, or Slavic Linguistics, etc.).

d) Dissertation

An original dissertation of such substance and scope as would justify publication.

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 his-
historical linguistics; the development of modern schools and trends of historical linguistics in the nineteenth and twentieth centuries.

3 units, spring, (Politzer), 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), T 4:15-6:05

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), T 4:15-6:05

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), T 4:15-6:05

General Courses—A101, Science of Language. (See French and Italian.)

Anthropology—176, Language and Culture; 177, Anthropological Linguistics; 204, Phonetics and Phonemes; 205, Morphology and Syntax; 253, Linguistic Field Methods.

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; Fr310, Old French; Fr311, Old French Texts. (See French and Italian.)

German—G205, Modern German; G251, Gothic and Historical German Grammar; G253, Old Norse; G255, Old Saxon; G257, Old High German; G258, Middle High German; G259, Advanced Middle High German. (See Modern European Languages.)

Romance Linguistics and Philology—L180, An Introduction to the Study of Language; L203, Vulgar Latin; L204, Introduction to Romance Linguistics; L205, Old Provençal; L250, Seminar in Romance Linguistics; L270, Topics in Structural Linguistics. (See French and Italian or Modern European Languages.)

Philosophy—157, Introduction to Logic; 157b, Intermediate Logic; 161, Philosophy of Language; 202, Theory of Meaning.

Roumanian—Rou221, Rou222, Rou 223, Intensive Roumanian; Rou231, Rou232, Rou 233, Modern Roumanian—Literature, Composition and Advanced Grammar; Rou241, Rou242, Rou243, The Structure of Roumanian. (See French and Italian.)

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—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 Szegő (Professors)

Executive Head: David Gilbarg
Associate Executive Head: Karel deLeeuw
Assistant Professors: Mary Virginia Sunseri. Acting: Leonard Sarason, Walter Strauss

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) 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 23; Physics 51, 52, 53, 54, 55, 56, 57.

Master of Science

The University's basic requirements for the Master's degree (residence, thesis, etc.) are discussed in the section "Degrees" in this Bulletin. The following are Departmental requirements:

Candidates must complete an approved course program which will ordinarily consist of a minimum of 45 units, at least 36 of which will be in this department. The Master's Thesis is optional: If a thesis is presented, the candidate's program must contain 15 units of 200-level courses (in addition to the thesis). If no thesis is to be presented, the candidate's program must include 24 units of courses numbered 200 or above. The candidate must have a B average over all course work taken in Mathematics and must achieve a satisfactory score in the Department's comprehensive examination.

For the degree of Master of Science in Computer Science, see below.

Doctor of Philosophy

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section "Degrees" in this Bulletin. The following are Departmental requirements:

In order that a student be admitted to candidacy for the Ph.D. degree, he must
have successfully completed 45 units of graduate courses (i.e., courses numbered 200 and above). These courses should include Mathematics 205a, b, c, 206a, b, c, 210a, b, and 212. In addition he must pass qualifying examinations given by the Department and demonstrate the ability to read French, German, or Russian.

Beyond the requirements for candidacy, the student must complete a course of study of at least 30 units approved by the Graduate Study Committee of the Department of Mathematics. This program must either display sufficient breadth in mathematics outside the student's field of specialization, or fulfill the requirements for a minor in another department. In addition, the student must pass his second language examination and the University oral examination, and submit an acceptable dissertation. A student must receive a grade of B or better in a course in order that it satisfy a requirement for the Ph.D. degree.

A candidate for the Ph.D. degree in Mathematics may specialize in computer science and submit his dissertation in this area. He must satisfy the usual requirements for the degree as established by the Mathematics Department. In addition he should be expert in communicating with automatic digital computers. His program of study should include Computer Science 136, 137, 138, 237a, b, c, 236a, b or 238a, b, 382 (or equivalent courses taken elsewhere). In view of the several requirements in Computer Science, consideration will be given to a reduction in the variety of other mathematics courses required for the degree.

For further information concerning degree programs, requirements for a Ph.D. 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 (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 (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, and 157 as particularly appropriate to these programs.

**Master of Arts in Teaching (Mathematics)**

In cooperation with the School of Education, the Department offers a program leading to a degree, Master of Arts in Teaching (Mathematics). This degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish to further strengthen their academic preparation. Detailed requirements are outlined in this Bulletin under "School of Education, the Master of Arts in Teaching."
SCHOOL OF HUMANITIES AND SCIENCES

MATHEMATICS

INTRODUCTORY AND UNDERGRADUATE COURSES

Introductory courses will be offered only if ten or more students enroll.

A. Algebra—Fundamental laws: negative and fractional powers; quadratic equations, curve plotting, logarithms, binomial theorem, complex numbers.

3 units, autumn, winter, (———), MTWThF 10 or 2:15

C. Plane Trigonometry—Trigonometric functions; identities, equations; solution of right triangles, oblique triangles, including use of logarithms; applications to practical problems; De Moivre's theorem. Continuation in course depends upon student's passing a qualifying examination given during first week of course and covering algebra.

3 units, autumn, winter, (———) MTWThF 10 or 2:15

#1. Elementary Mathematical Analysis I—Structure of the real number system; logic of algebra; fundamental concepts of geometry. No credit allowed if taken after courses numbered 10 or higher.

3 units, 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 plane 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 8, 10, 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 8, 10, 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
winter, (—), MWF 8 or 12
spring, (—), MWF 9, 11, 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 or 2:15
winter, (—), MTWThF 12

#42. Analytic Geometry and Calculus—Continuation of 41.

5 units, winter, (—), MTWThF 8, 9, or 10
spring, (—), MTWThF 12

#43. Analytic Geometry and Calculus—Continuation of 42. Improper integrals, Simpson's Rule, determinants, simultaneous equations, hyperbolic functions, inverse hyperbolic functions, polar coordinates, polar curves, angle between radius vector and tangent line, areas, parametric equations, vector components, differentiation of vectors, tangential and normal acceleration, space coordinates, vectors, scalar product, planes and lines in space, space curves, cylinders and quadric surfaces, functions of several variables, partial derivatives, tangent plane, chain rule for partial derivatives, differential equations of first order (homogeneous, linear), special second order differential equations, l'Hospital's rule. Prerequisite: 42.

5 units, autumn, (—), MTWThF 12
winter, (—), MTWThF 8, 9, or 10
spring, (—), MTWThF 12

#44. Advanced Calculus I—Infinite series, convergence tests, parallel topics on improper integrals. Uniform convergence. Power series, Fourier series. Prerequisite: 23 or 43 or concurrent registration in 23 or 43 and consent of instructor.

3 units, autumn, (—), MWF 8, 9, or 1:15
winter, (—), MWF 12
spring, (—), MWF 9 or 11

#45. Advanced Calculus II—Vectors in the plane and space, linear dependence, inner product, wedge product, vector product. Geometry of lines and planes. Vector functions of one variable, curves and motion. Scalar functions of several variables, gradient, partial derivatives, differentials, extreme values, line integrals. Prerequisite: 44 or concurrent registration in 44 and consent of instructor.

3 units, winter, (—), MWF 8, 9, or 1:15
autumn, (—), MWF 9 or 11

#46. Advanced Calculus III—Multiple integrals, vector functions of several variables, divergence theorem, Stokes' theorem. Curvilinear coordinate systems, differential geometry of surfaces. Vector spaces of higher dimension. Prerequisite: 45.

3 units, winter, (—), MWF 9 or 11
spring, (—), MWF 8 or 9

#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.
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

114a. Linear Algebra and Matrix Theory—The study of the algebraic properties of matrices and their interpretation in geometric terms. The relationship between the algebraic and geometric points of view and matters that are fundamental to the study and solution of linear equations are dealt with. Topics include: Fields, linear equations; vector spaces, linear dependence, bases and coordinate systems; linear transformations and matrices, rank and nullity, equivalence, congruence.
3 units, autumn, (———), MWF 9; (———), MWF 1:15
winter, (———), MWF 10; (———), MWF 1:15
summer (———)

114b. Linear Algebra and Matrix Theory—Continuation of 114a. A deeper study of the algebra of matrices. Topics include: Similarity and characteristic values; inner products, orthogonal and Hermitian matrices; orthogonal congruence and the reduction of quadratic forms.
3 units, winter, (———), MWF 9
spring, (———), MWF 10

115. Fundamental Concepts of Analysis—Rigorous treatment of real numbers, limits, function, continuity, differentiability, integral, infinite series, other infinite processes. Especially recommended for students who intend to take graduate work in mathematics.
3 units, autumn, (———), MWF 11; (———), 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, ( ), MWF 2:15

124. Theory of Probability—Continuation of 123.

3 units, spring, ( ), MWF 2:15

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, ( )


3 units, winter, ( ), MWF 8, 11, or 2:15
spring, ( ), MWF 10


3 units, spring, ( ), MWF 9, 11, or 2:15

136. Use of Automatic Digital Computers—(Enroll in Computer Science 136.)

137. Numerical Analysis—(Enroll in Computer Science 137.)

138. Numerical Analysis—(Enroll in Computer Science 138.)

139. Intermediate Computer Programming—(Enroll in Computer Science 139.)

142. Higher Geometry—Homogeneous and projective coordinates with applications; projective correspondence in forms of one dimension; involution; projective correspondence in forms of two dimensions; collineations, their classification; correlation, polarity; projective, affine, metric properties of conics.
Alternate years, to be given in 1965-66

143. Topics in Geometry—Discussion of the various geometries and the axiom systems which characterize them; the concept of betweenness and the axiom of Pasch; Desargues's theorem and the introduction of coordinates; consequences of the metric axioms; elliptic, Euclidean, and hyperbolic planes. Prerequisites: 120 and 142.

Alternate years, to be given in 1965-66

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 1964-65

160a. Symbolic Logic—Propositional and restricted predicate calculi. Validity,
provability, consistency, completeness, definability, decision problems for these calculi. (Enroll in Philosophy 160a.)

3 units, winter, (Tait), MWF 1:15

160b. Symbolic Logic—Continuation of 160a. (Enroll in Philosophy 160b.)

3 units, spring, (Tait), MWF 2:15

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), MWF 1:15

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, (———), MWF 2:15

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, (Royden), MWF 9
205b. 3 units, winter, (Royden), MWF 9
205c. 3 units, spring, (Royden), MWF 9

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, (Schiffer), MWF 10
206b. 3 units, winter, (Schiffer), MWF 10
206c. 3 units, spring, (Schiffer), 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, (———), MWF 1:15
210b. 3 units, winter, (———), MWF 1:15
210c. 3 units, spring, (———), 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, winter, (Hawley), MWF 4:15


3 units, autumn, (Osserman), MWF 11


3 units, winter, (Osserman), MWF 11


3 units, spring, (Osserman), MWF 11
218a, b. Introduction to Differential Analysis—An introductory course in
analysis on manifolds, including structures on manifolds defined by pseudogroups and
deforation of these structures, existence of local coordinates for these structures,
differential operators in manifolds. No background in these subjects required.
   218a. 3 units, winter, (Spencer), MWF 1:15
   218b. 3 units, spring, (Spencer), MWF 1:15
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, (Levine), MWF 2:15
   220b. 3 units, winter, (Levine), MWF 2:15
   220c. 3 units, spring, (Levine), MWF 2:15
221a. Calculus of Variations — Euler-Lagrange equations, sufficient conditions;
applications to eigenvalue problems, geometry, mechanics; direct methods, Dirichlet’s
principle.
   3 units, winter, (Latta), MWF 1:15
230a, b. Advanced Probability—Fundamental concepts, limit law theorems, weak
and strong laws of large numbers, convergence theorems, martingales, second order
processes, processes with independent increments. (Enroll in Statistics 230a, b.) Prereq:
230a. 3 units, winter, (Miller), MWF 10
   230b. 3 units, spring, (Miller), MWF 10
232a, b, c. Topics in Stochastic Processes — Foundations of general Markoff
processes, additive functionals and the relevant potential theory.
   232a. 3 units, autumn, (Chung, Getoor), MW 11:00-12:15
   232b. 3 units, winter, (Chung, Getoor), MW 11:00-12:15
   232c. 3 units, spring, (Chung, Getoor), MW 11:00-12:15
236a, b. Advanced Computer Programming—(Enroll in Computer Science
236a, b.)
237a, b, c. Advanced Numerical Analysis—(Enroll in Computer Science 237
a, b, c.)
239. Computer Laboratory—(Enroll in Computer Science 239.)
242. Analytic Number Theory—Dirichlet’s series, Riemann’s zeta function, the
prime number theorem. Remainder terms and further classical theory of the zeta
function. Prerequisite: 206a.
   3 units, spring, (Havilcy), MWF 4:15
249. Transform Theory—Selected topics from classical transform theory includ-
ing Fourier, Laplace, Hankel, Mellin, Lebedeff transforms with applications to bound-
dary value problems. Prerequisite: 206b.
   3 units, spring, (Latta), MWF 1
250a, b. Theory of Approximation—Norms and inequalities. Linear manifolds of
vectors. Theorems of Weierstrass, completeness. Theorem of Müntz. Best approx-
imation. Polynomials of Chebychev and Zolotarev. Inequalities of A. Markov and S.
Bernstein. Prerequisite: 116 or equivalent.
   250a. 3 units, autumn, (Szegő), MWF 3:15
   250b. 3 units, winter, (Szegő), MWF 3:15
251a, b. Fourier Analysis in Several Variables—An introduction to some of the
ideas and techniques such as weak type, the Marcinkiewicz interpolation theorem, and
singular integral operators used in current research. These will then be applied to the
study of selected topics taken from recent work of Zygmund, Calderon, Stein, etc.
Prerequisites: 205 and 206.
   251a. 3 units, autumn, (Hirschman), TTh 9:30-10:45
   251b. 3 units, winter, (Hirschman), TTh 9:30-10:45
252a, b. Orthogonal Polynomials—Definition and principal properties of orthog-
onal polynomials with particular references to special classes and problems of importance in probability and mathematical statistics.

252a. 3 units, autumn, (Szegö), MWF 2:15
252b. 3 units, winter, (Szegö), MWF 2:15


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

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.

Alternate years, to be given in 1965–66


254a. 3 units, autumn, (Berg), MWF 11
254b. 3 units, winter, (Berg), MWF 11
254c. 3 units, spring, (Berg), MWF 11


261a. 3 units, autumn, (Phillips), TTh 1:15–2:30
261b. 3 units, winter, (Phillips), TTh 1:15–2:30
261c. 3 units, spring, (Phillips), TTh 1:15–2:30

272a, b. Topics in Fluid Dynamics—Mathematical questions in the theory of viscous fluids.

272a. 3 units, spring, (Finn), MWF 1:15
272b. 3 units, summer, (Finn), MWF 1:15


3 units, winter, (Schiffer), TTh 11:00–12:15


Alternate years, to be given in 1965–66

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, (Samelson), MWF 9
283b. 3 units, winter, (Samelson), MWF 9

291a, b, c. Set Theory—Axiomatic set theory; cardinal and ordinal numbers; alter-
native axiomatizations, questions of consistency and independence. Prerequisite: 161 or consent of instructor.

Alternate years, to be given in 1965-66

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, (Tait), MWF 2:15
292b. 3 units, winter, (Tait), MWF 2:15
292c. 3 units, spring, (Tait), MWF 2:15

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.

293a. 3 units, autumn, (Shoenfield), TTh 2:00-3:15
293b. 3 units, winter, (Shoenfield), TTh 2:00-3:15
293c. 3 units, spring, (Shoenfield), TTh 2:00-3:15

360. Advanced Reading and Research.
   Any quarter, (Staff), by arrangement

   By arrangement

381. Seminar in Analysis.
   By arrangement

382. Seminar in Computer Science—(Enroll in Computer Science 382.)
   By arrangement

385. Seminar in Abstract Analysis.
   By arrangement

386. Seminar in Geometry and Topology.
   By arrangement

387. Seminar in Function Theory.
   By arrangement

   By arrangement

389. Seminar in Mathematical Biology.
   By arrangement

391. Seminar in Foundations of Mathematics.
   By arrangement

COMPUTER SCIENCE DIVISION

Director: George E. Forsythe
Professors: George E. Forsythe, John George Herriot, John McCarthy
Assistant Professors: Gene H. Golub, Niklaus E. Wirth
Affiliated Faculty: Robert Vernon Oakford (Professor of Industrial Engineering)

Offerings and Facilities

The Computer Science Division aims to acquaint students with the power and capabilities of automatic digital computers as revolutionary tools for research and operations in many different fields of human activity. In spite of the diversity of the applications, the methods of attacking problems with computers show a consider-
able unity, and computer science is concerned with the underlying principles. The field is still young, and the student will find many more questions than answers.

Since the solutions of many problems involve the execution of very large numbers of individual instructions, each of which is obeyed in a few microseconds, it is essential that the machines prepare their own instructions. Thus one of the basic problems of computer science is the design of languages for the description of algorithms and the preparation of translation programs for the generation of machine programs from the algorithms stated in the language. The Computer Science Division offers courses and carries on research in this area.

One use of computers is for the extension or simulation of human perceptual and cognitive activities in recognizing patterns, manipulating symbols, and solving problems. The Computer Science Division offers courses and carries on research in these areas, collectively known as "artificial intelligence."

Computer science also includes numerical analysis, the study of data processing, the design of computer systems, etc. The Division offers both beginning and advanced courses in numerical analysis, and is actively engaged in research in this area.

Courses in data processing are offered by the Industrial Engineering Department and in the Graduate School of Business. Computer system design is studied in the Electrical Engineering Department. Several other departments offer courses which are of interest to students of computer science.

In connection with its courses and research, the Division makes considerable use of the Computation Center. See the section, "Computation Center," in this Bulletin.

Students majoring in mathematics who wish to specialize in computer science should include Computer Science 136, 137, and 138 in their course of study. There is no Bachelor's degree in computer science.

There is no regular Ph.D. degree program in Computer Science. As described above, Ph.D. students specializing in Computer Science will frequently work for the Ph.D. in Mathematics. Some students in other departments may write Ph.D. dissertations under the supervision of members of the Computer Science Division.

If it seems appropriate, and if a student is especially well qualified, a special program may be arranged. (See "Graduate Division Special Programs" in this Bulletin.)

Master of Science

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin. The following are requirements of this Division for the Master of Science in Computer Science:

A candidate is expected to complete an approved course program of 45 units; at least 36 units will be in this Division, or in the Mathematics Department, or selected from relevant courses in such other departments as Statistics, Philosophy, Psychology, or Electrical Engineering. (See the list of suggested courses at the end of the course offerings in Computer Science below.)

As an undergraduate or graduate student he should have taken Mathematics 106, 114a, b, 115, 130, 131 and Computer Science 136, 137, 138, 139, or equivalent courses elsewhere. The candidate should take 6 units of Computer Science 239, Computer Science 236a, b or 237a, b or 238a, b, and 9 additional units of courses numbered 200 or above.

The candidate must have a 2.50 average in his course work and a 3.00 average in his courses taken in the Computer Science Division.

Course for Freshmen and Sophomores

CS5. Computer Programming for Engineers—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 com-
puters. The course is limited to freshman and sophomore students. Prerequisites: Mathematics A and C, or equivalents.

2 units, autumn, (———), WF 11
winter, (———), TTh 1:15
spring, (———), WF 11

Courses for Undergraduate and Graduate Students


In spring quarter, the section MWF at 11 is directed to students of social science and the humanities, and is closed to students of mathematics, engineering, or the physical sciences, and to students with prior experience in computing. Prerequisite for this section only: Mathematics A or C, or equivalent.

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

CS137. Numerical Analysis—This course and 138 are designed to acquaint seniors and graduate students of mathematics, science, and engineering with methods of solving technical problems on automatic digital computers. Problems discussed include numerical differentiation and integration, solution of linear and nonlinear equations and systems of equations, solution of differential equations, and approximation of functions. Introduction to the analysis of convergence and errors. Pitfalls in automatic computation and their remedies. Prerequisites: Mathematics 114a, 130, and CS136, or equivalents.

3 units, winter, (———), MWF 11; (Herriot), MWF 2:15

CS138. Numerical Analysis—Continuation of CS137. The instructor may occasionally give permission to take CS138 without CS137.

3 units, spring, (———), MWF 2:15


3 units, autumn, (Wirth), TTh 9:30-10:45
winter, (———), MWF 1:15

Courses Intended Primarily for Graduate Students

CS233. Topics in Numerical Analysis—Selected topics in numerical analysis. Prerequisite: CS138 or consent of instructor.

3 units, spring, (———), TTh 9:30-10:45

CS236a, b. Advanced Computer Programming—Selected topics from the theory and practice of devising languages for communication between men and digital computers, and constructing machine programs to translate among these languages, including construction of ALGOL translators and development of programming and operating systems for modern high-speed digital computers. Prerequisite: CS139 or consent of instructor.

CS236a. 3 units, winter, (Wirth), TTh 9:30-10:45
CS236b. 3 units, spring, (Wirth), TTh 9:30-10:45

CS237a, b. Advanced Numerical Analysis—Selected topics from the theory and practice of using automatic digital computers for: approximating arithmetic operations, approximating functions, solving systems of linear and nonlinear equations, computing eigenvalues, and solving ordinary and partial differential equations. Test-
ing of methods on a digital computer. Automation of methods. Prerequisite: CS138 or consent of instructor.

CS237a. 3 units, autumn, (Golub), MWF 2:15
CS237b. 3 units, winter, (———), MWF 2:15
CS237c. 3 units, spring, (———), MWF 2:15

CS238a, b, c. Selected Topics in Computer Science—In 1964–65 the following will be included: Autumn: Computing with symbolic expressions; the LISP language. Winter: A mathematical theory of computation. Spring: Artificial intelligence. Prerequisites: graduate standing and experience with some programming language.

CS238a. 3 units, autumn, (———), TTh 11:00–12:15
CS238b. 3 units, winter, (McCarthy), TTh 11:00–12:15
CS238c. 3 units, spring, (McCarthy), TTh 11:00–12:15

CS239. Computer Laboratory—Prerequisite: CS138 or CS139 (or equivalent). A substantial computational program is undertaken and written up.

Any quarter, (Staff), by arrangement

CS360. Advanced Reading and Research.

Any quarter, (Staff), by arrangement

CS382. Computer Science Seminar—There is ordinarily a section on numerical analysis and one on non-numerical aspects of computer science.

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

The following courses offered in other departments may be of interest to students of Computer Science:

Data Processing—See Industrial Engineering 110, 210, 257, 261, and 263.
Data Processing in Business Problems—See Business 367 and 368.
Linear Programming—See Statistics 255.
Statistical Inference in Economics—See Economics 272.
Advanced Statistical Methods in Psychology—See Psychology 250.
Organizational Behavior—See Psychology 213.
Mathematical Models in Behavioral Sciences—See Behavioral Sciences offerings.

Mathematical Logic—See Philosophy 160a, b.
Recursion Theory—See Philosophy 293a, b, c.
Theory of Automata—See Philosophy 162.
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.
Analog Computation—See Electrical Engineering 268.

MILITARY SCIENCE

Professor: David Y. Nanney (Colonel, Artillery)
Assistant Professors: 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 commission in the United States Army.
OBJECTIVE

The objective of the Army ROTC program is to produce junior officers who by their education, training and inherent qualities are suitable for continued development. The aim is to provide a basic military education and in conjunction with other University disciplines to develop individual character and attributes essential to an officer. The Army ROTC training is designed to develop and perfect the qualities of leadership required in both military and civilian life and to give the student an opportunity to reinforce his knowledge with actual practice in the techniques of leadership. In this respect, then, the ROTC is a training ground for tomorrow's leaders in the armed forces as well as in private enterprise and government.

PROGRAM OF STUDY

The program consists of a two-year basic course, a two-year advanced course and a six-week summer camp. The program includes 25 credit units, which are military in nature and are taught by officers of the U. S. Army. An additional 11 units required by the program are nonmilitary subjects selected by the student with the approval of the PMS within the general fields of Effective Communication, Science Comprehension, General Psychology, or Political Development and Political Institutions. 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, U.S. Army and national security, U.S. role in world affairs, military history, teaching principles, basic tactics, map reading, command and staff problems and procedures. For the first year the course consists of one classroom hour per week; and for the second year two classroom hours per week. Each of the last two years consists of two quarters of three classroom hours and one quarter of two classroom hours per week. Throughout the four years leadership laboratory is conducted one hour per week. Military science courses are accepted in lieu of the University physical education requirement and as fulfillment of the Group Activity requirement of the General Studies Program. Military science is not offered during the summer quarter. Extra-curricular activities on a voluntary basis are sponsored to develop cadet interests and to provide opportunity to apply principles of leadership, management and staff procedures.

Several awards for distinction are made each year to those who excel in the program.

DEFERMENT—DELAY

Students in the Army ROTC program are granted deferment from selective service induction. Furthermore this insures completion of schooling normally including graduate courses of study for advanced degrees before performing military service.

ENROLLMENT IN ROTC

Courses are open only to Stanford University men who are citizens of the United States and who meet the physical requirements. Students to be enrolled must be not less than 14 years of age, 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

A monetary allowance of approximately $27 per month for the last two years of the course is made to students in good standing. Uniforms and texts are supplied without cost.

ROTC SUMMER CAMP

Every student attends one six-week ROTC summer camp normally between the junior and senior academic year. The objective of camp training is to provide the ROTC student with practical experience in tactical, technical, and administrative subjects. Camp training is designed to supplement institutional instruction by providing students with applicatory type training which cannot be presented adequately at the University. During this training cadets receive pay and travel allowances.

COURSES

LEADERSHIP LABORATORY

Leadership laboratory is conducted on Tuesday from 3:15 to 4:15. Here, students have the opportunity to develop their ability to lead. Advancement to command positions in the cadet corps depends on demonstrated ability in leadership.

FIRST-YEAR COURSES

   1 unit, autumn

   1 unit, winter

   1 unit, spring

Each course normally has eight sections meeting at the following hours: (I) M 8; (II) M 9; (III) M 10; (IV) M 1:15; (V) M 2:15; (VI) M 3:15; (VII) T 10; (VIII) T 11.

SECOND-YEAR COURSES

   2 units, autumn
22. American Military History and Map and Aerial Photograph Reading—
American Military History continued. Basic principles of map reading.
2 units, winter

2 units, spring

Each course normally has five sections meeting at the following hours: (I) MW 10; (II) MW 1:15; (III) MW 2:15; (IV) TTh 10; (V) TTh 2:15.

THIRD-YEAR COURSES

131. Leadership and Military Teaching Principles—Basic problems in small unit leadership. Techniques of military instruction.
2 units, autumn

3 units, winter

133. Small Unit Tactics and Communications—Principles of offensive and defensive combat. Communications systems, procedures, and security. Counterinsurgency operations.
3 units, spring

Each course normally has five sections meeting at the following hours:
autumn, (I) TTh 8; (II) TTh 9; (III) TTh 11; (IV) TTh 1:15; (V) TTh 2:15
winter, spring, (I) TWTh 8; (II) TWTh 9; (III) TWTh 11; (IV) TWTh 1:15; (V) TWTh 2:15.

FOURTH-YEAR COURSES

3 units, autumn

3 units, winter

2 units, spring

Each course normally has three sections meeting at the following hours:
autumn, winter, (I) TWTh 9; (II) TWTh 12; (III) TWTh 1:15
spring, (I) TTh 9; (II) TTh 12; (III) TTh 1:15.

199. Command and Staff Procedures—Theory, practice in developing staff studies and military programs. Prerequisites: completion of basic course and permission of PMS.
1 unit, autumn, winter, spring, by arrangement
MODERN EUROPEAN LANGUAGES

Emeriti: Bayard Quincy Morgan, Kurt F. Reinhardt (Professors); Grace Knopp (Assistant Professor)

Executive Head: F. W. Strothmann
Associate Executive Heads: Aurelio Macedonio Espinosa, Jr., Cornelis H. van Schooneveld, Gertrude L. Schuelke


Associate Professors: Helmut R. Boeninger, Daniel C. McCluney, Jr., Isabel Schevill, Gertrude L. Schuelke, Ruth Hirsch Weir

Assistant Professors: Sarra Kliachko, William J. Lillyman, Walter F. W. Lohnes, Kurt Mueller-Vollmer, Lawrence L. Stalhberger, Elisabeth Stenbock-Fermor
Instructors: Herbert John Izzo, Gisela Luther, Rudolph Morgan. Acting: Edwin A. Hopkins, Luise A. Schipporeit

Lecturer: Nicholas S. Pashin

The Department accepts candidates for the degree of Bachelor of Arts, Master of Arts, and Doctor of Philosophy, and for certification as high school and junior college teachers. Special consideration is given to the needs of those who intend to make teaching their profession.

PROGRAMS OF STUDY

Bachelor of Arts

The degree of Bachelor of Arts may be taken in German, Russian, or Spanish.

Candidates must have completed the first- and second-year courses in reading, composition, and conversation (or their equivalent) offered in the language of their choice.

Candidates are expected to complete a minimum of 35 units, selected with the approval of their adviser, from courses numbered 100 and higher, designated G, R, or Sp. These 35 units must include:

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, R184 (or equivalent), 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 Sp120–126 may be used to satisfy major requirements.)

In addition to the 35 units mentioned above, students not enrolled in the Honors Program in Humanities (for a description see “Humanities—Special Programs” in this Bulletin) are to select with the help of their adviser a minimum of three general courses (9 units) in support of their major program.
Teaching Credentials

For information concerning the requirements for teaching credentials, consult the “School of Education” section of this Bulletin and the Credential Secretary, Room 43, School of Education.

Special Three-Year Master’s Degree Program for College Teaching of German

In addition to the regular major programs, the Department of Modern European Languages offers, with the support of the Ford Foundation, a special three-year Master of Arts program especially designed to prepare college teachers of German. Highly qualified students begin this program at the beginning of their junior year and continue for eleven consecutive quarters. Two of these quarters are spent at a German university. This program is planned to include sufficient course work in a second foreign language to equip the student with a minor teaching field. For information regarding eligibility, admission to the program, and special scholarships write to Professor Daniel C. McCluney, Jr., Program Director, Three-Year Master’s Degree Program, Office of the Dean, Graduate Division, Stanford University, Stanford, California.

Master of Arts in Teaching

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

Master of Arts: German

To be accepted as a candidate for the degree of Master of Arts, a student needs to establish that he has completed creditably either an A.B. degree with a major in German or an equivalent of this work. A working knowledge of Latin is also 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, enable him to follow a richer program during the required period of residence, and, in the event that he continue his studies, could shorten the time needed for completion of the Ph.D. degree.

The Departmental requirements for the completion of the Master-of Arts degree are given below:

I. 30 units of graduate work in the major field, to be distributed as follows:
   a) G201, G202. Advanced composition 4 units
   b) G249, G250. Proseminar and seminar 4 units
   c) Courses in philology or linguistics selected from G190, G205, G251-259 8 units
   d) Literature: G213; one course selected from G211, G212, G214, and G215; and an additional course numbered 180 or higher 10 units
   e) G299. A thesis (Individual Work) 4 units

II. 14 units of electives in support of the major, selections subject to the approval of the graduate adviser. With minor exceptions, these courses will be numbered 100 or higher.

III. A Departmental oral examination on completion of the required courses. The thesis will generally be nearing completion at this point.
A candidate for whom the Master of Arts is a terminal degree can complete the requirements in one year. If, however, he intends to continue with work toward the Ph.D. degree, he is advised to include in his Master's program certain requirements for the higher degree. This will result in a delay before completion of the Master's degree but will appreciably shorten the additional time needed for the doctorate.

**Doctor of Philosophy: German**

Students should read carefully the University regulations governing the conferring of this degree as described in the section "Degrees" in this Bulletin.

The Master of Arts degree is a prerequisite for admission to the program. Exceptions are made only for those students who have completed a substantial equivalent at a foreign university.

The complete program of course work leading to the doctorate falls within the range of 72 to 90 units of graduate work after the A.B. degree. The lower limit may reflect superior preparation on entry or private study not evident in registered units. The dissertation may be written either before or after the oral examination.

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:**

I. A working knowledge of Latin and a reading knowledge of one modern language other than English or German.

II. Course Work—The total Ph.D. requirement is measured by knowledge and not by units. The following statements may, however, serve as a guide for the selection of courses.

a) Regardless of his field of specialization, each student needs to take the courses (45 units) listed in this section or establish that he has already fulfilled the requirement.

1) G201, G202. Advanced composition 4 units
2) G205. Modern German 4 units
3) G213. German classicism 4 units
4) G211, G212, G214, G215. Literary and cultural history 16 units
5) G190, G251, G257, G258. Philology and applied linguistics 13 units
6) Two seminars beyond the A.M. requirement 4 units

b) A minimum of 25 additional units in elective courses in German language or literature numbered 200 or higher is required. It should be noted that this number can easily be increased for some students, while others who are more advanced on entry can apply part of the requirement to individual work for the dissertation.

c) Each candidate is to take a minimum of 18 units of advanced work either in a formal minor or in an area (such as history) other than that of German language or literature. Students enrolled in the Graduate Humanities Program fulfill this requirement automatically. Others are advised to plan a program with the help of the graduate adviser.

III. Candidates may specialize either in language or in literature. In either case, they will write a dissertation that embodies such results of research as would merit publication.
IV. A Departmental as well as a University oral examination is required.

V. Teaching experience is required of all candidates as a condition to receiving the Ph.D. degree. Teaching assistantships are available to help candidates fulfill this requirement, which may be waived only for those students who have had teaching experience in other institutions. All prospective teachers are advised 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) R184. Advanced composition .......................... 3 units
   b) Graduate seminar ...................................... 2–4 units
   c) Philology or general linguistics ......................... 8 units
   d) Three graduate courses in the history of Russian literature ... 9–12 units
   e) Thesis ...................................................... 4 units

II. Electives chosen with the approval of the student's adviser....... 13–18 units

Total .......................................................... 44 units

Doctor of Philosophy: Slavics

Candidates are not obliged to present a minor but they are urged to offer one. A minor in a second language is strongly recommended. If it is in French, German, or Spanish, it should be equivalent to the course requirements for the degree of Master of Arts.

Candidacy:

Candidates should read carefully the general regulations governing the conferring of this degree, as described in the section “Degrees” in this Bulletin. For specific Departmental requirements and recommendations, the student should consult with his adviser. No student is accepted as a candidate until he has completed the equivalent of the training represented by the requirements for the Master of Arts degree as described above.

General Requirements:

All candidates, regardless of their field of specialization, are expected to fulfill these requirements.

1. Have a working knowledge of Latin and a reading knowledge of French and German. Knowledge of the modern languages must be demonstrated by passing 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.

Specialization:

Candidates in Slavic Languages and Literatures specialize either in linguistics or literature. Candidates who specialize in linguistics must complete the amount of literary study required of candidates for the Master of Arts degree (i.e., three graduate courses in the history of literature, and one graduate seminar dealing with a literary problem). Candidates in literature must complete a minimum of 12 units in philology and linguistics.

Course Work:

Candidates for the Ph.D. degree should arrange their course work in such a way as to fulfill all requirements for their major and minor within nine quarters after receiving the A.B. degree. This can be done by enrolling for a minimum of 12 units per quarter. Candidates who enroll for less must expect a corresponding delay.

Master of Arts: Spanish

General Requirements:

No student is accepted for candidacy unless he has completed the equivalent of the training represented by the requirements for the A.B. degree in Spanish.

For the A.M. program in Hispanic American Studies, see under Institute of Hispanic American and Luso-Brazilian Studies.

Course Requirements:

I. A working knowledge of Latin.
II. 30 units of graduate-level work, to be distributed approximately as follows:
   a) Sp201, Sp202. Advanced composition and grammar ............... 5 units
   b) Sp249 and Sp250 or Sp251; or HAS250. Graduate proseminar and/or seminar ........................................... 5 units
   c) Courses in philology or linguistics selected from L180, Sp190, Sp205, Sp260 or Sp261 ............................................. 8 units
   d) Two graduate courses in the history of Spanish and Spanish-American literature ................................................. 8 units
   e) Thesis ........................................................................ 4 units

III. Advanced or graduate courses dealing with Spain or Hispanic America other than in the fields of language and literature .............................................. 8 units
IV. Electives in Spanish, Hispanic American Studies or related fields, chosen with the approval of the student's adviser, to bring the total to 44 units.

Doctor of Philosophy: Spanish

Students should read carefully the University regulations governing the conferring of this degree as described in the section "Degrees" in this Bulletin.

No student is accepted for candidacy unless he has completed the equivalent of the requirements for the Master of Arts degree in Spanish, as described above.

For the Ph.D. program in Hispanic American Studies, see under Institute of Hispanic American and Luso-Brazilian Studies.
Requirements:

All candidates for the Ph.D. degree in Spanish must fulfill the following requirements:

1. Have a working knowledge of Latin and a reading knowledge of French and Portuguese (or Italian). This knowledge must be demonstrated by passing a Departmental examination (preferably by the end of the first year of graduate work).

2. Pass a preliminary examination in the history of Spanish and Spanish American literature and in the essentials of the political and cultural history of the Hispanic world. This examination should normally be taken shortly after completion of the work for the A.M. degree.

3. Pass the final Departmental oral and written examinations, and the University oral examination, along the following lines:
   a) The principles of general and descriptive linguistics.
   b) The history of the Spanish language, and the outlines of the history of the other Romance languages.
   c) The history of Spanish and of Spanish American literature.
   d) The political and cultural history of the Hispanic world, with specialization in approved areas.

4. Write a dissertation that embodies such results of research as would merit publication.

5. 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.

Specialization:

Candidates for the Ph.D. degree in Spanish specialize in one of the following fields: Spanish literature; Spanish American literature; philology and linguistics; or Hispanic American Studies. In addition to specializing in one of these fields, all candidates must complete a substantial amount of work (normally, at least three advanced or graduate courses) in each of the other three fields. Those specializing in Hispanic American Studies will work out a program in agreement with the Institute of Hispanic American and Luso-Brazilian Studies.

Minor:

1. Candidates are not obliged to present a minor, but they are urged to offer one. A minor in a second language or Hispanic American Studies is strongly recommended. A minor in these fields is equivalent to the course requirements for the degree of Master of Arts.

2. Candidates who do not elect a formal minor and are not enrolled in the Graduate Humanities Program are required to take a substantial amount of work in a related minor field. If the minor field selected is French, German, or Russian, the amount of work completed should total not less than 18 units, or equivalent, of advanced work (including Fr113, G113, or R113). If the minor field selected is Hispanic American Studies, a minimum of three quarters of HAS250 is required.

Graduate Program in Humanities

The Department of Modern European Languages participates in the Graduate Program in Humanities leading to a joint Ph.D. degree. For a description of that program, and fellowships offered in connection with it, see the section “Humanities (Special Programs)” in this Bulletin.

Hispanic American Studies

The attention of students majoring in Spanish (A.B., A.M., or Ph.D) is called to the possibility of qualifying for a special certificate by working for four quarters on
the *Hispanic American Report* (HAS250). For details about this program, consult the Institute of Hispanic American and Luso-Brazilian Studies.

**Intensive Language Work in European Study Centers**

Each student accepted by the Committee on General Studies for work at a Stanford center in France, Germany, or Italy will complete twelve units of Intensive French, German, or Italian during the six months of his residence abroad. The intensive work is oriented to the development of the student's individual ability to understand, speak, write, and read French, German, or Italian. All courses regardless of the level at which the work is completed bear the designation Fr, G, It80, with the successive levels, the lowest 2 and the highest 6, indicated as second digit. Assignment to a particular level is made by the director of each center.

**COURSES OPEN TO ALL STUDENTS**

The courses in this section do not require a knowledge of any language other than English. Students desiring German, Russian, or Spanish language credit for these courses must secure the permission of the Department and do the assigned readings in German, Russian, or Spanish.

**A. General Courses**

#A142. The Theological Novel of Modern Europe—Lectures, discussions on theological problems in works of Dostoevsky, Bloy, Mauriac, Greene, Waugh, C. S. Lewis, Le Fort, Werfel, etc.

3 units, winter, ( ), MWF 9
   summer, (Reinhardt), MTWTh 10

A150. Introduction to the Critical Reading of Literature.

3 units, autumn, (Mueller-Vollmer), M 2:15-4:05 and Th 2:15

A185. Existentialism in Modern Thought and Literature—Problems of human existence in the works of Pascal, Kierkegaard, Nietzsche, Heidegger, Jaspers, Rilke, Kafka, Camus, Marcel, Caruso, etc.

3 units, summer, (Reinhardt), alternate years, to be given in 1965-66

A199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor.

1 to 3 units, each quarter, (Staff), by arrangement

**AG. German**

#AG75. Goethe's Faust—Lectures in English, reading of *Faust* in translation. Not open to freshmen.

3 units, alternate years, to be given in 1965-66

AG101. Contemporary German Civilization—Background and contemporary trends in German civilization, including major aspects of German cultural, political, social, and economic life. Given only at Stanford in Germany.

2 units, summer, winter, (Staff)

AG102. Contemporary German Civilization—A continuation of AG101. Given only at Stanford in Germany.

2 units, autumn, spring, (Staff)

AG156. Brecht—Representative works in English translation.

3 units, spring, (Sokel), MWF 9

AG181. Nietzsche—Life and works, considered in relation to contemporary German thought and culture.

3 units, alternate years, to be given in 1965-66

AG183. Thomas Mann—Major works in both fiction and essay in English translation.

3 units, autumn, (Boeninger), alternate years, to be given in 1965-66
AP. AND AR. POLISH AND RUSSIAN

AP150. Introduction to Polish Civilization and Culture.
2 units, spring, (Stahlberger), TTh 9

AR145. Russian Literature—Russian literature of nineteenth century up to and
including Tolstoy in English translation. Open to all students except freshmen.
5 units, winter, (Posin), MTWThF 11

AR151. Fedor Dostoevsky.
4 units, autumn, (Stenbock-Fermor), MWF 9

AR153. Leo Tolstoy—Chief works of fiction in English translation. Open to all
students except freshmen.
4 units, winter, (Stahlberger), MWF 9

AR162. Modern Russian Literature—Social and literary scene and personali-
ties from end of nineteenth century to present. Open to all students except freshmen.
4 units, spring, (Posin), MTWTh 10

AR191. Russian Civilization—Geography and history; peoples and institutions;
religion and philosophy; language and literature; art and music. Open to all students
except freshmen.
5 units, autumn, (Posin), MTWThF 11

AS. SPANISH

AS75. Don Quixote in Translation—Reading, interpretation of Don Quixote.
3 units, spring, (Schevill), alternate years, to be given in 1965–66

AS150. Unamuno and Ortega—Present-day conflicts in literary works of Una-
muno, 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, winter, (Schevill), alternate years, to be given in 1965–66

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), MWF 2:15

AS156. Introduction to Mexican Culture—Mainly Mexican folkways, but also
illustrated lectures on fine arts, arts and crafts.
2 units, (——), alternate years, to be given in 1966–67

Note—For other courses in the civilization of Spain and Latin America see under
Hispanic American Studies.

G. GERMAN COURSES

FIRST- AND SECOND-YEAR

[Under the direction of Walter F. W. Lohnes]

Note—Students registering for the first time in a first- or second-year course must
take a placement test if they have had any work in German before entering Stanford.

#G1. First-Year German.
4 units, autumn, winter, spring, (Staff)

#G1a. First-Year German (Special Course)—This course covers material simi-
lar to that of G1, but with additional emphasis on oral-aural skills. Enrollment
limited.
4 units, autumn, winter, (Staff)

#G2. First-Year German—Continuation of G1.
4 units, autumn, winter, spring, (Staff)
#G2s. First-Year German (Special Course)—Prerequisite: G1s or permission of Department.
4 units, winter, spring, (Staff)

#G3. First-Year German—Continuation of G2.
4 units, autumn, winter, spring, (Staff)

#G3s. First-Year German (Special Course)—Prerequisite: G2s or permission of Department.
4 units, 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), MTWThF 8
summer, (Staff), MTWThF 8 or 9

Note—Students wishing to stress speaking and writing in addition to reading are advised to take G52, G53, and G54.

#G22. Second-Year Reading—Prerequisite: G3.
3 units, autumn, winter, 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. Reading material corresponds to that of G22. A grade of B in G3 (or equivalent) required for admission. Students electing this course may not take G22 and G24. Enrollment limited to 15.
5 units, autumn, (Staff), MTWThF 8, 9, or 1:15

#G53. Second-Year German—Continuation of G52. Level of reading material corresponds to that of G23. 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 9 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 9 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, university 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, (______), MWF 9
MODERN EUROPEAN LANGUAGES

G110. German Pronunciation—Prerequisite: G22.
3 units, winter, (———), MWF 9; (Luther), MWF 2:15

G111. Third-Year German Composition—Prerequisite: G54 or equivalent.
2 units, autumn, (———), TTh 9; (Luther), TTh 2:15

G112. Third-Year German Composition— Continuation of G111.
2 units, winter, (———), TTh 9; (Luther), 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, (Luther), MTThF 12

#G131. Masterworks of German Literature—The Classical Period. Prerequi-
site: G23 or G53.
4 units, autumn, (———), MTWTh 10

#G132. Masterworks of German Literature—Romanticism and Poetic Realism.
Prerequisite G23 or G53.
4 units, spring, (Lillyman), MTWTh 10

#G133. Masterworks of German Literature—From Naturalism to the Present.
Prerequisite: G23 or G53.
4 units, winter, (Sokel), MTWTh 10

#G142. The German Novelle—Reading and discussion of representative Novellen
of the nineteenth and twentieth centuries. Prerequisite: G23 or G53.
4 units, spring, (McCluney), alternate years, to be given in 1965–66

#G144. Goethe.
3 units, autumn, (Schipporeit), MWF 11

#G150. Schiller.
3 units, alternate years, to be given in 1965–66

#G158. Die deutsche Lyrik.
3 units, (Lillyman), MWF 3:15

#G165. Kafka.
3 units, spring, (Sokel), MWF 2:15

ADVANCED AND GRADUATE

#G180. The Dramas of Kleist, Grillparzer, and Hebbel.
4 units, autumn, (Sokel), MTThF 3:15

#G181. Der moderne Roman—Thomas Mann, Musil, Döblin, Broch u.a.
4 units, spring, (Boeninger), alternate years, to be given in 1965–66

#G182. Das moderne Drama—Wedekind, Hoifmannsthail, Kaiser, Brecht u.a.
3 units, autumn, (Lohner), alternate years, to be given in 1965–66

#G184. Goethe's Faust.
4 units, spring, (Lohner), TF 4:15-6:05

G185. History of the German Language.
2 units, autumn, (Schuelke), TTh 2:15

G188. Adalbert Stifter, Gottfried Keller und Conrad Ferdinand Meyer.
3 units, winter, (Lohnes), MTTh 2:15

G190. German Applied Linguistics—Phonology and Morphology. (Same as Edu-
cation 287.)
2 units, autumn, (Politzer), TTh 11

#G195. Moderne Lyrik—Von Nietzsche bis Celan.
3 units, winter, (Mueller-Vollmer), alternate years, to be given in 1965–66

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 GERMAN AND GERMAN LITERATURE

G200. Methods of Teaching German—(Same as Education 291.)
4 units, spring, (Lohnes), MTTh 4:15-6:05

G201. Advanced Composition and Grammar—Prerequisite: qualifying examination.
2 units, autumn, (Schipporeit), M 4:15-6:05

2 units, winter, (Schipporeit), M 4:15-6:05

G205. Modern German—The syntax of modern German.
4 units, winter, (Strothmann), MTWTh 11

G211. Deutsche Literatur- und Kulturgeschichte I—Das Mittelalter.
4 units, autumn, (Strothmann), alternate years, to be given in 1965-66

G211a. Einzelprobleme I—Frühneuhochdeutsch.
3 units, autumn, (Schuelke), MWF 2:15

G212. Deutsche Literatur- und Kulturgeschichte II—Von Luther bis Lessing.
4 units, winter, (———), alternate years, to be given in 1965-66

3 units, winter, (Lohner), TWTh 3:15

4 units, winter, (Lohner), TTh 4:15-6:05

4 units, spring, (Mueller-Vollmer), MTWTh 11

3 units, autumn, (Lohner), alternate years, to be given in 1965-66

4 units, autumn, (Sokel), TF 4:15-6:05

3 units, alternate years, to be given in 1965-66

G230. Methoden der Literaturwissenschaft—New approaches to literary criticism.
2 units, spring, (Mueller-Vollmer), alternate years, to be given in 1965-66

2 units, autumn, (Mueller-Vollmer), Th 4:15-6:05

G250. Graduate Seminar—Subject to be announced in Time Schedule.
2 units, autumn, (Mueller-Vollmer), W 4:15-6:05
winter, (Sokel), W 4:15-6:05

spring, (Lohner), W 4:15-6:05

G251. Gothic and Historical German Grammar—Development of Germanic languages; reading of selected texts from the Gothic Bible.
3 units, autumn, (Schuelke), MTWThF 10

G253. Old Norse.
4 units, spring, (Schuelke), MTWTh 2:15

G255. Old Saxon.
2 units, alternate years, to be given in 1965-66

G257. Old High German.
2 units, winter, (Schuelke), alternate years, to be given in 1965-66

G258. Middle High German.
4 units, spring, (Schuelke), MTWTh 10

G259. Advanced Middle High German.
4 units, spring, (Schuelke), alternate years, to be given in 1965-66
G299. Individual Work—Exclusively for graduate students in German working on thesis or engaged in special work.
   1 to 12 units, each quarter, (Staff), by arrangement

L. LINGUISTICS COURSE

L180. An Introduction to General Linguistics—A survey of the fields of phonemics, morphology, linguistic geography, and related areas.
   2 units, autumn, (Weir), to be given in 1965-66

P. PORTUGUESE COURSES

[Under the direction of Ronald Hilton]

P11. Elementary Portuguese—Intensive course primarily for social scientists, students specializing in Hispanic American literature, civilization. Cannot be taken to fulfill General Studies language requirements. Prerequisite: knowledge of Spanish or French.
   4 units, autumn, ( ), MTWF 12

   4 units, winter, ( ), MTWF 12

   4 units, spring, ( ), MTWF 12

P99. Individual Reading—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

Note—For advanced Portuguese and courses in Luso-Brazilian studies, see under Hispanic American Studies.

R. RUSSIAN AND SL. SLAVIC COURSES

FIRST- AND SECOND-YEAR

[Under the direction of Elisabeth Stenbock-Fermor]

#R1. First-Year Russian.
   4 units, autumn, spring, (Staff)

#R2. First-Year Russian—Continuation of R1.
   4 units, autumn, winter, (Staff)

#R3. First-Year Russian—Continuation of R2.
   4 units, winter, 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, (Stenbock-Fermor), MTWTh 8

#R22. Second-Year Reading—Prerequisite: R3.
   3 units, autumn (Staff)

#R23. Second-Year Reading—Continuation of R22.
   3 units, winter, (Staff)

R27. Russian Conversation—May be taken twice for credit.
   2 units, winter, ( ), by arrangement

   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. Reading material corresponds to that of R22. A grade of B in R3 (or equiva-
SCHOOL OF HUMANITIES AND SCIENCES

Third- and Fourth-Year

R100. Third-Year Russian Conversation—Course may be repeated for credit. Prerequisite: R54 or equivalent.
3 units, winter, (Pashin), MWF 11
R110. Russian Pronunciation—Prerequisite: R23 or equivalent.
3 units, spring, (Pashin), MWF 10
R111. Third-Year Russian Composition—Prerequisite: R54 or equivalent.
2 units, autumn, (Pashin), TTh 10
R112. Third-Year Russian Composition—Continuation of R111.
2 units, winter, (Pashin), TTh 9
R113. Third-Year Russian Composition—Continuation of R112.
2 units, spring, (Pashin), TTh 9
#R131. The Russian Novel—Prerequisite: R23.
4 units, winter, (Stenbock-Fermor), MWF 10
#R132. The Russian Short Story—Prerequisite: R23.
4 units, autumn, (Pashin), MTWTh 11
#R133. The Russian Drama—Prerequisite: R131 or equivalent.
4 units, spring, (Stenbock-Fermor), MWF 9
#R134. Russian Epic and Lyrical Poetry—Prerequisite: R23.
4 units, alternate years, to be given in 1965–66

Advanced and Graduate

#R181. Russian Literature from the Eleventh to the Seventeenth Century.
4 units, autumn, (Stahlberger), MTWTh 9
#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
R184. Advanced Russian Composition and Conversation.
4 units, autumn, (Stenbock-Fermor), MTWTh 10
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

SL201. Synchronic Phonology, Morphology, and Syntax of Russian I.
3 units, autumn, (van Schooneveld), MWF 2:15
SL202. Synchronic Phonology, Morphology, and Syntax of Russian II.
3 units, winter, (van Schooneveld), MWF 2:15
SL203. *Synchronic Phonology, Morphology, and Syntax of Russian III.*
2 units, autumn, (van Schooneveld), alternate years, to be given in 1965-66

SL204. *Synchronic Phonology, Morphology, and Syntax of Russian IV.*
3 units, winter, (van Schooneveld), alternate years, to be given in 1965-66

SL211. *Old Church Slavonic I.*
3 units, autumn, (van Schooneveld), alternate years, to be given in 1065-66

SL212. *Old Church Slavonic II.*
3 units, winter, (van Schooneveld), alternate years, to be given in 1965-66

SL214. *Old Church Slavonic Literature.*
2 units, autumn, ( ), alternate years, to be given in 1965-66

SL221. *Diachrony of East Slavic and Readings in Old Russian I.*
3 units, autumn, (van Schooneveld), TTh 2:15

SL222. *Diachrony of East Slavic and Readings in Old Russian II.*
3 units, winter, (van Schooneveld), TTh 3:15

SL226. *Diachrony and Synchrony of South Slavic.*
2 units, winter, (van Schooneveld), TTh 2:15

SL227. *Diachrony and Synchrony of Western Slavic.*
2 units, winter, (van Schooneveld), alternate years, to be given in 1965-66

SL228. *Divergence of Slavic Languages.*
2 units, autumn, (van Schooneveld), alternate years, to be given in 1965-66

SL231. *The Early History and Culture of the Slavs.*
2 units, winter, (Stahlberger), TTh 9

SL250. *Graduate Seminar in Linguistics—Subject announced in Time Schedule.*
2 units, autumn, ( ), by arrangement

2 units, spring, ( ), alternate years, to be given in 1965-66

2 units, spring, (Stenbock-Fermor), TTh 10

3 units, autumn, ( ), every third year, to be given in 1966-67

SL277. *Gogol.*
3 units, spring, (Posin), MWF 9

SL278. *Tolstoy.*
3 units, autumn, ( ), every third year, to be given in 1965-66

SL279. *Dostoevsky.*
3 units, winter, ( ), every third year, to be given in 1965-66

SL281. *Comparative Slavic Mediaeval Literature.*
2 units, winter, (Stahlberger), alternate years, to be given in 1965-66

2 units, winter, (Stahlberger), alternate years, to be given in 1965-66

2 units, winter, (Stahlberger), TTh 10

SL299. *Individual Work—Exclusively for graduate students in Slavic working on thesis or engaged in special work.*
1 to 12 units, each quarter, (Staff), by arrangement

SL300. *Graduate Seminar in Literature—Subject to be announced in Time Schedule.*
2 units, spring, (Stahlberger), M 2:15-4:05

**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

Note—Students wishing to stress speaking and writing in addition to reading are advised to take Sp52 and Sp53 instead of Sp22 and Sp23.

#Sp22. Second-Year Reading—Aims primarily at reading ability. Prerequisite: Sp3.
3 units, autumn, 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 development of Latin America. For 3 units, reading of Américo Castro's *Iberoamérica*, and training in the understanding of talks in Spanish. For the 4th unit, reading of Spanish-language newspapers under the supervision of *Hispanic American Report* staff. An alternative to Sp23. Prerequisite: Sp22, with a grade of B or better.
3 to 4 units, autumn, winter, spring, (Hilton), 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. Reading material corresponds to that of Sp22. Grade of B in Sp3 (or equivalent) required for admission. Students electing this course may not take Sp22 and Sp24. Enrollment limited to 15.
5 units, autumn, (Staff), MTWThF 9 or 1:15

#Sp53. Second-Year Spanish—Continuation of Sp52. Level of reading material corresponds to that of Sp23 or Sp23a. Students electing this course may not take Sp23, Sp23a, Sp25, and Sp27. 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, summer, (Staff), by arrangement,
MODERN EUROPEAN LANGUAGES

THIRD- AND FOURTH-YEAR

Sp100. Advanced Spanish Conversation—May be repeated for credit. Prerequisite: Sp28 or equivalent.
3 units, winter, (Schevill), MWF 3:15

Sp110. Spanish Pronunciation—Prerequisite: Sp22.
3 units, autumn, (Izzo), TTh 11 and one hour by arrangement

Sp111. Third-Year Spanish Grammar and Composition—Prerequisite: Sp53 or equivalent (Sp23 or Sp23a plus Sp25).
3 units, autumn, (Rael), MWF 9 or 11

Sp112. Third-Year Spanish Composition—Prerequisite: Sp11 or equivalent.
2 units, winter, (Rael), TTh 8 or 9

Sp113. Third-Year Spanish Composition—Continuation of Sp112.
2 units, spring, (Rael), TTh 8 or 9

#Sp120. Readings in Current Periodicals—Readings in Spanish language newspapers and journals to familiarize students with the structure of Latin American society and the language in which that society is described. It is of special interest for social science majors and those planning to work on the Hispanic American Report. Students who wish to take this course to satisfy General Studies requirements should take it for four units. Prerequisite: Sp23 (Sp23a is recommended) or equivalent.
3 to 4 units, each quarter, (Hilton), MWF 9

#Sp121. Hispanic American Cultural Readings—The life of Simón Bolívar. For 3 units, reading of Campos Menéndez, Se llamaba Bolívar, and training in the understanding of talks in Spanish. For the 4th unit, reading of Spanish-language newspapers under the supervision of Hispanic American Report staff. Students wishing to take this course to satisfy General Studies requirements should take the course for four units. Prerequisite: Sp23 (Sp23a is recommended) or equivalent.
3 to 4 units, autumn, winter, (Hilton), MWF 10

#Sp122. Hispanic American Cultural Readings—The life of José Vasconcelos. For 3 units, reading of selections of autobiography, in Spanish, and training in the understanding of talks in Spanish. For the 4th unit, see under Sp121. Prerequisite: Sp23 (Sp23a is recommended) or equivalent.
3 to 4 units, spring, summer, (Hilton), MWF 10

#Sp125. Spanish Cultural Readings—Training in careful reading of books with significant cultural content. Prerequisite: Sp23 or Sp53 or equivalent.
4 units, autumn, (Rael), MTWTh 1:15

#Sp126. Cervantes—Reading and interpretation of selected passages from Don Quijote and the Novelas ejemplares. Prerequisite: Sp23 or equivalent.
4 units, spring, (Izzo), MTWTh 11

#Sp131. Masterworks of Spanish Literature I—From its origins to end of fifteenth century. Prerequisite: Sp23 or equivalent.
3 to 4 units, spring, (Espinosa), alternate years, to be given in 1965–66

#Sp132. Masterworks of Spanish Literature II—Sixteenth and seventeenth centuries. Prerequisite: Sp23 or equivalent.
3 to 4 units, (Espinosa), alternate years, to be given in 1965–66

#Sp133. Masterworks of Spanish Literature III—From 1700 to 1898. Prerequisite: Sp23 or equivalent.
3 to 4 units, winter, (Espinosa), MWF 10

#Sp134. Modern and Contemporary Spanish Literature I—The Generation of 1898. Prerequisite: Sp23 or equivalent.
3 to 4 units, autumn, (Schevill), MWF 10

#Sp135. Modern and Contemporary Spanish Literature II—Outstanding writers of present-day Spain. Prerequisite: Sp23 or equivalent.
3 to 4 units, autumn, (Schevill), alternate years, to be given in 1965–66

#Sp142. The Spanish Novel of the Nineteenth Century.
3 to 4 units, spring, (Gullón), MWF 1:15
# Sp143. The Spanish Romantic Drama.
3 to 4 units, winter, (Izzo), MWF 11

# Sp151. Masterworks of Spanish-American Literature I—Prerequisite: Sp23 or equivalent.
3 to 4 units, spring, (———), alternate years, to be given in 1965-66

# Sp152. Masterworks of Spanish-American Literature II—Prerequisite: Sp23 or equivalent.
3 to 4 units, spring, (———), MWF 10

ADVANCED AND GRADUATE

# Sp180. Lope de Vega, Tirso y Calderón—Estudio e interpretación de cuatro o cinco comedias representativas.
3 to 4 units, spring, (Espinosa), MWF 11

# Sp182. Teatro español contemporáneo.
3 to 4 units, spring, (Schevill), alternate years, to be given in 1965-66

Sp184. Spanish Dramatics—Reading, staging of a Spanish play. May be repeated for credit. Prerequisites: Sp100 and Sp112 and permission of instructor.
3 to 4 units, winter, (Schevill), TTh 4:15-6:05

# Sp186. Literatura hispanoamericana I—General introduction to Spanish-American Colonial literature; literature of Cuba, Venezuela. Open only to graduate and advanced undergraduate students.
3 to 4 units, autumn, (Rael), MWF 8

# Sp187. Literatura hispanoamericana II—Literature of Bolivia, Chile, Colombia, Ecuador, Peru. Open only to graduate and advanced undergraduate students.
3 to 4 units, winter, (Rael), MWF 8

# Sp188. Literatura hispanoamericana III—Literatures, cultural history of Argentina, Uruguay. Open only to graduate and advanced undergraduate students.
3 to 4 units, autumn, (———), alternate years, to be given in 1965-66

# Sp189. Literatura hispanoamericana IV—Cultural history of Mexico, representative writers. Open only to graduate and advanced undergraduate students.
3 to 4 units, winter, (———), alternate years, to be given in 1965-66

Sp190. Spanish Applied Linguistics—Phonology and Morphology. (Same as Education 283.)
2 units, autumn, (Politser), TTh 3:15

Sp199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit. Open only to majors in Spanish.
1 to 3 units, summer, (Staff), by arrangement

Note—For other courses see under Hispanic American Studies.

GRADUATE COURSES IN SPANISH AND SPANISH LITERATURE

Sp200. Methods of Teaching Spanish—(Same as Education 292.)
3 units, winter, (Morgan), MWF 3:15

Sp201. Advanced Composition and Grammar—Translation of connected English prose into Spanish; original compositions; dictation. Prerequisite: qualifying examination.
3 units, autumn, (Schevill), MWF 3:15

2 units, winter, (Schevill), by arrangement

Sp205. Modern Spanish—The syntax of modern Spanish.
3 units, spring, (Espinosa), MTWTh 2:15

Sp211. Historia de la literatura española I—From the origins to 1500.
4 units, spring, (———), alternate years, to be given in 1965-66

Sp212. Historia de la literatura española II—Sixteenth and seventeenth centuries.
4 units, winter, (Espinosa), MTWTh 11
MODERN EUROPEAN LANGUAGES

SP213. Historia de la literatura española III—Desde 1700-hasta 1850.
4 units, autumn, (Espinosa), MTWTh 11

SP214. Historia de la literatura española IV—Desde 1850 hasta 1923.
4 units, autumn, (Schevill), alternate years, to be given in 1965-66

4 units, winter, (Gullon), TTh 2:15-4:05

SP217. Teatro español del Siglo de Oro.
4 units, autumn, (Espinosa), alternate years, to be given in 1965-66

SP218. Renaissance Prose and Mysticism.
3 units, autumn, (———), alternate years, to be given in 1965-66

SP220. Cervantes.
4 units, winter, (Espinosa), alternate years, to be given in 1965-66

SP223. La novela española moderna.
3 to 4 units, winter, (Schevill), alternate years, to be given in 1965-66

SP224. La novela hispanoamericana.
3 units, spring, (———), alternate years, to be given in 1965-66

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

SP228. La poesía española contemporánea.
3 to 4 units, spring, (Gullón), MWF 3

SP230. Hispanic Folklore.
3 units, (Espinosa), every third year, to be given in 1965-66

SP232. The Spanish Epic Tradition.
3 units, (Espinosa), every third year, to be given in 1965-66

SP240. Spanish Versification.
2 units, winter, (Espinosa), every third year, to be given in 1966-67

SP249. Proseminar: Bibliography and Introduction to Research.
2 units, winter, spring, (Staff), by arrangement

SP250. Graduate Seminar in Spanish Literature—Subject announced in Time Schedule.
3 to 4 units, winter, (Gullón), W 2:15-4:05

SP251. Graduate Seminar in Spanish-American Literature—Subject announced in Time Schedule.
3 to 4 units, spring, (Rael), Th 2:15-4:05

SP260. History of the Spanish Language.
3 units, spring, (Espinosa), alternate years, to be given in 1965-66

SP261. Old Spanish—Elements of phonology, morphology; reading of Old Spanish texts.
3 units, autumn, (Espinosa), MWF 2:15

SP263. Historical Spanish Linguistics I—Prerequisite: SP260 or 261.
3 units, spring, (Espinosa), MWF 10

SP264. Historical Spanish Linguistics II.
3 units, spring, (Weir), alternate years, to be given in 1965-66

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.

Note—For other courses see under Hispanic American Studies.

T. TEACHER TRAINING COURSES
[Under the direction of Ruth H. Weir]

T200. Use of the Language Laboratory—(Same as Education 295.)
2 units, autumn, (Morgan), W 7-9 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

TS252. Spanish for Elementary Teachers—For those intending to teach Spanish in elementary schools. Pronunciation of Spanish; its basic vocabulary, grammar, syntax. Prerequisite: Sp3 or equivalent.
6 units, summer, (Staff), MTWThF 9 and MWF 1

6 units, summer, (Staff), MTWThF 9 and MWF 1

TS300. Seminar in the Development of Instructional Materials and Techniques.
4 units, summer, (Staff), MTWThF 3

See also Senior Colloquia.

MUSIC

Emeritus: Warren Dwight Allen (Professor)

Executive Head: William Loran Crosten
Professors: Putnam Calder Aldrich, William Loran Crosten, Wolfgang Erasmus Kuhn, Herbert Boswell Nanney, Leonard Gilbert Ratner, Sandor Salgo, Harold Carl Schmidt
Associate Professor: Leland Clayton Smith (on leave 1964-65)
Assistant Professor: George Louis Houle
Director of Bands: To be announced
Music Librarian: Edward Eugene Colby
Lecturers: Earle Blew (Piano), Charles R. Bubb (Brass Instruments), Marjorie Chauvel (Harp), Raymond Herbert Duste (Oboe), Lloyd Gowen (Flute), Ivan Burdette Rasmussen (Voice), Joseph Schuster (Violoncello)

OFFERINGS AND FACILITIES

The Department's aims are to promote understanding and enjoyment of music in the University at large and to provide specialized training for those who plan careers in music as teachers, composers, performers, or research scholars.

Excellent facilities for practice are available in Stanford's new Music Building, which also includes a well-equipped modern theater for concert and operatic productions. In addition to practice pianos and a practice organ, rare instruments from the Harry R. Lange Historical Collection may be used by qualified students.

The Departmental library contains a comprehensive collection of complete editions, scores, books, and records. Supplementing this is the Stanford Memorial Library of Music, which is an invaluable collection of musical manuscripts and first editions.

PROGRAMS OF STUDY

Bachelor of Arts

Undergraduate major—Prospective music majors are required to take an examination for the purpose of determining their proficiency in musical performance.

The following Departmental courses and proficiencies are required in addition to the University's basic requirements for the Bachelor's degree:
I. Theory of Music: 21, 22, 26, 121, 122
II. Music History: 100, 101, 102, 103, 104
III. Musical Performance:
   a) All students are required to demonstrate a minimum proficiency in piano
      which will include sight-reading as well as playing two prepared pieces on
      the order of an easier Chopin Prelude or a Clementi Sonatina. This re-
      quirement should be fulfilled as early as possible and not later than the be-
      ginning 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 de-
      gree of proficiency in solo performance may petition for exemption from
      this requirement.) Assignments to particular teachers will be made on the
      basis of auditions.
IV. Musical Repertory:
   Supplementing the detailed study of individual compositions in the music his-
   tory 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.
V. Listening and Reading Skills:
   The student's ability to hear and perform music accurately at sight will be
   checked by two examinations, the first to be passed before entering Music 121,
   the second to be passed 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:
   I. Music Literature: Music 1 and any two other courses in music history or
      literature given by the Department.
   II. Theory of Music: Music 21 and 22.
   III. Musical Performance: At least three consecutive quarters of (a) individual
      study, and (b) ensemble.
      (Note—The music minor may not enroll for individual vocal or instrumental instruc-
      tion 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 de-
veloping 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 undergrad-
uate courses in music.
   A faculty sponsor will be assigned to each student who is selected, and an inde-
pendent study program totaling 9–12 units will be planned to extend over the senior
year. This work may be centered on composition, musical research or musical per-
formance.
   An Honors Program in Humanities is offered for undergraduate majors in this
Department who wish to supplement their Departmental major by a related and care-
fully guided program of studies. See Humanities (Special Programs) for a descrip-
tion of the Honors Program.
SAMPLE SCHEDULE FOR FOUR-YEAR A.B. PROGRAM WITH MAJOR IN MUSIC

**First Year**

<table>
<thead>
<tr>
<th>Course No. Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1, 2, 3.</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Language 1, 2, 3. (if completed, substitute Western Civ.)</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Music 21, 22, 26. Elements of Music and Counterpoint</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Ensemble (Music 160, 161, 162, 163, 165, 166 or 171)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 172. (Individual Vocal or Instrumental Instruction)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Group activities</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Electives (optional)</td>
<td>—</td>
<td>3 and/or 3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
<td>14-17</td>
<td>14-17</td>
</tr>
</tbody>
</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course No. Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language 22, 23.</td>
<td>3</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>History 1, 2, 3. Western Civ.</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Music 100, 101, 102. History and Literature</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Music 121, 122. Advanced Harmony</td>
<td>—</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Ensemble</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 172.</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Group activities</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Course No. 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>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Social Science</td>
<td>5</td>
<td>—</td>
<td>5</td>
</tr>
<tr>
<td>Music 103, 104. History and Literature</td>
<td>4</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Elective in Music History or Literature (optional)</td>
<td>—</td>
<td>—</td>
<td>4</td>
</tr>
<tr>
<td>Additional A.B. requirement (i.e., language reading or Phil. 3)</td>
<td>—</td>
<td>4-5</td>
<td>—</td>
</tr>
<tr>
<td>Ensemble (optional)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 172. (optional)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15</td>
<td>14-15</td>
<td>15</td>
</tr>
</tbody>
</table>

**Fourth Year**

<table>
<thead>
<tr>
<th>Course No. Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional science</td>
<td>3-5</td>
<td>3-5</td>
<td>—</td>
</tr>
<tr>
<td>Senior Colloquia</td>
<td>2</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>Senior Honors Program in Music or Electives in music (optional)</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Electives in Humanities</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Ensemble (optional)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 172. (optional)</td>
<td>2</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></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,</td>
<td>Instrumental Classes</td>
<td>1</td>
<td>(1)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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,</td>
<td>Instrumental Classes</td>
<td>(1)</td>
<td>1</td>
<td>(1)</td>
</tr>
<tr>
<td>85, 86.</td>
<td></td>
<td></td>
<td></td>
<td></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</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>
</tbody>
</table>

Proficiency examinations must be taken in piano, voice, and conducting.

### GRADUATE DEGREES IN MUSIC

The following statements apply to all the graduate degrees described below, unless otherwise indicated.

Applicants for admission to graduate study should possess a well-rounded general education as well as sound basic training in the theory, history, and performance of music. An entrance test will be given each applicant as a measure of his ability 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. Although the A.B. is the normal antecedent to the A.M. degree, persons holding the Bachelor of Music degree may be admitted to Stanford subject to the possibility that they may be asked to do extra work in humanistic fields outside music. Admission
to any of the concentrations listed below requires permission of the faculty adviser in that area.

To be recommended for the A.M. degree, a candidate must complete a program of 40 units based on the graduate courses offered by the Department and must pass a comprehensive examination. The recommended programs for the different concentrations are indicated below.

### I. Concentration in Musical Research:

<table>
<thead>
<tr>
<th>Units</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Music 200. Music Bibliography</td>
</tr>
<tr>
<td>3</td>
<td>Music 221. History of Music Theory</td>
</tr>
<tr>
<td>4</td>
<td>Music 229. Tonality and Structure</td>
</tr>
<tr>
<td>4</td>
<td>Music 240. Seminar in Music History and Analysis (two quarters)</td>
</tr>
<tr>
<td>4</td>
<td>Music 299. Master of Arts Project</td>
</tr>
<tr>
<td>3-6</td>
<td>Ensemble (three quarters)</td>
</tr>
<tr>
<td>12-15</td>
<td>Electives</td>
</tr>
</tbody>
</table>

Foreign Language—Demonstrate a reading knowledge of French, German, or Italian, and a comprehension of the principal musical terms encountered in the selected language. This test will be given before the student's initial registration.

### II. Concentration in Composition:

<table>
<thead>
<tr>
<th>Units</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Music 200. Music Bibliography</td>
</tr>
<tr>
<td>3</td>
<td>Music 221. History of Music Theory</td>
</tr>
<tr>
<td>8</td>
<td>Music 223. Seminar in Composition (two quarters)</td>
</tr>
<tr>
<td>4</td>
<td>Music 240. Seminar in Music History and Analysis</td>
</tr>
<tr>
<td>4</td>
<td>Music 299. Master of Arts Project</td>
</tr>
<tr>
<td>3-6</td>
<td>Ensemble (three quarters)</td>
</tr>
<tr>
<td>12-15</td>
<td>Electives</td>
</tr>
</tbody>
</table>

Foreign Language—Same as under Concentration in Musical Research

### III. Concentration in Music Education:

<table>
<thead>
<tr>
<th>Units</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Music 200. Music Bibliography</td>
</tr>
<tr>
<td>4-8</td>
<td>Advanced Studies in Performance or Conducting</td>
</tr>
<tr>
<td>4</td>
<td>Music 240. Seminar in Music History and Analysis</td>
</tr>
<tr>
<td>4</td>
<td>Music 280. Seminar in Music Education</td>
</tr>
<tr>
<td>4</td>
<td>Music 281. Administration and Supervision of Public School Music</td>
</tr>
<tr>
<td>4</td>
<td>Music 299. Master of Arts Project</td>
</tr>
<tr>
<td>3-6</td>
<td>Ensemble (three quarters)</td>
</tr>
<tr>
<td>7-14</td>
<td>Electives</td>
</tr>
</tbody>
</table>

Foreign Language—Same as under Concentration in Musical Research

### IV. Concentration in Performance Practice:

<table>
<thead>
<tr>
<th>Units</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Music 200. Music Bibliography</td>
</tr>
<tr>
<td>4</td>
<td>Music 226. Advanced Counterpoint, or</td>
</tr>
<tr>
<td>4</td>
<td>Music 229. Tonality and Structure</td>
</tr>
<tr>
<td>4</td>
<td>Music 240. Seminar in Music History and Analysis</td>
</tr>
<tr>
<td>8</td>
<td>Studies in performance practice appropriate to the candidate's chosen instrument or voice (two quarters)</td>
</tr>
<tr>
<td>6</td>
<td>Music 272. Advanced Studies in Solo Performance</td>
</tr>
<tr>
<td>4</td>
<td>Music 299. Master of Arts Project</td>
</tr>
<tr>
<td>3-6</td>
<td>Ensemble (three quarters)</td>
</tr>
<tr>
<td>5-8</td>
<td>Electives</td>
</tr>
</tbody>
</table>

Foreign Language—Same as under Concentration in Musical Research

### V. Concentration in Conducting (Choral or Orchestral):

<table>
<thead>
<tr>
<th>Units</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Music 151. Studies in Choral Music, or</td>
</tr>
<tr>
<td>4</td>
<td>Music 153. Studies in Orchestral Music</td>
</tr>
</tbody>
</table>
Music 200. Music Bibliography .............................................. 3
Music 224 and 225. Solfege and Score Reading ......................... 8
Music 226. Advanced Counterpoint, or
Music 229. Tonality and Structure ........................................ 4
Music 230a, b. Advanced Orchestral Conducting, or
Music 231a, b. Advanced Choral Conducting ............................. 8
Music 240. Seminar in Music History and Analysis ..................... 4
Music 299. Master of Arts Project ......................................... 4
Ensemble (three quarters) .................................................. 3-6

Foreign Language—Same as under Concentration in Musical Research

Doctor of Education

In cooperation with the School of Education the Department offers work leading to the Doctor of Education degree with a concentration in music education. Students in this program normally will take about one-third of their work in Education and two-thirds in Music. General regulations covering this degree are discussed in the Manual on Advanced Graduate Degrees in Education, which may be obtained from the School of Education. The work in music education may center on curriculum 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 of music parallel to the musicological studies leading to the Ph.D. degree. Students may concentrate in composition, conducting, performance practice, or music education. Each concentration, however, will be given breadth through collateral studies in other branches of music and in relevant fields outside music. In all cases the work is planned especially with regard to possible careers in college or university teaching.

Enrollment in the D.M.A. program is limited and, except in the field of music education, preference will be given to applicants who are not over thirty years of age.

Admission—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 and theory of music as appear necessary on the basis of the placement and advisory examinations,
4. the teaching of music in college,
5. electives in the humanities (12 units),
6. final project or thesis.

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, culminating in the preparation and performance of four assigned works from different style periods. Two of these performances will be supplemented by written essays including stylistic analysis of the music in question, discussion of the
special performance problems that are involved, and detailed proposals for the solution of these problems. In all cases, particular effort is to be made to show the relationship between stylistic analysis and performance.

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) Conducting: a written analysis dealing with style and performance problems in a major composition, giving detailed proposals for the treatment of these problems. (3) Music education: a thesis based on independent research in the candidate’s field of specialization. (4) Performance practice: a written analysis dealing with style and performance problems in a major composition, giving detailed proposals for the treatment of these problems. A public lecture-demonstration of about one hour in length, and dealing with some aspect of his work, will be given by each candidate following the completion of his final project.

Foreign language requirements—All students are required to demonstrate (a) a reading knowledge of at least one foreign language chosen from French, German, or Italian, and (b) a knowledge of the common musical terms in all three of the above languages. This examination must be taken prior to the student’s first registration. A second language may be required if necessary to a particular concentration.

Departmental examinations—(1) An advisory examination will be given toward the end of the student’s first year in residence, to determine whether he will be recommended to continue work for the degree. (2) A final qualifying examination will 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 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) humanistic studies totaling 16 units outside the Department of Music.

Specialization—As soon as feasible the candidate will select the field of study in which he proposes to do independent research leading ultimately to the writing of a dissertation.
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 repertoires. 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 rhythm, melody, harmony to musical form. Written exercises in various textures, sight-reading, ear-training, analysis, elementary vocal and instrumental scoring, keyboard drill. Lectures and drill sections. Open to all students desiring basic technical knowledge of music. No prerequisite for Music 21 except ability to read music.

21. 4 units, autumn, (Nanney); winter, (Houle)
22. 4 units, winter, (Nanney); spring, (Houle)

26. Counterpoint—Prerequisite: 22.

4 units, autumn, spring, (Houle, Aldrich)

121, 122. Advanced Harmony—Chromatic harmony; harmonic materials of nineteenth and early twentieth centuries. Elementary orchestration and score reading. Prerequisite: 26 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, (—)

127. Orchestration—Prerequisite: 26 or equivalent.

3 units, autumn, (—)

221. History of Music Theory.

3 units, spring, (Ratner)

223. Seminar in Composition—May be repeated for credit.

4 units, any quarter, (—)
224, 225. Solfege and Score Reading.
   224. 4 units, winter, (Nanney)
   225. 4 units, spring, (Nanney)

   3 units, autumn, (Ratner)

227. Advanced Orchestration—Prerequisite: 127.
   3 units, winter, (———)

229. Tonality and Structure—Graduate review of harmonic functions; relation between details of progression and total structure.
   4 units, autumn, (Ratner)

History and Literature of Music

Unless otherwise stated, prerequisite for any course in this section is Music 22 or equivalent.

100. Medieval and Renaissance Music.
   4 units, autumn, (Houle)

   4 units, winter, (Aldrich)

102. Music of the Classic Period.
   4 units, spring, (Nanney)

   4 units, autumn, (Crosten)

104. Music of the Modern Period.
   4 units, winter, (———)

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, autumn, (Salgo)

   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)

Musical Performance

12. Introductory Piano.
   1 unit, autumn, winter, spring, (Blew)

172, 272. Vocal and Instrumental Instruction.
   2 units, autumn, winter, spring, (Staff)
   Before registering for any branch of this instruction, the student must obtain approval of the staff member in charge of the division in which he wishes to enroll.
MUSIC

172a, 272a. Keyboard Instruments (piano, organ, harpsichord).
   Piano, organ: Professor Nanney in charge
   Harpsichord: Professor Aldrich in charge

172b, 272b. Voice.
   Mr. Rasmussen in charge

172c, 272c. Stringed Instruments (violin, viola, violoncello, viola da gamba, contrabass, harp).
   Professor Salgo in charge

172d, 272d. Wind Instruments (flute, recorder, oboe, clarinet, bassoon, trumpet, horn, trombone).
   Professor Houle in charge

Note—A special fee of $40 per quarter is charged for enrollment in Music 12 or in any branch of 172 or 272.

130a. Orchestral Conducting—Prerequisite: 127.
   To be given in 1965-66

130b. Orchestral Conducting—Continuation of 130a.
   3 units, spring, (Salgo), to be given in 1965-66

131a. Choral Conducting.
   3 units, autumn, (Schmidt)

131b. Choral Conducting—Continuation of 131a.
   3 units, winter, (Schmidt)

169. Performance Practice.
   169a. Renaissance and Early Baroque.
      4 units, autumn, (Houle)
   169b. Eighteenth Century.
      4 units, winter, (Houle)
      4 units, spring, (Houle)

230a, b. Advanced Orchestral Conducting.
   230a. 4 units, autumn, (Salgo)
   230b. 4 units, winter, (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 7:30 p.m.

161. University Band—Autumn: marching band open only to men. Winter, spring: concert band open to both men, women.
   1 unit, autumn, winter, spring, (—), TTh 7:15 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
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)

166. Chamber Orchestra—Open to advanced players who have had orchestral experience.
1 unit, autumn, winter, spring, (Salgo)

1 unit, autumn, winter, spring, (Schmidt), T 7:00-8:30 and Th 4:15-5:30 p.m.

1 unit, autumn, winter, spring, (——)

171. Chamber Music—Open to any student with sufficient technical ability to play in combinations for strings, wind instruments, piano, harpsichord.
1 unit, autumn, winter, spring, (Salgo, Staff)

Music Education

83. Voice Class—For Secondary Credential Candidates.
1 unit, autumn, winter, spring, (Rasmussen)

84, 85, 86. Instrumental Classes for Secondary Credential Candidates.
84a. Strings.
1 unit, autumn, (Kuhn), to be given in 1965-66

84b. Strings—Continuation of 84a.
1 unit, winter, (Kuhn), to be given in 1965-66

85a. Woodwinds.
1 unit, winter, (——)

85b. Woodwinds—Continuation of 85a.
1 unit, spring, (——)

86a. Brass and Percussion.
1 unit, winter, (——), to be given in 1965-66

86b. Brass and Percussion—Continuation of 86a.
1 unit, spring, (——), to be given in 1965-66

280. Seminar in Music Education.
4 units, any quarter, (——)

281. Administration and Supervision of Public School Music.
4 units, (——)

4 units, autumn, (Rasmussen)

3 units, summer, (Kuhn)

2 units, autumn, (——)

2 units, winter, (——)

2 units, spring, (——)

380. The Teaching of Music in College.
4 units, spring, (Staff)
GRADUATE RESEARCH AND SPECIAL STUDIES

200. Music Bibliography—Use of bibliographical materials in graduate study; introduction to methods of research.
   3 units, winter, (Colby)

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, (Crosten)

301c. Doctoral Seminar in Musical Analysis—Continuation of 301b.
   4 units, spring, (—)

302. Doctoral Research in Musicology.
   Autumn, winter, spring, (Aldrich, Crosten, Ratner), by arrangement

321. Readings in Music Theory.
   3 units, (Aldrich, Ratner)

   Any quarter, (Aldrich, Crosten, Ratner), by arrangement

390. Tutorial—For Doctor of Musical Arts candidates.
   4 units, any quarter, (Staff)

399. Doctor of Musical Arts Project.
   Any quarter, (Staff), by arrangement

NAVAL SCIENCE

Executive Head: George F. Waters, Jr. (Colonel, USMC), Commanding Officer
Executive Officer: To be announced
Professor: George F. Waters, Jr. (Colonel, USMC)
Assistant Professors: Edward I. McQuiston (Lieutenant Commander, USN), Lawrence A. Bennigson (Lieutenant j.g., USN)

OFFERINGS AND FACILITIES

The Naval Science Department affords the opportunity for selected male students to receive instruction in essential Naval subjects which, in conjunction with a baccalaureate degree earned through undergraduate work in fields of their own choice, will qualify them for a commission in the U.S. Naval Service.

The Regular NROTC Midshipman is chosen in nation-wide competition and attends the University under Navy sponsorship. In addition to payment for tuition, books, and fees, he draws retainer pay of $50 per month. Contract NROTC students are selected by the Professor of Naval Science at the beginning of the academic year from among applicants of the incoming freshman class. During the last two years of their undergraduate work, Contract students are paid at the rate of $27 per month. Applicants for the Contract NROTC program should communicate directly with the Professor of Naval Science, Stanford University.
Upon successful completion of the required courses in Naval Science, together with the University requirements for a baccalaureate degree, NROTC students are appointed Ensigns and serve on active duty with the Fleet as commissioned officers. Qualified students who so desire may pursue Marine Corps professional studies during the last two years of attendance. Upon completion they may be appointed Second Lieutenants.

Regular Midshipmen must complete three summer cruises with Fleet units. Contract students must complete one such cruise, normally between their junior and senior years.

REQUIREMENTS FOR COMMISSIONING

1. All NROTC students must complete the entire sequence of Naval Science courses offered.
2. Regular NROTC Midshipmen must satisfactorily complete one year of college physics, including laboratory, by the end of their second year. Contract students should complete this requirement if their schedule permits.
3. Regular NROTC Midshipmen must satisfactorily complete one year of college mathematics by the end of their second year. Contract students must complete mathematics through trigonometry (in secondary school or college) prior to the end of their second year.
4. All NROTC students must satisfactorily complete Psychology 1 by the end of their sophomore year.
5. All NROTC students must take such instruction in swimming as is necessary to achieve proficiency equal to that of a First Class swimmer prior to graduation.
6. All NROTC students majoring in engineering who have completed Engineering 41, 41L, 42 and 42L and one of the following: 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.

3 units, autumn, (Staff), 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, (Staff), MWF 8 or 12; lab. Th 8 or 12

113. Evolution of Sea Power II—Continuation of 112.
3 units, spring, (Staff), 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, (Bennigson), 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, (Bennigson), 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, (Staff), MWF 10 or 12; lab. Th 10 or 12


3 units, winter, (Staff), MWF 10 or 12; lab. Th 10 or 12

313. **Naval Operations**—Maneuvering and screening instructions. Fleet communications and meteorology.

3 units, spring, (Staff), 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, (Staff), 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, (Staff), 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, (Staff), MWF 10 or 2:15; lab. Th 10 or 2:15

411. **Naval Machinery**—Application of thermodynamics to design, installation and operation of naval propulsion plants. Introduction to principles of nuclear reactors, problems of radiation shielding and instrumentation. Principles of stability, experimental determination of righting moment, metacentric height, list and trim.

3 units, autumn, (McQuiston), MWF 11 or 1:15; lab. Th 11 or 1:15

412. **Naval Machinery and Introduction to Naval Leadership**—Continuation of 411. Stress on preparation of Midshipmen for immediate assumption of command responsibilities upon graduation and commissioning.

3 units, winter, (McQuiston), 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, (McQuiston), 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, (McQuiston), 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, (Staff), MWF 11 or 1:15; lab. Th 11 or 1:15

412M. **Amphibious Warfare II**—Continuation of 411M.

3 units, winter, (Staff), MWF 11 or 1:15; lab. Th 11 or 1:15

413M. **Military Justice and Leadership**—Leadership principles in military organization. Purposes and administration of the uniform Code of Military Justice.

3 units, spring, (Staff), MWF 11 or 1:15; lab. Th 11 or 1:15

**Naval Science Laboratory**—Two hours a week of Naval Science Laboratory required of all NROTC students. Monday session held on Drill Field at 3:15 p.m. Thursday session practical work conducted in regular classroom.
PHILOSOPHY

Executive Head: Patrick Suppes
Director: Philip H. Rhinelander (Tutorial Program)
Associate Professors: David S. Nivison, Jeffery Smith
Assistant Professor: Richard C. Jeffrey (on leave 1964–65)

LOGIC DIVISION

Director: Dana S. Scott
Professors: Georg Kreisel. Visiting: Joseph Shoenfield
Associate Professors: Solomon Feferman (on leave 1964–65), Dana S. Scott
Assistant Professor: William Tait

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 described below and 24–39 units of regular course work. The course work shall include at least one course from each of the following groups of courses: Group A: 3, 157, 160, 161, 181; Group B: 2, 170, 172, 174, 177; Group C: 164, 168, 182, 184, 188, 189; and Group D: 100, 101, 102, 103, 104. Majors who do not take senior tutorial will select, in consultation with their Departmental advisers, a program of courses emphasizing one of the major areas of philosophy indicated by the four groups of courses. All majors will select, in consultation with their Departmental advisers, programs of courses outside the Department which will complement their major programs or enable them to further an interest in some other area of knowledge.
Philosophy courses taken in fulfillment of General Studies requirements may also be counted in fulfillment of Departmental requirements. Majors in philosophy must maintain at least a C average in their work in the Department.

**Tutorial Work**

The Department offers intensive tutorial instruction for qualified and interested juniors and seniors. Juniors whose grade point averages warrant, and who wish to, shall do 9 units total of tutorial work. This work shall consist of extensive reading in, and the writing of weekly essays on, important works of either Plato or Aristotle and either Hume or Kant. At the end of the year juniors will take a comprehensive examination, their performance on which, balanced by their written and oral performances in the tutorial session, shall determine both their grades for the year in tutorial and their qualification for participation in Senior Tutorial. Exceptions to this rule may be made in special cases, e.g., cases where the student has not had the opportunity to take Junior Tutorial. In such a case, the student must pass a comprehensive examination equivalent to the Junior Tutorial Examination with distinction.

Senior Tutorial involves 15 units total of tutorial work. For the academic year 1964-65 all students accepted for Senior Tutorial automatically become candidates for Departmental Honors. To achieve Departmental Honors, the Senior Tutorial Essay must be distinguished. Failing to attain Departmental Honors, a student may nevertheless qualify for Senior Tutorial credit.

**Combined Major in Classics and Philosophy**

Students may, with the consent of the Heads of departments concerned, offer for the degree of Bachelor of Arts a combined major in Classics (Latin and/or Greek) and Philosophy. Students interested in such a major should consult the Heads of each of the departments concerned.

**Honors Program in Humanities**

An Honors Program in Humanities is offered for philosophy majors who wish to supplement their Departmental work for the A.B. degree by a related carefully guided program of studies. See the section "Humanities (Special Programs)" for a description of the Honors Program.

**Honors Program in Behavioral Sciences**

Philosophy majors with a central interest in methodological problems may participate in an Interdepartmental Program in Quantitative Methods in the Behavioral Sciences. See the section "Behavioral Sciences (Honors Program) in Quantitative Methods" for a description.

**Advanced Degrees**

The members of the Department are prepared to direct and supervise individual study and research to supplement instruction offered in courses listed below. In addition, advanced seminars, unlisted in the catalog, are frequently organized in response to student interest. Candidates for advanced degrees are urged to discuss their entire program of study with 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—Candidates for the Ph.D. must pass written examinations in the following fields: ethics and theory of value; epistemology and metaphysics; the history of philosophy; and logic and the philosophy of science. These examinations of four hours each must be taken and passed as a group. They are normally taken toward the end of the first year of graduate work at Stanford; they may be taken a second time at the end of the second year. In special circumstances, an extension of time or permission to take the examination a third time may be granted.

Language Requirements—Candidates for the Ph.D. must demonstrate a reading knowledge of French and German. When it is relevant to a proposed dissertation topic, the department will give permission to substitute other modern languages, or ancient languages, for one or both of the required languages.

Dissertation—Upon passing the preliminary examinations the candidate will submit a brief written statement of his dissertation topic to the Department, and a committee will be appointed to direct the research for and writing of the dissertation. Departmental approval of the dissertation topic is required for formal admission to candidacy for the doctoral degree.

The dissertation must be submitted to the committee in substantially final form at least four weeks before the University deadline in the quarter during which the candidate expects to receive his degree.

Immediately after passing the preliminary examinations, the candidate will file a formal application for candidacy as prescribed by the University. Dissertations must be completed and approved within five years from the date of that application. A candidate taking more than five years will be required to reinstate his candidacy by repassing the preliminary examinations.

Oral Examination—The University oral examination is taken after completion of the dissertation. The oral examination is to be considered primarily as a defense of the dissertation, but it may range over related topics as well.
Graduate Fellowships and Assistantships

A number of fellowships, including those provided by the Weiss and Locke funds which are reserved for students of philosophy, are available to graduate students.

In addition, the department has four or five teaching assistantships which may be held separately or combined with additional scholarship funds. Teaching assistants are expected to devote about half their time to their teaching duties. There are sections taught by teaching assistants in Philosophy 2, 3, and 5.

Application forms for fellowships and teaching assistantships may be secured by writing the Office of Financial Aids; applicants for teaching assistantships should in addition address a specific request to the Director of Graduate Studies in Philosophy. In general, teaching assistantships are not offered to first-year graduate students. Students who do not intend to become candidates for the doctor's degree are ineligible for graduate fellowships and teaching assistantships.

Graduate Program in Humanities

The Department of Philosophy also participates in the Graduate Program in Humanities leading to the joint Ph.D. degree in Philosophy and Humanities. For a description of that program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)."

Graduate Program in Logic and Foundations of Mathematics

This program is intended to lead to a doctorate in mathematics, in philosophy, or in a field of study especially designed for the individual student, as circumstances may dictate. Candidates for the doctor's degree must meet the requirements of the department concerned. Students interested in a specially designed field of study should consult the section "Graduate Division Special Programs" in this Bulletin. For further information concerning this program, students should write Professor Dana Scott, Director, Division of Logic.

At the beginning graduate level there are courses in Theory of Automata (162), Intermediate Logic (160a, b), and Introduction to Set Theory (161), designed in such a manner as to permit the entering graduate student either to start his logical studies from scratch or, if he has had some previous logical training, to make up whatever deficiencies there may have been in it, with a view to bringing his level up to that required by the three basic groups of courses.

These three basic groups comprise a three-quarter sequence in Metamathematics (292a, b, c), a three-quarter sequence in Recursion Theory (293a, b, c), and a three-quarter sequence in Set Theory (291a, b, c). Students working for a Ph.D. under the Program will be required to take two quarters of each of these courses and three quarters of at least one. From time to time special courses may be offered as warranted by student interest. Satisfactory completion of graduate courses offered under the Program will be counted toward fulfilling the basic course requirements for a Ph.D. in either mathematics or philosophy.

The culmination of the Program is the Seminars. These will be given at a Ph.D. level. There will be one or two in 1964-65 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, (———), 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, (Suppes), MTWTh 2:15 and Th or F section |
| spring, (Scott), MTWTh 11 and Th or F section |
| summer, (Dummett), MTWThF 1:15 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, autumn, (Nivison), MTWTh 3:15 |

#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, (———), MTWTh F 10 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, autumn, (Rhinelander), MWF 10 |
| 6b. 3 units, winter, (Rhinelander), 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, winter, (Goheen), MTWTh 10 and Th or F section, to be given in 1965-66 |

21. Sophomore Proseminar 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, (Rhinelander), T 2:15-4:15 |
COURSES FOR ADVANCED UNDERGRADUATE AND GRADUATE STUDENTS

I. HISTORY OF PHILOSOPHY FROM ANCIENT TIMES TO THE PRESENT

100. Greek Philosophy—Characterization of historical situation in which Western science and philosophy began. Rise of critical thought. Early metaphysical speculation. Sophists and Socrates. Post-Socratic ethical schools. Philosophies of Plato, Aristotle, the Epicureans, the Stoics, and the Skeptics. Prerequisite: some general course in philosophy, such as 2, 5, or 10.
   4 units, autumn, (Mothershead), MTWTh 11

   4 units, winter, (Mothershead), 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, (———), MTWTh 1:15

106. Introduction to Philosophy—For graduate students. Lectures same as Philosophy 5.
   4 units, summer, (———), MTWThF 10 and Th or F section

II. COURSES IN THE PHILOSOPHY OF A PERIOD AND IN INDIVIDUAL PHILOSOPHERS

The following courses will be offered in 1964–65. 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

137. Seminar in the Philosophy of Plato—A study of selected dialogues. Prerequisite: 100 or equivalent.
   3 units, spring, (Goheen), by arrangement, to be given in 1965–66

140. The Philosophy of St. Thomas Aquinas.
   4 units, spring, (———), MTWTh 2:15, to be given in 1965–66

144. Seminar in the Philosophy of Spinoza—A study of the basic works of Spinoza.
   4 units, autumn, (Rihelander), TTh 2:15–4:05, to be given in 1965–66

145. The Philosophy of David Hume—Prerequisite: 102 or equivalent.
   4 units, spring, (Nivison), MTWTh 9, to be given in 1965–66
147. The Philosophy of Kant—An intensive examination of Kant's *Critique of Pure Reason*. Prerequisite: 102 or equivalent.
3 units, autumn, (Quinton), M 4:15–6:05

150. Seminar in the Philosophy of A. N. Whitehead.
3 units, spring, (Goheen), Th 4:15–6:05, to be given in 1965–66

3 units, autumn, (Tait), by arrangement

### III. Systematic Philosophy

Unless otherwise specified the prerequisite for the following courses is one course in philosophy or permission of the instructor.

156. Introduction to Ethics—For graduate students. Lectures same as Philosophy 2. Special section for graduate students.
4 units, winter, (———), MTWTh 1:15 and Th or F section

157a. Introduction to Logic—For graduate students. Lectures same as Philosophy 3.
5 units, autumn, (Suppes), MTWTh 2:15 and Th or F section
spring, (Scott), MTWTh 11 and Th or F section
summer, (Dummett), MTWThF 1 and Th or F section

3 units, winter, (———), MWF 10

164. Philosophy of Science—A study of conflicting accounts of the structure and methods of empirical science and of its connections with logic and mathematics, in the context of questions about probability, induction, observability, and measurability. Prerequisite: 3.
4 units, spring, (Suppes), 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 1:00–2:15

166. Probability and Induction—Development of the notions of probability and utility within an axiomatic theory of preference. Rational behavior and inductive inference. Inductive probability measures. Examination of alternative accounts of probability and induction. Prerequisite: consent of instructor.
3 units, winter, (———), MWF 10

168. Philosophy of History—Nature and limits of our knowledge of the past, the categories of explanation used by historians, and the aims of historical inquiry; relation of these problems to speculation about the “meaning” of history and the structure of historical process.
4 units, winter, (———), MTWTh 9

170. Theory of Value—Definitions of “value”; psychological and social conditions of different values; function of value judgments; nature of standards and their role in criticism—in art, science, morals. Foundations of the normative disciplines, i.e., logic, ethics, aesthetics. Prerequisite: 2 or permission of instructor.
4 units, autumn, (———), MTWTh 11

172. Proseminar in Ethical Theory—Analysis and class discussion of selected writings in contemporary ethical theory leading to short student papers to be read and discussed in class. Prerequisite: 2 or permission of instructor.
4 units, spring, (Mothershead), MTWTh 9, to be given in 1965–66

4 units, spring, (———), MTWTh 4:15
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, (Quinton), MTWTh 1:15

180. Philosophy of Religion—Critical inquiry into the nature and validity of religious experience, its unity and variety, its relation to other human interests.
4 units, spring, (Smith), MWF 9

4 units, autumn, (———), 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, (———), MTWTh 3:15

184. Theory of Knowledge—Systematic analysis of the central problems of epistemology. Idealism, phenomenalism, pragmatism, empiricism, realism as theories of knowledge will be discussed in the light of contemporary developments.
4 units, 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, (Armstrong), MTWTh 11

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.

191. Tutorial—Junior year.
3 units, each quarter, (Rhinelander, Staff), by arrangement

192. Ideas in Literature—This course will explore ways in which philosophical ideas receive literary expression. Readings in such authors as Homer, Greek dramatists, Augustine, Dante, Montaigne, Marlowe, Shakespeare, Milton, Wordsworth, Hardy, Kafka, Eliot, Joyce.
4 units, spring, (Davidson), MTWTh 1:15, to be given in 1965-66

194. Problems in Chinese Philosophy—In 1964-65 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, winter, (Nivison), MTWTh 2:15

196. Tutorial—Senior year.
5 units, each quarter, (Rhinelander, Staff), by arrangement

197. Individual Work for Undergraduates.
Each quarter, (Staff), by arrangement

199. Seminar in Recent Philosophical Literature—Open to junior and senior students with consent of instructor.
Topic: Explanation
3 units, spring, (Nivison), by arrangement

Topic: The Law of Excluded Middle
3 units, summer, (Dummett), by arrangement

202. Theory of Meaning—Theory of truth. Survey of positions of Frege, Quine, Church, Fitch, Carnap, Wittgenstein, Strawson, others. Analysis of belief sentences and modal sentences; Russell's theory of descriptions; problem of analyticity. Prerequisite: two courses in logic or permission of instructor.
4 units, spring, (Hintikka), 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, spring, (———), MWF 1:15

205. Philosophical Foundations of Quantum Mechanics—The course will center around problems in the foundations of quantum mechanics which have been considered philosophically important, such as the uncertainty principle, the status of causality, complementarity principle, the role of probability concepts and the need for a multi-valued logic. Various axiomatic formulations of classical quantum mechanics will also be discussed.
3 units, winter, (Suppes), MW 2:15 and one hour by arrangement

206. Mathematical Models in Behavioral Sciences: Measurement and Utility Theory—After a general introduction to the theory of models in the empirical sciences, the course will concentrate on the general theory of measurement and scaling. The last part of the course will deal with utility theory and related topics like subjective probability and decision criteria. (Same as Statistics 206.) Prerequisite: Mathematics 63 or equivalent.
3 units, autumn, (Suppes), TTh 3:15 and one hour by arrangement

207. Mathematical Models in Behavioral Sciences: Behavior Theory—Stimulus sampling and linear models for learning will receive the main emphasis. Modification of the basic models to deal with concept formation and perceptual problems will be discussed. (Same as Statistics 207.) Prerequisite: Mathematics 63 or equivalent.
3 units, winter, (Suppes), TTh 3:15 and one hour by arrangement

3 units, winter, (———, Davidson), M 8-10 p.m., to be given in 1965-66

240. Individual Work for Graduates.
Each quarter, (Staff), by arrangement

242. Seminar in the Philosophy of Science.
3 units, spring, (Suppes), Th 4:15-6:05

243. Seminar in Foundations of Mathematical Behavior Theory—(Same as Psychology 272.)
2 to 3 units, spring, (Estes, Suppes), M 3:15-5:05

244. Seminar in Metaphysics.
3 units, winter, (Armstrong), by arrangement

Each quarter, (Staff), by arrangement

299. Advanced Seminar in Recent Philosophical Literature.
Topic: Wittgenstein's Investigations
3 units, winter, (———), by arrangement
Topic: History of Philosophical Ideas.
3 units, spring, (Hintikka), by arrangement

IV. THE GRADUATE PROGRAM IN LOGIC

160a. Symbolic Logic—Propositional and restricted predicate calculi. Validity, provability, consistency, completeness, definability, decision problems for these calculi.
3 units, winter, (Tait), MWF 1:15

160b. Symbolic Logic—Continuation of 160a which is prerequisite.
3 units, spring, (Tait), MWF 1:15

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), MWF 1:15
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), TTh 1:00-2:15

291a. **Set Theory**—Axiomatic set theory; cardinal and ordinal numbers; alternative axiomatizations, questions of consistency and independence. Prerequisite: 161 or consent of instructor.

3 units, autumn, ( ), TTh 1:00-2:15, to be given in 1965-66

291b. **Set Theory**—Continuation of 291a which is prerequisite.

3 units, winter, ( ), TTh 1:00-2:15, to be given in 1965-66

291c. **Set Theory**—Continuation of 291b which is prerequisite.

3 units, spring, ( ), TTh 1:00-2:15, to be given in 1965-66

292a. **Metamathematics**—Formalized first-order theories. Validity and decidability. Model theory. Completeness and decidability of various algebraic theories. Incompleteness and undecidability of elementary number theory and various extensions. Introduction to the Hilbert consistency problem, Gödel's theorem, cut-free proofs. The final quarter will discuss more advanced topics as the interests of the instructor and students warrant. Prerequisite: 160b or consent of instructor.

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

292b. **Metamathematics**—Continuation of 292a which is prerequisite.

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

292c. **Metamathematics**—Continuation of 292b which is prerequisite.

3 units, spring, (Tait), MWF 2:15

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, (Shoenfield), TTh 2:00-3:15

293b. **Recursion Theory**—Continuation of 293a which is prerequisite.

3 units, winter, (Shoenfield), TTh 2:00-3:15

293c. **Recursion Theory**—Continuation of 293b which is prerequisite.

3 units, spring, (Shoenfield), TTh 2:00-3:15

391a. **Seminar in Foundations of Mathematics.**

*Autumn, ( ), by arrangement*

391b. **Seminar in Foundations of Mathematics.**

*Winter, (Kreisel), 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.
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, (Alvarez-Tostado), TTh 8 or 9; lab. by arrangement
2. 3 units, winter, (Alvarez-Tostado), TTh 8 or 9; lab. by arrangement
3. 3 units, spring, (Alvarez-Tostado), TTh 8 or 9; lab. by arrangement

#50. Modern Astronomy—A review of current concepts and ideas regarding the nature of the solar system, galaxy, and extragalactic systems; essentially nonmathematical discussion of the basis for these concepts. Telescopic observations if possible.

3 units, spring, (Perkins), MWF 11

#100. Physical Science and Modern Life—Review of important conclusions, theories of modern physical science; discussion of methods, values, limitations of scientific inquiry; survey of relations of science to technology, economics, sociology, philosophy, religion. Prerequisite: junior or senior standing.

3 units, winter, (Krauskopf), MWF 11

140. Electron Tubes in Research—Elementary study of electron tubes, their characteristics and application to control, measurement. Emphasis on applications, particular attention to photo tube, d.c. amplifier circuits. Prerequisite: Physics 23, or equivalent.

3 units, autumn, (Alvarez-Tostado), alternate years, to be given in 1964–65


Any quarter, (Staff)
Emeriti: Joseph Grant Brown, Paul Harmon Kirkpatrick, David Locke Webster
(Professors)

Executive Head: Leonard Isaac Schiff
Proffessors: Felix Bloch, Marvin Chodorow, William Martin Fairbank, Edward Leonard Ginzton (on leave), Stanley Sweet Hanna, Robert Hofstadter, Walter Ernst Meyerhof, Calvin Forrest Quate, Arthur Leonard Schawlow, Leonard Isaac Schiff, Peter Andrew Sturrock
Associate Professors: William Arthur Little (on leave 1964–65), David Mark Ritson, Marshall Scott Sparks, John Dirk Walecka
Assistant Professors: Sam Manly Austin (on leave 1964–65), Philip Raymond Bevington, Frank Chilton, Frank Sigel Dietrich, Carl Kenneth Iddings, Arthur Wesley Martin III, Robert James Oakes, Richard Prepost, Peter Leslie Scott, Gordon Lionel Shaw, Mason Russell Yearian

OFFERINGS AND FACILITIES

The new Russell H. Varian Laboratory of Physics, the adjacent Physics Lecture Hall, and the nearby W. W. Hansen Laboratories of Physics (High Energy Physics Laboratory, Microwave Laboratory, and Biophysics Laboratory) form a closely related complex housing a range of physics activities from general courses through advanced research, and including several accelerators up to 1 Bev in size. Separated from this group is the Stanford Linear Accelerator Center (SLAC), a very high energy physics laboratory now under construction which will contain as its principal tool the recently authorized two-mile-long 45-Bev electron accelerator. It is hoped that research involving this machine will commence by 1966 or 1967. Professor Walter Carlisle Barber is the Director of the High Energy Physics Laboratory; Professors Hofstadter, Mozley, Prepost, Ritson and Yearian are on the staff of the Laboratory. The staffs of the other branches of the W. W. Hansen Laboratories of Physics and of the Stanford Linear Accelerator Center are mentioned elsewhere in this catalog (see Applied Physics Division, Biophysics Laboratory, Stanford Linear Accelerator Center).

One of the most important facilities is the Physics-Mathematics-Statistics Library, located in the Varian Laboratory. In physics, this excellent collection includes current subscriptions and back sets of important journals, together with textbooks, scholarly treatises in English, French, and German, and the collected works of the most eminent physicists. It is a center for reading and study of physics at all levels.

In addition to course work providing a sound foundation in classical and modern physics, undergraduates are offered laboratory work at several levels. Both series of introductory courses include laboratories in which students carry out individual experiments. The Intermediate and Advanced Physics Laboratories offer facilities for increasingly complex individual work, including independent investigations.

Graduate students find opportunities for research in the fields of theoretical physics, low temperature physics, electron and nuclear resonance, nuclear physics, high energy physics, coherent optical radiation, and solid state physics. The fields of microwave physics, plasma physics, ferrites, biophysics, and others of a similar nature are offered in the Applied Physics Division and in the Biophysics Laboratory. The number of graduate students admitted to the Physics Department is strictly limited. Students should complete application by January 15, 1965, for the following autumn. Graduate students may normally enter the Department only at the beginning of autumn quarter.

PROGRAMS OF STUDY

The study of physics is undertaken by three principal classes of undergraduates: those including physics as part of a general education, those preparing for careers in
professional fields that require a knowledge of physics, such as medicine or engineering, and those preparing for teaching or research careers in physics itself. In this Department the courses numbered below 200 are planned to serve all three of these groups. The courses numbered above 200 meet the needs mainly of the third group, but also of some students majoring in other branches of science and in engineering.

**Bachelor of Science**

Department requirements for the degree of Bachelor of Science are as follows: Physics 51, 52, 53, 54, 61, 100, 101, 110, 111, 120, 121, 122, 130, 131, 132, 170, 171, 200, 201; 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).

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.

**Normal Sequence**

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* Not required for degree in physics.
† Additional elective units must be added to bring this total to 180 as required by the University.
### Accelerated Sequence

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* 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, even though the course may be listed by another 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.

(The student interested in applied physics and biophysics research should also be aware of the Ph.D. granted independently by the Applied Physics Division and by the Biophysics Laboratory. See elsewhere in this Bulletin.)

Minors in physics must take either Physics 210, 211, and 212 or Physics 130, 131, and 132, with the appropriate prerequisites. All physics minors must pass the comprehensive examination given to physics majors, but need take this examination only when they feel prepared for it.

The office of the Physics Department has more detailed information on how to obtain an advanced degree in Physics. This should be consulted by prospective candidates for advanced degrees.

Teaching Credentials 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, 1965.

COURSES

Of the two series into which beginning courses are divided, the Twenty series (21, 23, 29) includes courses prescribed or recommended for general students and for students preparing for medicine or biology; the Fifty series (51, 52, 53, 54, 55, 56, 57) includes courses for students of engineering, chemistry, geology, and physics.

The two series are similar in content and objectives. Both comprise demonstration lectures on fundamental principles of physics, problem work on application of these principles to actual cases, and laboratory experiments closely correlated with the lectures. Their objectives are not only to give information on particular subjects, but also to provide training in the use of the scientific method. The primary difference
between the two series of courses lies in the fact that topics are discussed more thoroughly and are treated with greater mathematical rigor in the Fifty series.

Courses beyond 61 are numbered in accordance with the following three-digit code. The first digit indicates the approximate level of the course: sophomore and junior courses (1), senior and first-year graduate courses (2), more advanced courses (3). The second digit indicates the general subject matter: laboratory (0), mathematical physics and mechanics (1), electricity (2), atomic and quantum physics (3), nuclear physics (4), microwaves (5), structure of matter (7), independent study and research (9). Graduate courses in microwave physics, plasma physics, solid state physics and biophysics are offered in the Applied Physics Division and the Biophysics Laboratory.

#21. Mechanics and Heat—Equilibrium, uniform and accelerated motion, force, work, momentum and energy; heat, temperature, properties of matter. Prerequisite: working knowledge of elementary algebra, geometry, i.e., ability to pass examination in these subjects.

4 units, autumn, (Schawlow), lec. and lab.

#23. Electricity and Optics—Electric charges and currents, magnetism, induced currents; wave motion, interference, diffraction, geometrical optics. Prerequisite: 21.

4 units, winter, (Hofstadter), lec. and lab.

#29. Modern Physics—Basis of modern atomic theory, structure and properties of atoms, the nucleus, radioactivity. Prerequisite: 23.

4 units, spring, (Fairbank), lec. and lab.

#51. Mechanics—Equilibrium, uniform and accelerated motion, force, work, momentum and energy; fluids, mechanical vibrations. Discussions based on use of calculus. Prerequisites: Mathematics 41 or 11 and continuation in Mathematics 42, or permission of instructor.

4 units, winter, (Meyerhof), lec.; (——), discussions

#52. Mechanics Laboratory—Concurrent registration in Physics 51 is required.

1 unit, winter, (——)

#53. Electricity—Electric charges and currents, magnetism, induced currents, electric oscillations; atomic origin of electromagnetic phenomena. Prerequisites: 51 and Mathematics 42 or 21, or permission of instructor.

4 units, spring, (——), lec.; (Yearian), discussions

#54. Electricity Laboratory—Concurrent registration in Physics 53 is required.

1 unit, spring, (Scott)

#55. Light and Heat—Reflection and refraction of light, lens systems; light as electromagnetic waves; temperature, properties of matter, introduction to kinetic theory of matter. Prerequisites: 53 and Mathematics 43 or 23, or permission of instructor.

4 units, autumn, (Ritson), lec.; (Yearian), discussions

#56. Light and Heat Laboratory—Concurrent registration in Physics 55 is required.

1 unit, autumn, (Fairbank)

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—Experiments in mechanics, heat, electricity and magnetism, optics and atomic physics. Equipment for a number of experiments will be simultaneously available so that one or two students will perform a given experiment during a particular laboratory session. Students will work one or
two weeks per experiment, completing ten or fifteen during two quarters. Concurrent registration in 121 and 122 is required.

100. 2 units, winter, (Prepost, Scott), 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, elementary mechanics of deformable solids. Prerequisites: 51 and Mathematics 130.

110. 3 units, winter, (Shaw), MWF 11
111. 3 units, spring, (Shaw), MWF 11

120, 121, 122. Intermediate Electricity and Magnetism—Passive d.c., a.c. circuits in steady, transient states; fields, potential; electrostatics in simple geometries, law of magnetostatics, magnetic circuits, slowly varying magnetic fields, Maxwell's equations, plane waves, dispersion, skin effect, waveguides, propagation in nonisotropic media, motion of charged particles in electric and magnetic fields. Prerequisite: 53. Concurrent or prior registration in Mathematics 130 and 131 with Physics 120 and 121, respectively, is required.

120. 3 units, autumn, ( ), MWF 8
121. 3 units, winter, ( ), MWF 8
122. 3 units, spring, ( ), MWF 8

130, 131, 132. Atomic and Nuclear Structure—Fundamental concepts of quantum mechanics and their application to the structure of atoms and atomic nuclei. Prerequisites: 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, (Iddings), MWF 11
131. 3 units, winter, (Iddings), MWF 11
132. 3 units, spring, (Iddings), MWF 11

140. Elementary Nuclear Physics—Elements of nuclear structure, systematics of nuclei, radioactive interactions of nuclear radiations with matter, detection of nuclear radiations, nuclear models, fission and fusion, neutron physics. Prerequisites: 57 or 130 and knowledge of calculus.

170. Thermodynamics—Derivation of laws of thermodynamics from basic postulates. Macroscopic properties of matter as consequences of these laws. Prerequisites: 55 or admission to Accelerated Sequence and Mathematics 130.

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.

172. Physics of Solids—Introduction to the principal types of solids, with emphasis on their electrical and magnetic properties. Elementary treatment of electrons in metals, energy bands, semiconductors, rectification, and ferromagnetism. Prerequisites: 171, or 57 and Electrical Engineering 255.

190. Independent Study and Senior Thesis—Experimental or theoretical physics under supervision of a faculty member. Prerequisites: superior work as an undergraduate physics major, approval of the instructor, and of the Undergraduate Study Committee of the Department of Physics.

Any quarter, (Staff), by arrangement

200, 201, 202, 203. Advanced Physics Laboratory—Experiments in atomic physics, nuclear physics, solid state physics, and cosmic rays, including Zeeman effect, isotope shift, charge and gyromagnetic ratio of the electron, \( \beta \) spectra, \( \alpha \)-particle scattering, Compton effect, \( \pi - \mu \) decay, semiconductor characteristics, and others. Experiments in electronic circuits, including amplifiers, oscillators, scaling circuits, transmission lines, etc. Physics 200 and 201 consist of a selection of fundamental
experiments chosen mainly from the field of atomic and nuclear physics. Physics 202 and 203 consist of experiments chosen by the student who wishes to do more advanced work in one or more special areas. Prerequisites: for Physics 200 and 201: 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, Scott), by arrangement
201. 2 units, autumn, winter, spring, (Hanna, Scott), by arrangement
202. 3 units, autumn, winter, spring, (Hanna, Scott), by arrangement
203. 3 units, autumn, winter, spring, (Hanna, Scott), by arrangement


210. 3 units, autumn, (Chilton), MWF 10
211. 3 units, winter, (Chilton), MWF 10
212. 3 units, spring, (Chilton), MWF 10


220. 3 units, autumn, (Chilton), MWF 9
221. 3 units, winter, (Chilton), MWF 9
222. 3 units, spring, (Chilton), MWF 9

230, 231, 232. Quantum Mechanics—Physical basis of quantum mechanics, Schrödinger wave equation, energy levels, collision theory. Heisenberg matrix mechanics and transformation theory, approximation methods, identical particles, spin, radiation theory; applications to atomic, molecular, and nuclear systems. Prerequisites: 131 and 212 and Mathematics 106 and 132, and preferably Physics 132 and 220.

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


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

290. Literature of Physics—Intensive study of literature of any special topic. Chiefly preparation, presentation of reports upon topics studied. Prerequisites: 25 units of college physics and permission of instructor.

Any quarter, (Staff), by arrangement
330, 331, 332. **Advanced Quantum Mechanics**—Dirac’s relativistic electron theory; quantization of electron, electromagnetic fields; covariant perturbation theory, applications to high energy processes; mass and charge renormalization of quantum electro dynamics; radiative corrections to scattering; Lamb shift. Prerequisites: 222 and 232.

330. 3 units, autumn, (Oakes), MW 1:15-2:30
331. 3 units, winter, (Oakes), MW 1:15-2:30
332. 3 units, spring, (Oakes), MW 1:15-2:30


3 units, spring, (Schawlow), 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, (Shaw), by arrangement

340, 341, 342. **Nuclear Theory**—Theory of properties of atomic nuclei by application of quantum mechanics to proton-neutron model. Collision of nuclear fragments, radioactive decay, nuclear energy levels, reactions and models. Prerequisites: 232, 241, and preferably 222.

340. 3 units, autumn, (Walecka), TTh 1:15-3:05
341. 3 units, winter, (Walecka), TTh 1:15-3:05
342. 3 units, spring, (Walecka), TTh 1:15-3:05

346. **Nuclear Moments**—Electric, magnetic moments of atomic nuclei, their relation to nuclear constitution. Investigation of the moments by measurements on hyperfine structure, molecular beams, nuclear induction. Prerequisite: 232.

3 units, spring, ( ), TTh 8:00-9:15, in alternate years, to be given in 1965–66

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, ( ), TTh 9:30-10:45, alternate years, to be given in 1965–66
371. 3 units, winter, ( ), 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

**DIVISION OF APPLIED PHYSICS**

**Executive Head:** Marvin Chodorow

**Executive Committee:** Professors Marvin Chodorow (Applied Physics and Electrical Engineering), Edward Leonard Ginzton (Applied Physics and Electrical Engineering) (on leave 1964–65), Hubert Heffner (Electrical Engineering), Calvin Forrest Quate (Applied Physics and Electrical Engineering), Peter A. Sturrock (Applied Physics and Engineering Science)

**Associate Professor:** Marshall Scott Sparks (Applied Physics and Electrical Engineering)
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 supervised by the faculty members listed above and also by various members of other departments such as Materials Science and Electrical Engineering, who are engaged in related research fields. Research activities are carried out in the W. W. Hansen Laboratories of Physics and the Stanford Electronics Laboratories.

The number of graduate students admitted to Applied Physics is limited. Applications should be received by February 7, 1965.

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, 210, 211, 212, 220 (or Electrical Engineering 272), Physics 130, 131, 132 (or Electrical Engineering 259, 260, Applied Physics 237), 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 Departmental requirements include a good reading knowledge in any one of the four languages: French, German, Italian, or Russian. Each candidate for this degree will be required to pass an oral qualifying examination before his candidacy for the Ph.D. degree is accepted. All graduate students majoring in Applied Physics who have not qualified for candidacy for advanced degrees will be required to take a comprehensive examination which is given annually in the winter quarter. Minimum subject matter requirements for the Ph.D. degree include: Physics 170, 171, 172, 210, 211, 212, 220 (or Electrical Engineering 272), 221, Physics 230, 231, Applied Physics 237 (or Electrical Engineering 259, 260), 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, 1965.

COURSES

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; multiple-quantum effects; group theory with applications to atomic structure, crystalline fields. Prerequisite: E.E. 260 or Physics 231.

3 units, spring, (———), by arrangement

250, 251. Electron and Ion Dynamics—Detailed treatment of motion of electrons and ions stationary and time-varying in 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


3 units, spring, (Sparks), TThS 10

256. Advanced Microwave Theory—Reduction of field theory to circuit theory, general network theorems for microwave structures, analysis in terms of scattering matrices, interconnection of multiterminal structures, special microwave structures. Radiation from prescribed current distributions, theory of properties of materials at microwave frequencies. Prerequisite: 255.

3 units, winter, (———), by arrangement

290. Directed Studies in Applied Physics—Special studies under the direction of a faculty member for which academic credit may properly be allowed. Such studies may include laboratory work or directed reading.

Any quarter, (Staff), by arrangement

300. Thesis Research—A grade of + indicates satisfactory work; no letter grade is assigned.

Any quarter, (Staff), by arrangement

320. Introduction to Plasma Physics I—Theory illustrated by applications to laboratory, geophysical, and astrophysical phenomena. Atomic processes: ionization, recombination, radiation; plasma balance equations; surface phenomena. Orbit theory: drifts, adiabatic invariants; synchrotron radiation. Elementary magnetohydrodynamics: derivation of fluid equations; equilibrium configurations and flow patterns; simple stability theory; MHD waves. (Enroll in Engineering 204.) Prerequisites: Physics 122 or Electrical Engineering 271, or, preferably, Physics 212 or 222.

3 units, autumn, (Sturrock), MWF 11


3 units, winter, (Sturrock), MWF 11

3 units, spring, (Sturrock), MWF 11


3 units, autumn, (Siegman), MWF


3 units, winter, (Heffner), MWF

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, (Quate), TTh 8

351. Electromagnetic Measurements Laboratory I—Experimental work to accompany 350. Concurrent registration in 350 required.

2 units, autumn, (Quate), 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, (Quate), TTh 8

353. Electromagnetic Measurements Laboratory II—Laboratory course to accompany 352. Prerequisites: 350 and 351. Concurrent registration in 352 is required.

2 units, winter, (Quate), 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, TWT, parametric amplifiers, masers). Also selected topics of current interest. Prerequisites: 352 and 353.

2 units, spring, (Quate), TTh 8

355. Electromagnetic Measurements Laboratory III—Laboratory course to accompany 354. Prerequisites: 352 and 353.

2 units, spring, (Quate), by arrangement


377. 3 units, winter, (Sparks), MWF 10

378. 3 units, spring, (Sparks), MWF 10

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 prop-
erties; magnetic properties; transport theory; relaxation phenomena; phonon-electron interaction. Prerequisites: 235 and 236 and 237 or Physics 130 series and Physics 172 or E.E. 255.

379. 3 units, winter, (——), by arrangement
380. 3 units, spring, (——), by arrangement

POLITICAL SCIENCE

Emeriti: Thomas S. Barclay, Anthony E. Sokol, Graham H. Stuart (Professors)

Executive Head: Gabriel A. Almond


Associate Professors: Charles A. Drekmeier, Robert A. Horn, Hubert R. Marshall, Jan F. Triska

Assistant Professors: Irene Blumenthal, Richard A. Brody, Richard R. Fagen, Giuseppe Mammarella (Director of Administration, Stanford in Italy), Martin Shapiro, Raymond E. Wolfinger (on leave winter and spring quarters). Acting: Ole Holsti. Visiting: C. Kenneth Prewitt

Lecturers: Milorad M. Drachkovitch, Robert M. Rosenzweig, Carl F. Stover

OFFERINGS AND FACILITIES

The purpose of instruction in the Department of Political Science is (1) to offer all students courses designed to introduce them to the political aspects of society, to train them in the analysis of political problems and to equip them for the exercise of their duties as citizens, (2) to provide undergraduate majors with a program of study leading to the A.B. degree in political science as a foundation for a liberal education, (3) to prepare students for 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 in at least three of the following fields: administration, comparative government, international relations, political theory, politics, and public law. Political Science 150 may be counted as an advanced course in the field of political theory.

3. The completion of 15 units outside the department in courses appropriately related to political science. Such courses must be approved by the student's adviser.

Honors Program in Political Science

The Honors Program is designed to provide a few unusually well qualified students with special opportunities for intensive training and research. The honors candidate will enjoy a close relationship with members of the Department through his participation in seminars, tutorials, and research projects.

Application for admission to the Honors Program normally should be no later than the second quarter of the junior year. Applicants will be required to submit evidence of aptitude and promise, and no applicant will be considered who has not achieved a 3.00 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. In fulfilling these requirements they must take 15 units of work in undergraduate seminars or tutorials. In addition, all candidates will take the honors seminar, Political Science 198, in their senior year. Honors candidates will also submit an honors thesis during their senior year. The thesis, which will represent a full quarter's work, will be awarded a maximum of 15 credits. In certain cases, the honors thesis may relate to a research project in which a member of the Department is engaged. Following his selection of a thesis topic, the honors candidate will be assigned an adviser who will closely supervise his thesis research.

Graduation with Honors in Political Science will require (1) a 3.00 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. Fellowships and research fellowships for studies of the communist system are available for qualified graduate students.
Administered through the Department of Political Science, the Studies in International Conflict and Integration offer a limited number of assistantships for interdisciplinary research and training in international crises and the behavior of states.

GRADUATE STUDY

Admission to Graduate Standing

All applicants for admission to graduate work are required to take the Aptitude Test of the Graduate Record Examination. This examination may be taken at most American colleges and by arrangement may be taken in nearly all foreign countries. For details concerning this test see the Information Bulletin. Overseas applicants, who may not receive the Information Bulletin promptly, should write directly to the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey.

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; first 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 400, Method and Scope of Political Science. The Department will waive this requirement only when the candidate demonstrates to its satisfaction that he has training equivalent to that provided by this course.

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin.

(The Master's degree may also be awarded to doctoral candidates. See the description of the Ph.D. program below.)

Master of Arts in the Teaching of Political Science

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the section "School of Education" in this Bulletin.

Doctor of Philosophy

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:

a) further specialized work within one of the three fields of political science he offers for the degree; or

b) relevant work in a part of one of the fields of political science he does not offer for the degree; or

c) 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:

a) a reading knowledge of two Western languages (e.g., French and German); or

b) a reading knowledge of one non-Western language (e.g., Arabic, Chinese, or Japanese) or of Russian; or

c) a reading knowledge of and conversational ability in one language (e.g., French, German, Spanish, Italian); or

d) a reading knowledge of one language and knowledge of statistics and/or related skills.

The skill requirement may be fulfilled as follows:

a) by successfully completing a program of at least 15 quarter units of selected courses; or

b) 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 in their second year of graduate work will be expected to participate in the Departmental Research Seminar and, on invitation, to present to it a research paper.

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 other 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 with 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.

Upon completion of the requirements for the A.M. degree with the exception of
Political Science 400, Ph.D. candidates who have successfully completed Political Science 401 may be awarded the A.M. degree.

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 Graduate Student Adviser. They are then interviewed, prior to admission, by a committee of the faculty. The same committee determines the required preparation in the two fields, but no candidate shall take less than 10 units, including at least one graduate seminar in each field. Candidates will be examined in their fields in the general oral examination.

Teacher's Recommendation—For the recommendation for the Stanford Junior College Teacher's Credential with political science as a major, the applicant should have completed, in a manner satisfactory to the Department, at least 40 units in political science, including courses 10 and 20. For a minor, the applicant should have completed 24 units, including course 10.

ASSISTANTSHIPS, SCHOLARSHIPS, AND PRIZES

The Department has teaching assistantships in Political Science 1, 10, and 150 and graduate assistantships in connection with its other courses. These customarily are granted to applicants only after they have been at Stanford for at least one quarter.

A number of scholarships and fellowships are also available. Graduate students, specializing in comparative politics, may apply for fellowships under the National Defense Education Act. The attention of undergraduate students is called to the annual Edwin A. Cottrell Memorial Prize for the best student in Political Science 1, the Arnaud B. Leavelle Memorial Prize for the best student in Political Science 150, the Lindsay Peters, Jr., Memorial Prize for the year's outstanding student in Political Science 10.

I. INTRODUCTORY COURSES

#1. Major Issues of American Public Policy—Alternative public policies in selected areas, including control of monopoly, labor relations, agriculture, 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, (Prewitt), MTWThF 09
    winter, (Shapiro), MTWThF 11
    spring, (Horn), MTWThF 11

20. Contemporary Governments Abroad—General survey of governments of England, France, Russia, Germany, Japan. Present-day political situation in these states described and analyzed.

4 to 5 units, autumn, (Buck), MTWThF 08
    winter, (Steiner), MTWThF 08
    spring, (Steiner), MTWThF 08
99. **International Relations: Advanced Practice** — Practice work in executive positions of the Institute of International Relations, with weekly conferences. Restricted to undergraduate officers of the Institute of International Relations admitted by consent of instructor. May be taken for a maximum of three quarters.

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

II. ADVANCED COURSES

Open to students who have taken the necessary prerequisites and also to graduates where advisable.

**ADMINISTRATION**

100. **Public Administration** — Relation of policy to administration, planning, principles of organization, problems of supervision and personal motivation, public relations, decision-making, the budget, administrative responsibility. Prerequisite: 1 or 10.

5 units, autumn, (———), MTWThF 11

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

110. **Administrative Behavior** — Environment of administrative action; political social, psychological factors in management; problem of incentives. Prerequisite: 100.

5 units, spring, (Walker), MTWThF 11

113. **Seminar in Government and Natural Resources** — Political, economic, administrative factors affecting public policy for river basin development, soil conservation, management of public domain, related problems. Pressure groups, legislative bodies, administrative agencies in the planning process. Prerequisite: 100. Economics 1 is desirable.

5 units, autumn, (Marshall), M 2:15-4:05

115. **Seminar in Administrative Responsibility** — Conflicting loyalties, accountabilities of administrative officials in decision-making process; responsibility to public at large, pressure groups, chief executive, legislature, profession. Case study method used. Prerequisite: 100.

5 units, winter, (Marshall), M 2:15-4:05

116. **Introductory Seminar in Administrative Regulation** — Administrative techniques for applying congressional regulatory policy. Scope of rule-making, decision-making, licensing, examining, enforcing powers; how to ensure their responsible exercise. Prerequisite: permission of instructor.

5 units, winter, (———), by arrangement

119. **Directed Reading in Administration** — Advanced individual study in public administration. Prerequisite: 100.

Autumn, winter, spring, (Marshall, Stover, Walker), by arrangement

For graduate courses in Administration, see Part III.

**COMPARATIVE GOVERNMENT**

120. **Problems of Modern Government** — Government organization, constitutional framework; administrative action and procedures; political parties and public opinion; emphasis on United States, Great Britain, France, Germany, Russia. Topics deal with each problem in several countries.

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

122. **The British Commonwealth and Empire** — Imperial organization, Dominion status; governments of Canada, Australia, South Africa. Prerequisites: 10 and 20.

5 units, winter, (Buck), TTh 2:15-4:05

123. **Government and Politics in Asia** — Survey of governmental institutions and the political process in Asian countries. Desirable prerequisite: 20 or previous study of the area.

4 to 5 units, autumn, (Steiner), MTWThR 10
124. Government and Politics in Japan—Governmental institutions and the political process in prewar and postwar Japan; the influence of tradition and social change; the impact of the occupation. Desirable prerequisite: 20 or 123.
   4 to 5 units, winter, (Steiner), to be given in 1965-66

125a. Government and Politics in Communist China—Governmental institutions and the political process in Communist China since 1949. Desirable prerequisite: 20 or 123.
   4 to 5 units, spring, (———), MTWThF 1:15

126. Politics in the Soviet Union—Analysis of the Soviet political community, i.e., those groups in the U.S.S.R. that politically matter: the party and the governmental officials, economic managers and bureaucrats, the military, the police, etc.
   4 to 5 units, winter, (Triska), MTWThF 2:15

127. 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, (———), MTWThF 11

   5 units, autumn, (———), by arrangement

   5 units, spring, (Steiner), to be given in 1965-66

   5 units, spring, (Buck), T 2:15-4:05

   5 units, winter, (Blumenthal), by arrangement

127e. Seminar in Comparative Government: Japan—Graduate students register for 227e.
   5 units, winter, (Steiner), Th 4:15-6:05

128a. Politics of Italy—Problems of Contemporary Italian Politics.
   2 units, winter, summer, (Mammarella), given at Stanford in Italy

129. Directed Reading in Comparative Government—Prerequisites: 10 and 20.
   5 units, (Blumenthal, Steiner), 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), MWF 11

131. Control of American Foreign Policy—How American foreign policy is made; problems of administrative coordination, public opinion, decision-making process. Special attention to State Department and the Foreign Service.
   4 to 5 units, spring, (Brody), MTW 9

   5 units, autumn, (Brody), T 2:15-4:05

132. Principles and Problems of American Foreign Policy—The great traditions and their contemporary application; neutrality, freedom of the sea, Monroe Doctrine, Pan-Americanism, pacific settlement, international cooperation, etc.
   4 to 5 units, autumn, (Watkins), MTWThF 10

136. Soviet Union in World and Communist System Politics—Analysis of contemporary Soviet foreign policy. Testing of hypotheses against empirical data concerning Soviet and communist system organization; decision making; risk-taking; diplomacy; agreements; conference behavior; Soviet-American relations; etc.
   4 to 5 units, autumn, (Triska), to be given in 1965-66

136a. Seminar on Soviet-Chinese Relations.
   5 units, spring, (North), to be given in 1965-66
POLITICAL SCIENCE

5 units, autumn, (Triska), Th 2:15-4:05

136c. Seminar on the Communist System: the Fourteen Communist Party-States ("The Socialist Camp").
5 units, spring, (Triska), Th 2:15-4:05

136d. Analysis of the Socialist and Communist Internationals (1864–1956)—Emphasis on the ideological bases, operational devices and historical meanings of the First, Second, and Third Internationals, including the Cominform period.
4 to 5 units, autumn, (Drachkovitch), MTWThF 9

138. Latin America and the United States—Diplomatic and commercial relations between United States and the republics of Latin America.
4 to 5 units, autumn, (——), MTW 9

139. Directed Reading in International Relations.
(Harris, Watkins), by arrangement

140. Introductory Seminar in International Relations—May be repeated for credit.
5 units, autumn, (Watkins), to be given in 1965-66

5 units, winter, (Brody), to be given in 1965-66

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), to be given in 1965-66

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), W 2:15-4:05

145. International Relations—Introductory survey of the national state system, its characteristic forms and the principal forces making for conflict and adjustment. Nationalism, imperialism, economic relations, war, diplomacy, international organization given special attention.
4 to 5 units, spring, (Watkins), MTWThF 10

146. 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.
4 to 5 units, autumn, (Harris), MWF 11

4 to 5 units, winter, (Watkins), MTThF 10

148. Introductory Seminar in International Organization—Prerequisite: 147 or equivalent.
5 units, autumn, (Watkins), Th 7:30-9:30 p.m.

149. Directed Reading in International Organization.
(Watkins), by arrangement

For graduate courses in International Relations, see Part III.
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, (Drekmeier), MTWThF 11

151. Roman, Medieval, and Early Modern Political Thought—The search for a principle of authority consistent with spiritual ideals, with new forms of social integration, and with the private goals of the individual. Prerequisite: third-year standing or consent of the instructor.

4 to 5 units, winter, (Drekmeier), MTWThF 11

152. Modern Political Thought—Philosophy and ideology of the Enlightenment, the nineteenth and early twentieth centuries, with particular attention to the critique of liberalism and the development of democratic and socialist theory.

4 to 5 units, spring, (Drekmeier), MTWThF 11

153. 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 1965-66

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), to be given in 1965-66

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), to be given in 1965-66

156. American Political Thought: 1620-1865—The development of the American political tradition from the Puritan Theocracy, to the Civil War. Special reference to pre-Revolutionary political thought, the American Revolution, the Constitutional Convention, Jacksonian Democracy, Slavery and Secession.

4 to 5 units, autumn, (———), MTWThF 10

157. American Political Thought: 1865 to the Present—The American political tradition since the Civil War. Special reference to the contributions of clergymen, businessmen, politicians, lawyers, economists, reformers and agitators.

4 to 5 units, winter, (———), MTWThF 10

159. Directed Reading in Political Theory—Prerequisite: 150. (Drekmeier), by arrangement

For graduate courses in Political Theory, see Part III.

Politics

160. American Parties and Politics—Nature and development of American political parties; party organization, structure, leadership, activities; theories, functions of party system, responsibility; attitudes and behavior in the political community; party and public opinion as influences upon government.

5 units, autumn, (———), MTWThF 9

161. Introduction to the Study of Political Behavior—The formation of opinions, perceptions of political events, political participation, voting behavior; the significance for democratic government of findings in these areas. Prerequisites: third-year standing and 10.

5 units, autumn, (Wolfinger), MTWThF 11
162. **Advanced Study of Political Behavior** — Intensive analysis of selected studies in political behavior: theory, method, and data requirements. Prerequisite: 161, graduate standing, or permission of the instructor.

3 units, winter, (Prewitt), MTWTh 1:15

163. **Practicum in Political Behavior** — Field work and analysis of political survey data. Prerequisite: permission of the instructor.

5 units, spring, (Prewitt), MW 1 and by arrangement

164. **Legislative Behavior** — Analysis of congressional elections, constituent relations, policy making and leadership; relations between Congress and administrative and executive agencies; the committee system, seniority and procedure; Congress as an element in the party system. Prerequisite: 10

5 units, spring, (Shapiro), MTWThF 2:15

165. **Seminar in Group Politics and Political Power** — Group pressures, role of interest groups in the political process; political, economic and social forces promoting conflict and consensus in contemporary society; analysis of internal politics of private associations; social structure, distribution of power as conditioning factors in American politics.

5 units, spring, (Rosensweig), T 2:15-4:05

166. **American Judicial Politics** — This course will sketch out the organization and functions of the Federal and State Courts. It will concern itself with the following questions: (1) What do various courts do to and for individuals, groups, and other government agencies? (2) What do various courts do to and for other courts? (3) What do individuals, groups, and other government agencies do to and for the various courts? No particular knowledge of, or interest in, law *per se* is required.

5 units, autumn, (Shapiro), MTWThF 2:15

167. **Introductory Seminar in Politics** — Historical, social and ideological factors affecting American politics; emergent patterns in the party system; stratification and class in American society; analysis of the nature of public opinion and voting behavior.

5 units, autumn, (Rosensweig), T 2:15-4:05

169. **Directed Reading in Politics** — Prerequisite: 10.

(______), by arrangement

For graduate courses in Politics, see Part III.

**PUBLIC LAW**

170. **The Supreme Court and the Constitution** — Theory and practice of constitutional government in the United States. Formation of the Constitution; federal court system; separation of powers; judicial review; Congressional and Presidential authority; exclusive national and concurrent state powers; emphasis on nature of legal reasoning and judicial process. Prerequisite: third-year standing. Graduate students register for 270.

5 units, autumn, (Horn), MTWThF 1:15

172. **The Constitution and Economic Justice** — Changing concepts of private property rights and governmental powers over the economy in American constitutional law; Supreme Court interpretation of the contract and due process clauses versus state police powers; recent expansion of congressional currency, commerce, taxing and spending, and war powers used to regulate property and the economy. Prerequisite: third-year standing; 170 desirable. Graduate students register for 272.

5 units, winter, (Staff), MTWThF 1:15

173. **Civil Liberties in the United States** — Civil liberties in contemporary American culture; theory, history underlying them. Free speech, press in era of mass communications; freedom of association 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
   4 to 5 units, spring, (Blumenthal, Triska), by arrangement

179. **Directed Reading in Public Law**—Prerequisite: consent of instructor.
   (Horn, Shapiro), by arrangement

**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

For graduate courses in Public Law, see Part III.

**III. GRADUATE COURSES**

Conducted as seminars or reading and discussion groups. Courses numbered 200-299 are limited to graduates and, with the consent of the instructor, to qualified seniors. Courses numbered 300 and above are limited to graduates. All students should consult the instructor before enrolling in any graduate course.

201a. **Seminar in Science and Government**—The nature and significance of the Federal government's role in scientific research and development: government organization for science and technology, national science policy, the government contract and grant systems, security and conflict of interest, the politics of science, the professional responsibility of scientists, and related issues. Prerequisite: consent of instructor.
   5 units, spring, (Stover), M 4:15-6:05

202a, 202b, 202c. **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.
   5 units, autumn, winter, spring, (Stover), by arrangement

221. **Reform and Revolution in Twentieth Century China and Japan.**
   5 units, spring, (Steiner), T 2:15-4:05

225. **Introductory Seminar on Comparative Politics**—Open to seniors with the consent of the instructor.
   5 units, autumn, (Almond), by arrangement

226. **Advanced Research in the Communist System.**
   5 units, autumn, (Triska), by arrangement

226a. **Advanced Research in Soviet-East European Integration and Conflict.**
   5 units, winter, (Triska), by arrangement

226b. **Advanced Research in the Communist System: The Committed States, and the Non-Ruling Communist Parties.**
   5 units, spring, (Triska), by arrangement

226d. **Research Seminar on Revolutionary Internationals.**
   5 units, winter, (Drachkovitch), M 4:15-6:05

227e. **Seminar in Comparative Government: Japan**—See 127e.

232. **Seminar in International Relations Theory.**
   5 units, winter, (Watkins), T 2:15-4:05

232a. **Seminar in International Relations Theory: Systems Analysis.**
   5 units, spring, (Brody), by arrangement
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.
247. Seminar in International Organization.
  5 units, spring, (Watkins), to be given in 1965-66
  5 units, winter, (Rogow), to be given in 1965-66
252. Seminar in Political Philosophy.
  5 units, winter, (Drekmeier), by arrangement
253. Seminar in Political Philosophy: Reason, Law, and Authority.
  5 units, winter, (Drekmeier), to be given in 1965-66
262. Seminar in Political Behavior: Modes of Analysis.
  5 units, winter, (Prewitt), by arrangement
262a, 262b. Seminar in Political Behavior: Advanced Studies—Open to limited number of undergraduates.
  262a. 5 units, winter, (Eulau), to be given in 1965-66
  262b. 5 units, spring, (Eulau), to be given in 1965-66
262c. Graduate Seminar in Politics: The Policy Formation Process—Basic concepts and important theories dealing with political institutions and practices; hierarchy and bargaining; the distribution of power in democratic societies. Open to advanced undergraduates with the consent of the instructor.
  5 units, winter, (Wolfinger), to be given in 1965-66
263c. Graduate Seminar in Politics: The American Party System—The party system as a means of coordinating political decisions; fragmentation, consensus and leadership in American politics. Open to advanced undergraduates with the consent of the instructor.
  5 units, autumn, (Wolfinger), by arrangement
270. The Supreme Court and the Constitution—See 170.
  5 units, (Horn), TTh 4:15-6:05
276. Seminar on the United States Circuit Courts—This seminar is open, with the instructor's permission, to undergraduates who have taken American Judicial Politics. Graduate students may enroll for either one or two quarters. This seminar is offered for two quarters because, in view of the nature of the material, it is difficult to complete a high quality graduate research paper in one quarter.
  5 units each quarter, winter, spring, (Shapiro), by arrangement
300. Thesis.
  Each quarter, (Staff), by arrangement
301. Colloquium in Public Administration.
  5 units, spring, (Walker), to be given in 1965-66
302. Research Seminar in Public Administration.
  5 units, winter, (Walker), to be arranged
303. Directed Reading and Research in Public Administration.
  (Walker), by arrangement
308. Directed Reading and Research in Comparative Public Administration.
  (Fagen), to be given in 1965-66
312. Research Seminar in International Organization and Administration.
  5 units, (——), to be given in 1965-66
313. Directed Reading and Research in International Organization and Administration.
   (Blumenthal, Watkins), by arrangement

317a. Research Seminar in American Politics: Public Opinion and Voting Behavior—Survey of current findings on attitude formation, perception, political participation and voting behavior; student research on numerous aspects of individual political behavior using data from the Inter-University Consortium for Political Research; these materials cover a very wide range, including such topics as voting, attitudes toward public policy and institutions, and organizational behavior.
   5 units, spring, (Prewitt), W 2:15-4:05

   318a. 5 units, winter, (Eulau), to be given in 1965-66
   318b. 5 units, spring, (Eulau), to be given in 1965-66

319. Directed Reading and Research in American Politics.
   (Eulau, Wolfinger), by arrangement

322. Research Seminar in Comparative Politics.
   5 units, winter, (Buck), M 2:15-4:05

323. Directed Reading and Research in Comparative Politics.
   (Almond, Blumenthal, Buck, Steiner, Triska), by arrangement

325. Research Seminar on Comparative Political Behavior.
   5 units, winter, (Verba), by arrangement

326. Colloquium in International Politics.
   5 units, winter, (Brody), T 2:15-4:05

327. Research Seminar in International Politics.
   5 units, spring, (Holsti), T 4:15-6:05

328. Directed Reading and Research in International Politics.
   (Brody, Harris, Holsti, Triska, Watkins), by arrangement

331. Colloquium in American Political Theory.
   5 units, spring, (Rogow), to be given in 1965-66

332. Research Seminar in American Political Theory.
   5 units, spring, (Rogow), to be given in 1965-66

333. Directed Reading and Research in American Political Theory.
   (Staff), by arrangement

336. Research Seminar in the Communist System.
   5 units, winter, (Triska), to be given in 1965-66

341. Colloquium in International Political Theory.
   5 units, winter, (North), to be given in 1965-66

342. Research Seminar in International Political Theory.
   5 units, autumn, (North), to be given in 1965-66

343. Directed Reading and Research in International Political Theory.
   (Staff), by arrangement

348. Directed Reading and Research in American Constitutional Law...
   (Horn, Shapiro), by arrangement

361. Essentials of Political Theory.
   5 units, autumn, (Rogow, Drekmeier), to be given in 1965-66

   5 units, spring, (Almond), by arrangement

400. Method and Scope of Political Science—Required of A.M. candidates in first graduate year. History of political science as an academic discipline; scope of the subject; relationship to the other social sciences; political theory and political research; research strategy and tactics: initiation of inquiry, formulation of research questions, and research design; problems of data requirements and techniques of data collection: the use of documentary sources in various fields; census materials; construction of bibliography; observation and interviewing; organization and classification of information.
   5 units, autumn, (——), F 2:15-5:05
401. Method and Scope of Political Science—Required of Ph.D. candidates in first graduate year at Stanford. Review of different modes of political analysis and research designs.

5 units, Autumn, (Drekmeier, Verba), MW 2:15-4:05, tutorial hours by arrangement

See also Senior Colloquia.

INTERNATIONAL RELATIONS PROGRAM

Director: James T. Watkins IV

The Program in International Relations is designed to serve two purposes: (1) to provide an undergraduate major for students interested in the whole field of international relations; and (2) to provide professional preparation for students expecting to enter one of the fields of work in international relations. Professional occupations exist in governmental service, in international agencies, in business and commercial activities, in the work of foundations and charitable institutions, and in teaching.

The program leads to the degree of Bachelor of Arts: 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. Europe Since 1914
      History 154. American Diplomatic History to 1898
      or
      History 155. American Diplomatic History Since 1898
      Political Science 10. American Government
      Political Science 20. Foreign Governments
      Political Science 100. Public Administration
      Political Science 130. Introduction to International Law
      Political Science 147. The United Nations and Its Antecedents
      Political Science 150. History of Political Thought
      (each to be taken for 5 units)

   b) Twenty additional units (of which ten must be in Political Science) of appropriate courses or seminars in Anthropology, Communication, Economics, Food Research, Geography, History, Modern European Languages, Political Science, or other departments in one of the following concentrations:

      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 Bloc, Latin America, Asia, or another Regional Group approved by the Director).
SCHOOL OF HUMANITIES AND SCIENCES

PSYCHOLOGY

Emeriti: Paul Randolph Farnsworth, Maud Merrill James, Lois Meek Stolz, (Professors)

Executive Head: Albert H. Hastorf
Associate Professors: Richard Chatham Atkinson, Gordon H. Bower, J. Anthony Deutsch, Edith Mary Dowley (Director, Stanford Nursery Schools), John D. Krumboltz, Frederick Joseph McDonald, Eleanor E. Maccoby, Walter Mischel
Assistant Professors: Leslie M. Cooper, Edward Joe Crothers, Jonathan L. Freedman, Leonard M. Horowitz, 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 two nursery schools, one in Stanford Village and one in the Escondido married students' housing area. These provide a laboratory for child observation, for training in nursery school practice, and for research.

SUMMER SESSION

The courses announced for the Summer Session are those regularly scheduled in the Department curriculum. Additional courses may be announced in the Summer Session Bulletin, to be issued in February, 1965.

PROGRAMS OF STUDY

Bachelor of Arts

For the Bachelor's degree, 45 units of psychology are required, including courses 1, 60, and one laboratory course from among 103a, 103b, 103c, and 103d. The following courses in other fields allied to psychology may be counted as fulfilling up to 10 of the nonlaboratory units for the degree. A year of physics counts as 3 units toward the major requirement.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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<tbody>
<tr>
<td>Anthropology 1.</td>
<td>General Anthropology</td>
<td>5</td>
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<tr>
<td>Anthropology 130.</td>
<td>Social Anthropology</td>
<td>5</td>
</tr>
<tr>
<td>Anthropology 163.</td>
<td>Cultural Dynamics</td>
<td>5</td>
</tr>
<tr>
<td>Anthropology 164.</td>
<td>Culture and Personality</td>
<td>5</td>
</tr>
<tr>
<td>Biology 25.</td>
<td>Genetics</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 27.</td>
<td>Introduction to Probability Theory</td>
<td>3</td>
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<tr>
<td>Statistics 116 (Math. 123 or Econ. 270).</td>
<td>Theory of Probability</td>
<td>4</td>
</tr>
<tr>
<td>Philosophy 3.</td>
<td>Introduction to Logic</td>
<td>5</td>
</tr>
<tr>
<td>Physiology 101.</td>
<td>Principles of Human Physiology</td>
<td>5</td>
</tr>
<tr>
<td>Sociology 60.</td>
<td>Introduction to Social Psychology</td>
<td>5</td>
</tr>
<tr>
<td>Sociology 61.</td>
<td>Introduction to Small Groups</td>
<td>5</td>
</tr>
</tbody>
</table>
A student must have an average grade of C or better for his work in psychology and have taken at least 15 units in the department in order to receive the Departmental recommendation for graduation.

A Psychology Honors Program is designed for those exceptionally able students who 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 150a must be elected as well as three other courses or seminars from the content areas, one to be selected from among 208, 209, 210, 260, 263, 264, and either 193a or 265a, one from among 211, 212, 213, 214, 215, 261, 266, 267, 268, and 269, and a third from either of these groups. No two of the courses may be from the same general area (e.g., 211 and 266). The student must spend half his time in research and present a thesis based on a portion of his research. Holders of 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, in addition to 150b must be met by all candidates for the doctorate. If a student already has a Master's degree in psychology from another institution, he must present evidence of his competence in these course-areas during his first year at Stanford. This may be done either by examination or by taking the courses. Holders of
the Master’s degree may be excused from the first year research requirement if the faculty feel that the previous research has been sufficient.

2. A written examination must be taken in the area of general psychology, including history and systems. A second, more individualized examination, with topics drawn chiefly from the fields represented by courses 208-215, will be arranged by the candidate’s dissertation committee.

3. Completion of a university minor, or its equivalent, satisfactory to the University Committee on the Graduate Division. Candidates for the Ph.D. degree may have the minor waived by selecting 12 units outside the Department and additional work in general psychology.

4. Demonstrated reading knowledge of a foreign language, preferably Russian, German, or French. Upon petition to the Department faculty another modern language may be substituted for one of these.

5. Passing of the University oral examination which may either be a defense of the dissertation or cover the areas of the major and the minor.

6. A dissertation satisfactory to (a) a Departmental committee of three members and to the University Committee on the Graduate Division, the latter to be appointed after the dissertation is completed, or (b) a Departmental committee of two or more members and an outside reader (approved by the Dean of the Graduate Division) who aids in the supervision of the research.

Ph.D. candidacy expires five years after admission to candidacy by the University Committee on the Graduate Division. Reapplication will require Departmental re-examination.

Minor for the Degree of Doctor of Philosophy—Candidates for the degree of Doctor of Philosophy in other departments who elect a minor in psychology will be expected to complete the equivalent of an A.B. in psychology, of which at least 15 units must be taken as a graduate student at Stanford. The program to be followed will be adapted to the needs of each candidate and will be under the direction of the Department’s Committee on Minors.

THE DOCTORAL TRAINING PROGRAM

As indicated by the examination requirements described above, a student may concentrate in any one of several areas within psychology. Regardless of area, however, the training program places emphasis on the development of research competence, and students are encouraged to develop those skills and attitudes which are appropriate to a career of continuing research productivity.

Two kinds of experience are necessary for this purpose. One involves the learning of substantial amounts of technical information. A number of courses, seminars, and reading lists are provided to assist in this learning, and a student is expected to work out a program, with his adviser, that will permit him to secure such knowledge in the most stimulating and economical fashion. Beyond the first-year graduate courses mentioned above, there are no required courses for any of the areas of concentration. The curriculum has been designed to offer as much help as possible for such learning, of course, and a glance at the list of courses and seminars available will suggest some of the help that may be gained in preparation for the doctoral examinations.

A second aspect of training is one that cannot be gained from reading or seminars. This is the 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 Nursery Schools and an Animal Laboratory, and provides supervised practice experiences in various hospitals, clinics, community agencies, and other facilities. Continuing research programs, sponsored by members of the faculty, offer direct opportunities for experience in the fields represented by the faculty's several research interests.

For certain areas, particularly clinical psychology, the amount of supervised practice ordinarily needed by students is quite substantial. For example, a clinical psychologist who plans a career to include professional employment in a Veterans Administration installation will require about two academic years of practicum work during his doctoral training because he will need to have a variety of skills immediately available when he enters his hospital position. Preparation for the degree in clinical psychology, therefore, requires at least four full years. On the other hand, a student who plans an academic career, in which college teaching rather than professional clinical work would accompany his research activities, may find himself able to complete his training in less time. So far as is practicable, the Department attempts to offer remunerative work opportunities (or other stipends) in connection with supervised practicum experiences.

Each student will achieve competence in somewhat unique ways and at a somewhat unique rate. Each student and his adviser share in planning a program which will lead to the objectives discussed.

FELLOWSHIPS AND ASSISTANTSHIPS

The Dr. C. Annette Buckel Foundation, supplemented by additional support from the Board of Trustees of the University, has provided a teaching assistantship in child psychology and the University provides several fellowships and scholarships. The Thomas Welton Stanford Fellowship in Psychic Research is a 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, and the nursery schools. Several research assistantships are available in connection with special investigations. Readers are employed to assist in course examinations. Veterans Administration assistantships are available locally, and United States Public Health Service stipends and National Defense Education Act Fellowships can be assigned.

COURSES OPEN TO ALL STUDENTS

#1. General Psychology—Introduction, survey.
5 units, autumn, (Atkinson, Freedman), MWFThF 2:15 and sections
winter, (Hilgard, Crothers), MWFThF 10 and sections
spring, (Landauer, ---------, Pribram), TWThF 2:15 and sections
4 to 5 units, summer, (--------), MWFThF 10 and sections

#60. Statistical Methods.
5 units, autumn, (McNemar), (I) MWFThF 8; (Horowitz), (II) MWFThF 11
winter, (McNemar), MWFThF 9
spring, (Lawrence), MWFThF 10
4 to 5 units, summer, (--------), MWFThF 8

100. Individual Differences Laboratory—Prerequisites: 1 and 60.
3 units, autumn, (--------), lec. TTh 1:15; lab. (I) T 2:15-4:05 or (II) Th 2:15-4:05
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, (Bower), MWF 3:15 and three hours by arrangement

103d. Experimental Psychology: Social Processes—Prerequisites: 1 and 60.
4 units, spring, (Wallace), MWF 3:15 and three hours by arrangement

104. Special Laboratory Projects—Prerequisites: 100, 103, or 133, and consent of instructor.
3 units, each quarter, (Staff), by arrangement

110. Effects of Early Experience—Prerequisite: 1 or equivalent.
3 units, autumn, (Landauer), MWF 9

111. Child Psychology—Prerequisite: 1 or equivalent.
4 units, autumn, (Maccoby), MWF 10
summer, (———), MTWTh 10

112. Social Psychology—Prerequisite: 1 or equivalent.
3 units, autumn, (———), MWF 11
summer, (———), MTWTh 11

113. Industrial Psychology—Prerequisite: 1 or equivalent.
3 units, spring, (Bavelas), MWF 8

115. Psychological Foundations of Education—(Enroll in Education 215.)
Prerequisite: 1 or equivalent.
4 units, spring, (Gage), MTWTh 9

116. Development in Middle Childhood—(Enroll in Education 116.)
Prerequisite: 111.
4 units, winter, (P. Sears), MWF 9 and one 3-hour block by arrangement

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

119. Adolescent Development—Prerequisite: 1.
3 units, summer, (———), MTWTh 11

127. Physiological Psychology—Prerequisites: 1 and a course in zoology or physiology.
3 units, winter, (Pribram), MWF 8

130: Comparative Psychology—Prerequisite: 1.
3 units, autumn, (Deutsch), MWF 1:15

133. Experimental Animal Behavior—Student may undertake series of experiments or one minor research. Prerequisite: 60 or special permission.
1 to 3 units, autumn, winter, spring, (Lawrence, Bower, Pribram, Deutsch), by arrangement

135. Intermediate Social Psychology—Prerequisite: permission of instructor.
3 units, winter, (Freedman), Th 2:15-5:05

136. Senior Research in Social Psychology—Designing, performing experiments. Limited to 10 students. Registration for two quarters preferred. Prerequisite: 135 or concurrent registration.
3 units, winter, spring, (Festinger), by arrangement

150a. Advanced Statistical Methods—Correlational analysis: for continuous variables, categorical data. Prerequisite: 60, or calculus.
3 units, autumn, (McNemar), MWF 10

3 units, winter, (McNemar), MWF 11
152. Measurement of Intelligence—Basic concepts, tests of intellectual abilities. Prerequisites: 1 and 60.

3 units, spring, (McNemar), MWF 8

160. Abnormal Psychology—Psychopathology and behavior deviations. Concepts and theories regarding these conditions. Two half-day clinics to be arranged. Prerequisites: 1 and at least second-year standing.

4 units, autumn, ( ), MWF 2:15
winter, (Mischel), MWF 1:15

169. 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

188. Psychological Sex Differences—Prerequisites: 1 and permission of instructor.

3 units, spring, (Maccoby), MW 2:15

189. Honors Seminar (Junior)—Limited to students in the Psychology Honors Program.

3 units, autumn, winter, spring, (Freedman), by arrangement

190. Exceptional Children—The study of children with deviant patterns of development; includes gifted, retarded, sensory defects, emotional problems. Prerequisite: 111.

3 units, spring, ( ), TTh 9 and by arrangement
summer, ( ), MTWTh 1:15

191. Seminar in Behavioral Change—Application of social learning principles to the modification of prosocial and deviant behavior. Prerequisite: permission of instructor.

2 units, spring, (Bandura), M 2:15–4:05

192. Industrial Relations—Meaning of industrial relations; scope, variety of problems that may be considered under it; policies of labor organizations, industrial relations programs of management; trade agreements, grievance procedures, other phases of collective bargaining.

4 units, autumn, (Troxell), MTWF 11
winter, (Troxell), MTWF 11

193a. Quantitative Learning Theory—Prerequisites: 1 and 60 or equivalent.

3 units, autumn, (Bower), TTh 11

193b. Quantitative Theories of Perception—Prerequisites: 1 and 60 or equivalent.

3 units, winter, (Estes), TTh 10

194. Honors Seminar (Senior)—Limited to students in the Psychology Honors Program.

5 units, autumn, winter, spring, (Estes), by arrangement

195. Personality—Prerequisite: 1 or equivalent.

3 units, winter, (Sanford), MWF 10

196. History of Psychology—Prerequisites: Four courses in psychology and senior standing.

3 units, autumn, (Hastorf), MWF 11

197. Dynamic Psychology—Personality development, emotional adjustment; emphasis on psychoanalytic theory. Prerequisites: 111 and 160, and senior or graduate standing.

4 units, spring, ( ), MWF 11

198. Trends in Cognitive Theory—Prerequisite: junior standing or better.

3 units, spring, (Hastorf), MWF 11

199. Reading and Special Work—Independent study. Prerequisite: permission of instructor.

1 to 3 units, each quarter, (Staff), by arrangement

See also Senior Colloquia.
COURSES PRIMARILY FOR GRADUATE STUDENTS

Undergraduate students may be admitted only by special permission.

208. Advanced Physiological Psychology—Prerequisites: 127 and permission of instructor.

3 units, winter, (Landauer), MWF 9

209. Advanced Perception—Prerequisite: permission of instructor.

3 units, autumn, (———), by arrangement

210. Advanced Learning—Prerequisite: permission of instructor.

3 units, winter, (Lawrence), by arrangement

211. Advanced Child Psychology—Prerequisites: 111 or equivalent and permission of instructor.

3 units, winter, (Maccoby, Sears), by arrangement

212. Advanced Social Psychology—Prerequisite: permission of instructor.

3 units, autumn, (Festinger), Th 3:15-5:30

213. Organizational Processes and Task Performance—Prerequisite: permission of instructor.

3 units, winter, (Bavelas), M 2:15-3:05; W 2:15-4:05

214. Motivation—Prerequisite: permission of instructor.

3 units, autumn, (Hilgard), by arrangement

215. Advanced Personality—Prerequisite: permission of instructor.

3 units, spring, (———), by arrangement

216. Mathematical Theories of Perception—Prerequisite: permission of instructor.

3 units, spring, (Atkinson), by arrangement

217. Child Research Practicum—Prerequisites: 117 and permission of instructor.

3 to 4 units, winter, (Dowley), TTh 1:15

250. Advanced Statistical Methods—Factor analysis, statistical theory of psychological tests. Prerequisites: 150a and 152.

3 units, spring, (McNemar), MWF 10

251. Personality Assessment I—Assumptions and principles underlying the development of measuring instruments for the prediction and classification of behavior. Prerequisite: permission of instructor.

3 units, winter, (Mischel), Th 9-12

252. Personality Assessment II—Applications of representative types of assessment devices to the measurement of personality dimensions. Prerequisite: permission of instructor.

3 units, spring, (Mischel), Th 9-12

253. Personality Assessment Practicum—Supervised experience in the administration, interpretation and validation of personality assessment methods. Must be taken concurrently with Psychology 251 and 252. Prerequisite: permission of instructor.

3 units, winter, spring, (Wallace), T 9-11

254. Psychopathology—Review and analysis of research literature and theory in the area of behavior deviation. Prerequisite: permission of instructor.

3 units, autumn, (Wallace), M 10-12

255. Behavioristic Psychotherapy—Application of social learning principles to the modification of deviant behavior. Prerequisite: permission of instructor.

3 units, autumn, (Bandura), M 9-12

256. Psychotherapy with Children—Review of specialized procedures for the treatment of childhood behavior disorders. Prerequisites: 255 and permission of instructor.

2 units, winter, (Bandura), M 9-12

257. Behavior Change Laboratory—Supervised experience in the application of psychotherapeutic procedures. Prerequisites: 255 and permission of instructor.

2 units, winter, (Bandura), by arrangement

spring, (———), by arrangement
258. **Intensive Psychotherapy**—A discussion of general principles of exploratory psychotherapy. Prerequisite: permission of instructor.
   2 units, spring, (——), by arrangement

260. **Seminar in Physiological Psychology**—Prerequisite: permission of instructor.
   2 to 3 units, spring, (Deutsch), by arrangement

261. **Seminar in Social Psychology**—Prerequisite: permission of instructor.
   2 to 3 units, winter, (——), Th 2:15-4:05
   spring, (Festinger), Th 2:15-4:05

262. **Seminar in Verbal Behavior**—Prerequisite: permission of instructor.
   2 to 3 units, winter, (Horowitz), T 1:15-3:05

263. **Seminar in Perception**—Prerequisite: permission of instructor.
   2 to 3 units, spring, (——), by arrangement

264. **Seminar in Learning Theory**—Prerequisite: permission of instructor.
   2 to 3 units, winter, (Estes), TTh 11

265a. **Seminar in Mathematical Psychology**—Prerequisite: permission of instructor.
   2 to 3 units, autumn, (Estes), TTh 10:00-11:30

265b. **Seminar in Mathematical Psychology**—Prerequisite: permission of instructor.
   2 to 3 units, winter, (Atkinson), TTh 10:00-11:30

265c. **Seminar in Mathematical Psychology**—Prerequisite: permission of instructor.
   2 to 3 units, spring, (Bower), TTh 10:00-11:30

266. **Seminar in Child Psychology**—Prerequisite: permission of instructor.
   2 to 3 units, spring, (Maccoby), to be given in 1965-66

267. **Seminar in Interpersonal Processes**—Prerequisite: permission of instructor.
   2 to 3 units, winter, (Hastorf), by arrangement

268. **Seminar in Motivation**—Prerequisite: permission of instructor.
   2 to 3 units, winter, (Hilgard), to be given in 1965-66

269. **Seminar in Personality**—Prerequisite: permission of instructor.
   2 to 3 units, autumn, (——), M 3:30-5:30

272. **Foundations of Mathematical Behavior Theory** (Same as Philosophy 243.)—Prerequisite: permission of instructors.
   2 to 3 units, spring, (Estes, Suppes), by arrangement

274. **Seminar in Perceptual Learning**—Prerequisite: permission of instructor.
   2 to 3 units, autumn, (Lawrence), 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

280. **Doctoral Research**—For dissertation.
   (Staff), by arrangement

**Counseling Techniques: The Interview**—See Education 333a.

**Counseling Techniques: Testing**—See Education 333b.

**Seminar in Educational Psychology**—See Education 415.
SOCIAL SCIENCES (SPECIAL PROGRAM)
HONORS PROGRAM IN SOCIAL THOUGHT
AND INSTITUTIONS

Committee in Charge: Charles A. Drekmeier (Chairman), Richard A. Brody, Roy G. D'Andrade, David Levin, Max Levin, William M. McCord, Otis A. Pease

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. The seminar is organized around a specific theme or concept each year. He will be asked to submit a thesis at the end of his senior year which should demonstrate his ability to synthesize and criticize materials drawn from several disciplines. A credit of 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

SOCIOMETRY

Emeritus: Charles Nathan Reynolds (Professor)

Executive Head: Morris Zelditch, Jr.
Professors: Sanford M. Dornbusch, Richard Tracy LaPiere, Paul Wallin
Associate Professors: Joseph Berger (on leave autumn quarter), Bernard P. Cohen, William Maxwell McCord, Morris Zelditch, Jr.
Assistant Professors: Bo Anderson, Adam Haber, James Kimberly, W. Richard Scott

PROGRAMS OF STUDY

Bachelor of Arts

The Bachelor of Arts degree, with a major in Sociology, may be obtained in one of two ways:

1. The Standard Major—If the student elects this program, he must take 45 units of sociology, in addition to basic University requirements. Introduction to Sociology, Introduction to Sociological Research, and Introduction to Sociological Theory are required of all majors, and, in addition, two courses must be selected from the remaining four courses in the Fundamental Program. These requirements are designed to provide each major with a sound basis for further work in more specialized fields in sociology.

To be recommended for the degree the student must maintain an average grade of C or higher in the major field. Normally, students who expect to graduate as Sociology majors must be registered with the Department two full quarters prior to graduation.

2. The Honors Program—This program is designed to meet the needs of those students who expect to pursue graduate work, or who have the interest and capacity for independent study and research. Students are admitted to the program only if they have maintained an average grade of B or better in all courses taken at Stanford.

Honors students are not required to take a fixed number of units in sociology. Each student in the Honors Program will have a special adviser, but he may work with various staff members on individual projects during the junior and senior years. He will plan his program with the adviser to include Introduction to Sociological
Research, a course in sociological theory, and a course in statistics. Honors students are exempt from prerequisites attached to courses at the discretion of the adviser, and may be admitted to graduate level courses. They are urged to take courses in related fields, such as anthropology, psychology, and philosophy.

Intensive work in the Honors Program will begin in the junior year, when the student will participate in Honors seminars. These seminars will examine basic readings in sociology and current faculty research. In the spring, he will present as his Junior Thesis a research proposal with a review of the relevant literature. This research proposal will be the prelude to the required Senior Thesis. The student will be granted 2 units of credit for each quarter's participation in the junior year and 10 units for the satisfactory completion of original research in the senior year.

To remain in the Honors Program, the student must maintain an average grade of B or better in all sociology courses. In the last quarter of the senior year, Honors students must pass a Comprehensive Examination in Sociology.

Master of Arts

Although it is desirable to have had undergraduate preparation in sociology, under special circumstances the Department will admit candidates for advanced degrees without such preparation. The Master of Arts degree is granted as a step toward eventual fulfillment of requirements for the Doctor of Philosophy degree. Ordinarily, the Department prefers not to admit students who are candidates solely for the A.M. degree.

To be recommended for the degree, the candidate must complete forty-five units of approved work, no units will count which do not have a grade of C or higher, and the student must receive an average grade of B or better. At least thirty of the forty-five units must be received in courses offered by the Department.

Twelve of the required 45 units may be obtained by completing a Master's Thesis, or by participating in one of the formal research programs being conducted by a faculty member, or by replicating a previous research study. For the latter two alternatives, the candidate is required to present to the Department a written report of article length and professional quality. The candidate must satisfactorily complete one of the three alternatives.

Doctor of Philosophy

The goal of training for the Ph.D. is the preparation of persons who may be expected to make significant contributions to the advancement of sociological knowledge. To be recommended to the University Committee on the Graduate Division for admission to candidacy for this degree, the student must satisfy the following requirements: (a) he must have a Master's degree in sociology, or the equivalent thereof in course work; (b) he must demonstrate to appropriate examiners his knowledge of a language other than English, which language is to be approved by the Department. Normally, this requirement will be satisfied no later than during the second year of graduate study.

All sociology graduate students must develop a thorough grounding in both sociological theory and research methods to provide a solid foundation for later specialization. To accomplish this, six graduate courses are required: Backgrounds of Contemporary Sociological Theory, Problems in Conceptualization and Theory Construction, Advanced Social Statistics, Research Design, all normally taken in the first year of graduate work; Logic of Social Research, normally taken in the second year; and Problems of Sociological Measurement, taken in either the first or second year. In addition, for students entering with a deficiency in statistics, Statistics 7, Psychology 60, Statistics 50 or some equivalent must be taken in the first quarter after entering.

Each candidate must select three fields within sociology as his areas of special
competence, in consultation with the Director of Graduate Studies. He must pass written examinations in these fields in order to be certified for the University oral examination. Examples of such fields are Small Groups, Organizational Behavior, Institutional Structure, and the Sociology of Medicine. Sociological Theory or Research Methods may be offered as a field only when the candidate has an exceptional grasp of materials in the area for competence in both fields is assumed for all graduate students. The written examinations will ordinarily be given only within the first seven weeks of autumn and spring quarters.

After passing the University oral examination, the candidate must satisfactorily complete a doctoral dissertation. Members of the faculty are available to assist the candidate at each stage of his research in fulfilling the dissertation requirement.

The Master of Arts in Teaching Degree

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education.

TEACHING ASSISTANTSHIPS AND FELLOWSHIPS

The University has a number of fellowships and scholarships available. Information about these, as well as application blanks, may be secured by writing the Office of Admissions.

In addition, the Department has annual teaching assistantships, traineeships in medical sociology, research assistantships, traineeships in mental health, and National Defense Education Fellowships for the support of its graduate students.

COURSES PRIMARILY FOR UNDERGRADUATES

INTRODUCTORY

#1. Introduction to Sociology — Basic concepts; theories; emphasizes group aspects of human behavior.
5 units, autumn, (Dornbusch), MTWThF 11
spring, (Scott), MTWThF 11
summer, (—), MTWThF 11 and by arrangement
7. Introduction to Statistics—(Same as Statistics 7.)
5 units, autumn, (Solomon), MTWThF 1:15

FUNDAMENTAL PROGRAM

10. 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. Prerequisite: consent of instructor.
5 units, winter, (Cohen), MW 11; labs. T or Th 2:15-5:05
51. 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. Prerequisite: consent of instructor.
5 units, autumn, (Anderson), MWF 9
52. Introduction to Institutional Analysis—The study of how the basic institutions such as the stratification system, the political family, the economy and political order affect one another in Western and non-Western societies. Prerequisite: consent of instructor.
5 units, autumn, (—), MWF 2:15
60. Introduction to Social Psychology—Special attention to the social basis of personality development, socialization, and the causes of such forms of deviance, as crime, alcoholism and psychosis. Prerequisite: consent of instructor.
5 units, winter, (McCord), MWF 10

61. Introduction to Small Groups—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. Prerequisite: consent of instructor.
5 units, autumn, (Kimberly), MWF 10

62. Introduction to Formal Organization—An analysis of the structural characteristics of economic, political, educational and other organizations and their impact on individual participants. Prerequisite: consent of instructor.
5 units, winter, (Scott), MWThF 9

COURSES OPEN TO UNDERGRADUATES AND GRADUATES

108. Stratification—This course is concerned with an examination of research relevant to social class structures and societies and social mobility processes.
5 units, winter, (Kimberly), MWF 2:15

110. Religious Institutions and Behavior—A sociological approach to organized religion, emphasizing the interaction between the church and its social setting.
5 units, to be given in 1965-66

112. Individual in a Changing Society—An analysis of the adjustment problems experienced by the individual in a society that is undergoing rapid change. Attention will be directed mainly to members of the middle class in contemporary American society.
5 units, spring, (LaPiere), MTWTh 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, winter, (Haber), TTh 1:15-3:05

126. Race and Ethnic Relations—An examination of ethnic group problems in the United States and the sources of prejudice.
5 units, to be given in 1965-66

129. Family and Kinship—Analysis of family behavior and the social structure of the family and kinship groups in Western and non-Western societies.
5 units, to be given in 1965-66

131. Advanced Social Psychology—An analysis of current research in social psychology including such topics as socialization, assimilation, interpersonal perception and social control. Prerequisite: 60 or consent of instructor.
5 units, spring, (Dornbusch), MWF 11

137. Advanced Formal Organization—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: 62 or consent of instructor.
5 units, spring, (Zelditch), MWF 9

145. Survey Methods—Training in the use of the questionnaire and the interview schedule for the systematic collection of data. Prerequisite: 10 or consent of instructor.
5 units, winter, (Wallin), T 2:15-5:05

146. Field Methods—Training in the use of participant observation, informants life histories, interview material, etc., for the study of sociological problems. Prerequisite: 10 or consent of instructor.
5 units, spring, (Wallin), T 2:15-5:05
SOCIOLOGY

147. Laboratory Methods—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: 10 or 61 or consent of instructor.

5 units, to be given in 1965–66

148. Social Change—Societal adjustments to changes in technology, ideology, social organization.

5 units, autumn, (LaPiere), MWF 10

149. Advanced Social Statistics—Prerequisite: 7 or consent of instructor.

5 units, spring, (——), TTh 1:15

161. Advanced Small Group Behavior—A more intensive examination of topics covered in Sociology 61. Prerequisite: 61 or consent of instructor.

5 units, to be given in 1965–66

162. Comparative Institutional Analysis—Cross-Cultural approach to the study of institutions and social systems. Prerequisite: 52 or consent of instructor.

5 units, to be given in 1965–66

165. Advanced Social Stratification—Examination of class and caste systems in Western and non-Western societies using research from sociology and social anthropology. Prerequisite: 108 or consent of instructor.

5 units, to be given in 1965–66

170. Sociology of Knowledge—The tradition of Scheler, Mannheim and French sociology is utilized in this course in combination with empirical material from contemporary psychology to explore the relationship between social structures and ways of thinking. Prerequisite: consent of instructor.

5 units, spring, (Haber), M 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, autumn, (McCord), MWF 11

176. Sociological Aspects of Latin-American Economic Development—Prerequisite: consent of instructor.

5 units, winter, (Anderson), Th 2:15–5:05

180. Honors Seminar—Basic readings in sociology and current faculty research.

2 units, autumn, (McCord), by arrangement

185. Honors Seminar—Basic readings in sociology and current faculty research.

2 units, winter, (McCord), by arrangement

190. Individual Study.

(Staff), by arrangement


2 units, spring, (Staff), by arrangement

192. Senior Thesis.

3 to 10 units, (Staff), by arrangement

COURSES PRIMARILY FOR GRADUATES

216. Theories of Interpersonal Processes—Prerequisite: consent of instructor.

5 units, spring, (Berger), MWF 1:15

217. Problems in Theoretical Analysis—Prerequisite: consent of instructor.

5 units, spring, (Anderson), MWF 10

250. Basic Problems in Sociological Theory—Prerequisite: consent of instructor.

5 units, autumn, (Haber), T 2:15–5:05

253. Theory Construction—Prerequisite: 250 or consent of instructor.

5 units, winter, (Berger), MWF 11

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, to be given in 1965–66
260. Research Design—Prerequisite: 149.  
5 units, to be given in 1965-66

261. Sociology of Mental Health.  
5 units, to be given in 1965-66

267. Problems of Sociological Measurement—Prerequisite: 149.  
5 units, spring, (Cohen), Th 2:15-5:05

The Nature of American Society—See Graduate Division Special Programs 323.

GRADUATE SEMINARS ON SPECIAL TOPICS

215. The Individual and Social Change—Prerequisite: consent of instructor.  
5 units, winter, (LaPiere), MTW 4

248. Research Problems in Sociology of Education—Prerequisite: consent of instructor.  
5 units, autumn, (Wallin), M 2:15-5:05

269. Authority and Sanctions—Prerequisite: consent of instructor.  
5 units, autumn, (Scott), W 2:15-5:05

275. Problems in Analysis of Status Structures—Prerequisite: consent of instructor.  
5 units, winter, (Zelditch), W 2:15-5:05

277. Problems in Institutional Analysis—Prerequisite: consent of instructor.  
5 units, winter, (Dornbusch), Th 2:15-5:05

278. Professionals and Bureaucracies—Prerequisite: consent of instructor.  
5 units, winter, (Dornbusch), Th 2:15-5:05

280. Research Seminar on Influence Processes—Prerequisite: consent of instructor.  
5 units, autumn, (Cohen), Th 2:15-5:05

284. Equilibrium Problems in the Small Group—Prerequisite: consent of instructor.  
5 units, spring, (Kimberly), W 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 Lee Buckingham (Associate Professors)

Executive Head: Robert Loper  
Professors: Wendell Cole, Robert Loper, Norman Philbrick, H. Donald Winbigler  
Acting: Raeburne S. Heimbeck, Paul Landry  
Instructors: Holmes Easley, Frederick Hunt, Griffith Richards.  
Acting: Marianne E. Crowder.
PROGRAMS OF STUDY

Bachelor of Arts

The requirements for the degree of Bachelor of Arts with a major in Speech and Drama are planned to allow the student the widest possible latitude in the development of his special aptitudes and interests. A minimum program is required of all students. Beyond this minimum requirement, the student is permitted to choose electives with the guidance of the adviser in accordance with his interests. The requirements for the degree of Bachelor of Arts may be summarized as follows:

1. The satisfactory completion, with an average grade of C or better, of not less than 45 units in Speech and Drama courses, including the following minimum general requirement: 1, 20, and 30.

2. The satisfactory completion of one of the following programs:
   a) Teaching Training—These courses are listed elsewhere in this Bulletin under teaching credentials.
   b) Theater and Drama
      Basic Skills: 1, 20, 30 ..................................................... 9
      Acting; Directing: 164a, 164b, 164c .................................. 12
      Technical Skills: Lighting (174c), Costuming (174b), Construction (174a) ................................................. 9
      Dramatic Literature: 90, 91, 92 ........................................... 12
      Total .................................................................................. 42
      Approved Electives: Playwriting (294a), American Drama (291, 292), Contemporary Drama (194), Design (175), History of Costume (170), Advanced Stage Lighting (176), Contemporary Theater (60)

3. The satisfactory completion, with an average grade of C or better, of a minor program of not less than 20 units of advanced course work chosen from courses offered in a department or departments other than Speech and Drama. The minor program must be chosen with the advice and approval of the student's faculty adviser from among those programs approved by the faculty of the Department.

   Special Major Program for the Honors Candidate in Humanities—Students who are planning to take the special Honors Program in Humanities may fulfill the requirements for their major in Speech and Drama by satisfactory completion of the following program in Theater and Drama
   Acting and Directing (164a, b, c),
   Dramatic Literature (90, 91, 92),
   American Drama (291, 292),
   Shakespeare (English 25) and 6 units of electives in theater and drama
   (Honor students are not held to the prerequisite of completing 1, 20, 30)

Honors and Graduate Programs in Humanities

For acceptable majors in Speech and Drama, an Honors Program in Humanities is offered, a description of which will be found under "Humanities (Special Programs)."

The Department of Speech and Drama also participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in Speech and Drama and Humanities. For a description of that program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)."
Teaching Credentials

The degree of Master of Arts in Teaching of Speech and Drama is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 30 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

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. Admission to courses of advanced standing does not, however, imply admission to candidacy for an advanced degree. Students who are deficient in their undergraduate training in the fields of speech and drama will be required to make up such deficiencies. Graduate students, when applying for admission, must furnish record of taking the Aptitude Test of the Graduate Records Examination and must submit also a sample of their best written scholarly work. All graduate students must be degree candidates.

Master of Arts

Before admission to candidacy for the Master of Arts degree, a student may be required by the faculty of his specific area of interest to take in his first quarter of residence written diagnostic or program-planning tests, consisting of written examinations. The written examinations covering the specific field of the student's major interest are normally given on the weekend prior to autumn registration.

The new graduate student will be interviewed by a committee of Department faculty members. Following this interview a permanent faculty adviser will be chosen for the student.

On the basis of the results of the interview and possible diagnostic tests, the student in consultation with a faculty adviser plans a complete program of study and selects a thesis subject. This program of study and the outline of the proposed research for the thesis should be submitted on proper forms to the Departmental Committee on Graduate Study for approval. There is no set program of graduate courses rigidly required of all prospective candidates for the Master of Arts degree. Each student with his adviser plans, in terms of his previous training and in terms of his goals, an individual program to meet the requirements of the Department.

Admission to candidacy is granted by the University Committee on the Graduate Division on the basis of a formal application approved in writing by the Department. Upon securing from the Department the approval of his program and thesis subject, the student should immediately file an application for admission to candidacy with the University Committee. This application must be filed not later than the fourth week of the quarter preceding that in which the candidate expects to receive his degree.

Requirements for the Degree—Candidates for the degree of Master of Arts in Speech and Drama must present a minimum of 40 units of graduate work and must spend at least one year (three quarters) or three summer quarters in full-time residence study. This program may include course work offered in other departments of the University. Of these units, not less than 4 nor more than 6 may be devoted to a thesis or project. If more than 6 units are desired, however, the candidate may...
petition the Departmental Committee on Graduate Study. Students are required to maintain a satisfactory scholastic rating in all course work. Candidates are normally required to plan their programs to include a major from one of the two fields of Speech and Drama: public speaking or theater and drama; and to include a minor from a second one of these fields or from a related field in another department of the University. The minor program consists of 12 units; these 12 units are included in the 40 required units of graduate work. First- and second-year courses required of a candidate because of deficiencies in undergraduate preparation, as revealed by a preliminary examination or interview, may not be used in satisfying the requirement of 40 units of advanced work. Full instructions concerning the Master of Arts program and review bibliographies should be obtained from the office of the Department.

Examinations—At the end of the last quarter of residence each candidate will be required to pass satisfactory comprehensive written examinations, demonstrating his command of that field or those fields of speech in which he has elected to study. A first draft of the thesis must be submitted before taking the examinations. Candidates who fail to pass these examinations may take them again but are disqualified by a second failure.

Candidates who fail to present an approved thesis in final form within one calendar year after passing the comprehensive examinations may be required to repeat the comprehensive examinations before being recommended for a degree. If the length of time intervening is beyond one calendar year, additional course work may be required before repetition of the examinations.

Thesis or Project—The thesis or research project must be carried on under the direction of a member of the faculty of the Department of Speech and Drama or under the direction of a member of the faculty of an allied department at the discretion of the adviser. Choice of subject and first steps in the work should be begun immediately after completion of the preliminary examination or interview and normally should not be delayed beyond the first quarter in residence. An adequate first draft must be submitted to the adviser not later than the end of the fourth week of the last quarter of resident study. The final draft must be submitted three weeks prior to the end of the quarter in which the degree is expected. After acceptance by the Department, three copies of the thesis or project must be presented for acceptance by the University Committee on the Graduate Division. The thesis form and time of presentation prescribed by that Committee must be adhered to.

A limited number of students with major interest in theater and drama may, upon selection by the theater and drama staff, present a production project in lieu of the regular research thesis. Such a project consists of the selection and direction or design of a production for public presentation. The production book in proper form is presented in lieu of the regular thesis. Students who elect this production program must plan to spend six quarters in residence. Full particulars of the program may be obtained from the Executive Secretary of the Department.

Doctor of Philosophy

The graduate student who is a candidate for the Ph.D. degree in theater and drama must offer, in addition to the emphasis in theater history and dramatic literature, at least one concentration in theater arts (acting-directing; costumes; scenery design; lighting). All theater and drama candidates must take at least 6 units of Speech and Drama 160 (Theater Practice). With certain dissertation subjects the student may work under "Plan B" in which the dissertation committee consists of two members from Speech and Drama and one from outside this Department, material from whose field is important to the dissertation area. The outside faculty member will be suggested by the student's Departmental adviser and submitted to the Executive Head for approval and recommendation to the Dean of the Graduate Division.

The Department of Speech and Drama requires the candidate to complete the dis-
sertation before taking the Departmental and University oral examinations. The following areas will be covered in the University oral examinations: (1) background of dissertation; (2) doctoral reading list; (3) area of specialization determined by consultation with Department. The written comprehensive examinations in theater and drama, which are taken upon completion of formal course work, will emphasize theater history, dramatic literature, criticism and one area of theater arts concentration.

SPEECH CORRECTION, HEARING, AND SPEECH SCIENCES

For programs and courses in Speech Correction, Hearing, and the Speech Sciences, please refer to the Division of Speech Pathology and Audiology listed in the section “Allied Medical Sciences” in this Bulletin.

Attention of Speech and Drama majors is especially directed to the following courses which may be of interest: Speech Pathology and Audiology 110 (Principles of Phonetics), and Speech Pathology and Audiology 232 (Principles of Voice Training).

SUMMER SESSION

The Summer Session courses regularly scheduled in the speech and drama curriculum are listed below. Additional courses will be published in the Summer Session Bulletin in February 1965.

Some courses which are repeated in the summer session carry decreased credit.

COURSES

GENERAL

General first- and second-year courses open to all interested students without prerequisites include Speech and Drama 1, 20, 30. Special courses for foreign students interested in improving their pronunciation and understanding of English speech and their use of the written language are Speech and Drama 47, 48, 49, 58, 59.

1. Characteristics of Spoken Language—Analysis of articulatory and vocal usage as they relate to spoken language. Practicum emphasizing these factors as they facilitate oral communication.

3 units, winter, spring, (Bush, Staff), MWF 10

#30. Oral Interpretation—Basic course in understanding the organization of the logical and emotional content of literature with emphasis on its communication to the listener.

3 units, autumn, winter, spring, (Staff), MWF 9 or 11

47. English Communication for Foreign Students I—Basic work in spoken English with emphasis on comprehension and intelligibility. Course also includes the use and comprehension of written English.

6 units, autumn, (Bush, Staff), MTFTh 9 and one hour by arrangement

48. English Communication for Foreign Students II—Intermediate work in spoken English with emphasis on comprehension and intelligibility. Prerequisite: 47 or consent of instructor.

4 units, autumn, winter, (Bush, Staff), MWF 4:15 and one hour by arrangement

49. English Communication for Foreign Students III—For students with some facility in spoken English. Emphasis on fluency, idiom, and current usage. 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, Staff), TTh 4:15 and one hour by arrangement

58. English Communication for Foreign Students IIa—Intermediate work on written English with emphasis on acceptable usage in the mechanics and form of expository writing. Prerequisite: 47 or consent of instructor.

2 units, autumn, winter, (Bush, Staff), TTh 4:15
59. English Communication for Foreign Students IIIa—For students with some facility in written English. Emphasis on fluency, idiomatic usage, and style. Upon recommendation of the adviser, the course may be repeated for a total of 6 units. Prerequisite: consent of instructor.

#60. Introduction to the Contemporary Theater—Survey of the arts of the theater; lectures, and discussion of readings in contemporary drama and of current plays to be seen by the class.

3 units, winter, (Staff), MWF 9

100. Individual Instruction—Continued study under direction and guidance in fields or subjects of special interest. Credit limited to 6 units.

2 to 3 units, any quarter, (Staff), by arrangement

308. Research—Special problems in dramatic literature, rhetoric and public address, theater arts. May be repeated for total of 8 units.

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


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

400. Doctoral Research.

Any quarter, (Staff), by arrangement

Rhetoric and Public Speaking

#20. Public Speaking: Practice and Criticism—Includes practice in the delivery of original speeches and the analysis, discussion, and written criticism of significant public addresses.

3 units, any quarter, (Ericson, Heimbeck). General sessions (1 hour): T 10; W 10: Th 9 or 11. Section meetings (2 hours): MW 8, 9, 10, 11, 1:15, 2:15; TTh 8, 9, 10, 11, 1:15, 2:15

120. Modes of Oral Discourse—The processes of exposition, argumentation, and group discussion.

120a. Exposition—Recommended for candidates for teaching credentials.

3 units, autumn, winter, spring, (Schrader, Staff), MWF 10 or 1:15

120b. Argumentation.

3 units, autumn, winter, spring, (Hastings), MWF 9

120c. Discussion.

3 units, winter, spring, summer, (Schrader), MWF 10

321. Seminar in Rhetoric and Public Address—May be repeated for credit.

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

Business and Professional Speaking—See Business 301, Graduate School of Business Bulletin.

Theater and Drama

#90. Development of Drama (Classical and Medieval)—Survey of masterpieces of Western drama from origins in Greece to the Renaissance. Emphasis on the social and theatrical environments of each play’s performance.

4 units, autumn, (———), MTWF 9

#91. Development of Drama (Renaissance and Baroque)—Survey of the art of drama from the Renaissance to Ibsen.

4 units, winter, (———), MTWF 9

92. Development of Drama (Modern)—Ibsen, subsequent dramatists, English and Continental. Lectures, discussions; critical papers.

4 units, spring, (———), MTWF 9

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. Techniques of Acting and Directing—All three quarters recommended, but 164a may be taken separately.

164a. Fundamental Principles of Acting and Directing—Play analysis, actor's resources and methods, basic bodily movement, voice articulation.
4 units, autumn, (Loper, Crowder), TTh 10; labs. TTh 1:15-3:05

164b. Advanced Acting and Directing—Techniques of composition, balance, and rhythm in acting and direction.
4 units, winter, (Loper, Crowder), TTh 10 and TTh 1:15-3:05

164c. Styles of Acting and Directing—Intensive theory and practice in historical and nonrealistic modern drama.
4 units, spring, (Loper, Crowder), TTh 10 and TTh 1:15-3:05

170. History of Costume—Historical costume for the stage from ancient times to the present.
3 units, autumn, (Russell), MWF 9

172. Costume Design—Design techniques for theater and television. Intensive sketching of costumes. Prerequisites: 170 and consent of instructor.
3 units, winter, (Russell), MWF 9

173. Theatrical Makeup—Laboratory course in the art of stage makeup. Required of all undergraduate theater and drama students.
1 unit, autumn, (Russell), F 1:15-3:05

174. Stage Production Survey—Training in (a) scenery construction, (b) costuming, (c) theatrical lighting. Lectures, demonstrations, laboratories, and crew assignments. Required of all graduate students who fail to demonstrate adequate previous training in these fields. May be taken in any sequence or in separate sections by those who can show previous training in one or more of these areas.

174a. Scenery construction.
3 units, autumn, (Easley), MW 11; 3-hour lab. and crew by arrangement

174b. Costume Construction.
3 units, spring, (Russell), TTh 11; 3-hour lab. and crew by arrangement

174c. Lighting.
3 units, winter, (Hunt), TTh 11; 3-hour lab. and crew by arrangement

175a. Stage Design I—Perspective and mechanical drawing for the stage; principles of design; limitations of the stage. Prerequisites: 174a and 174c, and consent of instructor.
4 units, autumn, (Easley), MWF 11; painting crew by arrangement

175b. Stage Design II—Practice in stage design; analysis and expression of the play in scenic terms. Prerequisites: 175a and 164a, or equivalent work, and consent of instructor.
4 units, winter, (Easley), MWF 11; painting crew by arrangement

176. Advanced Stage Lighting—Theory and practice in design, execution of lighting plot; theory of control board design, operation. Prerequisite: 174c.
3 units, spring, (Landry), MWF 10; lab. by arrangement

260. Projects in Theater Arts.

260a. Projects in Directing—Intensive analysis, rehearsal and production of a one-act play or a dramatic work of similar length. Prerequisites: 164 or equivalent, and consent of instructor.
3 units, any quarter, (Loper), by arrangement

260b. Projects in Stage Costume—Individual work in design, creating costumes, accessories for various productions. Prerequisite: 172 or consent of instructor.
3 to 5 units, any quarter, (Russell), by arrangement

260c. Projects in Stage Design—Advanced work and projects in areas of special interest to the student. Circumstances permitting, the design of a setting for actual production. Prerequisites: 176 and 175b and consent of instructor.
3 units, any quarter, (Easley), by arrangement

260d. Projects in Stage Lighting—Advanced work in styles of production, or
special lighting and model projects. Designing for productions. Prerequisite: 176 or consent of instructor.

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

260e. Projects in Technical Production—Advanced work involving technical direction, stage management of departmental productions. Theater, house management. Prerequisites: 174 and consent of instructor.

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

260f. Projects in Playwriting—Seminar in composition of full-length play. Open to students who have completed advanced playwriting or its equivalent, or who have through submission of original plays demonstrated an aptitude for advanced technical qualifications in playwriting. Prerequisite: consent of instructor.

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

291. Early American Drama—History of theater, dramatic literature of America from Colonial days to Civil War.

4 units, winter, (Philbrick), MTWTh 10

292. Modern American Drama—History of theater, dramatic literature of America from the Civil War to the present.

4 units, spring, (Cole), MTWF 10

#294a. Playwriting and Dramatic Structure—Critical analysis of dramatic structure and technique for students interested in dramatic literature, play directing, or writing of original plays for theater or television. May be taken for graduate credit.

4 units, autumn, (Philbrick), MTWTh 11

297. Theaters and Staging I (Classical)—Survey of theaters, staging methods, scenic design in relation to social, dramatic values, styles of theatrical production, from Greeks through Neo-Classical.

4 units, winter, (Cole), MW 4:15-6:05

298. Theaters and Staging II (Modern)—Survey of theaters, staging methods, scenic design in relation to social, dramatic values, styles of theatrical production, from Neo-Classical to Modern.

4 units, spring, (Cole), MW 4:15-6:05

360. Proseminar in Theater and Drama.

360a. Theater and Drama—Introduction to various types of research, research methods in theater, drama. Required of graduate students specializing in theater and drama.

3 units, autumn, (———), MWF 1:15

360b. History of Dramatic Criticism—Readings, discussion, term paper in dramatic criticism, from Aristotle through the 19th century. Required of candidates for the Ph.D.

3 units, winter, (———), MWF 1:15


3 units, spring, (———), MWF 1:15

361. Seminar in Directing.

361a. Problems in Directing—Intensive analysis, discussion and class performance of selected scenes.

4 units, autumn, (Staff), TTh 4:15-6:05

361b. Experiments in Directing.

4 units, winter, (Staff), TTh 4:15-6:05

390. Seminar in Theater History and Dramatic Literature—A sequence of six seminars, one per quarter, covering a span of two years. In each quarter the seminar will investigate a special problem in one of the six major areas of the study of dramatic literature: Classical, Medieval, Renaissance, Neo-Classic, 19th Century,
Contemporary. Material for study will vary from year to year, hence may be repeated for credit.

4 units, any quarter, (Staff), MW 2:15-4:05

391. Seminar in Comedy—Comedy as a dramatic form; emphasis on trends in American comedy, various historical theories of comedy.

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

397. Seminar in Stage Arts and Techniques—Reading, research in fields of design, lighting, acting and directing, and costume. Limited to ten students.

4 units, spring, (Staff), TTh 2–4, alternate years to be given in 1965–66

See also Senior Colloquia.

STATISTICS

Executive Head: Herbert Solomon
Associate Professors: Milton Vernon Johns, Rupert Griel Miller, Emanuel Parzen
Assistant Professors: Ronald Alfred Schaufele, Johannes Hendrik Venter. 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. A written examination to establish proficiency will be required and must be taken before the University oral examination.

FELLOWSHIPS AND ASSISTANTSHIPS

Fellowships and research assistantships carry stipends of $3,000 to $3,600 for the academic year of three quarters (nine months). Teaching assistants, who teach one section of elementary statistics per quarter, receive $2,100 for the academic year and scholarships covering tuition for nine units of course work per quarter. If qualified, they are awarded additional stipends of up to $1,500 as research assistants. Fellows and teaching assistants are also eligible for research assistantships during the fourth or summer quarter. Application for University fellowships, teaching assistantships, and research assistantships should be made to the Office of Admissions by January 15. Predoctoral fellowships for study in this Department are offered by outside agencies such as the National Science Foundation, the Woodrow Wilson Foundation, etc. Because of early deadlines, application should be made directly to these agencies in the early fall of the year preceding that in which admission is desired.

COURSES

7. Introduction to Statistics—Especially designed for students in economics, sociology, and other social sciences. (Same as Economics 7 and Sociology 7.)
   5 units, autumn, (Solomon), MTWThF 1:15

   3 units, autumn, (Venter), MWF 2:15
   winter, (Stein), MWF 2:15
   spring, (Stein), MWF 2:15

#50. Elementary Statistics—An introduction to statistics for the general student, with emphasis on concepts of decision making in the face of uncertainty.
   5 units, autumn, (Chernoff), MTWThF 11
   spring, (Venter), 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, (Schaujele), 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, (Schaujele), 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, (Venter), 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, (Chernoff), MTWF 9
   spring, (Solomon), MTWF 10
   summer, (———), MTWThF 11
111. **Experimental Statistics**—Continuation of 110. Multivariate normal distribution; multiple correlation, regression; estimation, tests of hypotheses about regression coefficients; analysis of variance; selected topics. Prerequisite: 110.

3 units, spring, (Schaufele), 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, (Miller), MTWF 11
winter, (Schaufele), MTWF 11
spring, (Van Ness), MTWF 11
summer, (——), MTWThF 1:15

119. **Elementary Statistical Inference**—Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. (Same as Economics 271.) Prerequisite: 116.

4 units, winter, (Olkin), MWF 9

120. **Statistical Inference**—Point estimation; interval estimation; tests of hypothesis; linear hypothesis; distribution free methods; sequential analysis. Prerequisite: 119.

4 units, spring, (Olkin), 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, (Johns), MW 3:15

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 11

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. (Same as I.E. 152). Prerequisite: Differential Calculus.

3 units, autumn, winter, (Hillier), MW 4:15-5:30


3 units, winter, (Veinott), MW 1:15

199. **Independent Study**—For undergraduates. (Staff)

204. **Sampling from Human Populations**—Theory of sampling from finite populations; efficiency of various survey designs; application.

3 units, spring, (Madow), MWF 1:15

206. **Mathematical Models in Behavioral Sciences: Measurement and Utility Theory**—After a general introduction to the theory of models in the empirical sciences, the course will concentrate on the general theory of measurement and scaling. The last part of the course will deal with utility theory and related topics like subjective probability and decision criteria. (Same as Philosophy 206.)

3 units, autumn, (Suppes), TTh 3:15 and one hour by arrangement
207. **Mathematical Models in Behavioral Sciences: Learning Theory** — Stimulus sampling and linear models for learning will receive the main emphasis. Modification of the basic models to deal with concept formation and perceptual problems will be discussed. (Same as Philosophy 207.) Prerequisite: Mathematics 63 or equivalent.

*3 units, winter, (Suppes), TTh 3:15 and one hour by arrangement*

208. **Mathematical Models in Behavioral Sciences: Psychometrics** — Examination of mathematical models in factor analysis, mental testing, and related topics.

*3 units, to be given in 1965–66*


*3 units, to be given in 1965–66*

216. **Sampling Inspection** — Review of principles of lot-by-lot acceptance inspection; variable inspection; general principles of sequential sampling plans; sampling plans for continuous production which control average outgoing quality. Prerequisite: 110.

*3 units, winter, (Lieberman), MWF 2:15*

217a. **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, (Venter), MWF 1:15*

217b. **Introduction to Stochastic Processes** — Continuation of 217a.

*3 units, spring, (Venter), MWF 1:15*

219. **Elementary Statistical Inference** — For graduate students. Lectures same as Statistics 119.

*3 units, winter, (Olkin), MWF 9*

220. **Statistical Inference** — For graduate students. Lectures same as Statistics 120.

*3 units, spring, (Olkin), 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, (Moses), MWF 2:15*

230a. **Advanced Probability** — Fundamental concepts, limit law theorems, weak and strong laws of large numbers, convergence theorems, martingales, second order processes, processes with independent increments. (Same as Mathematics 230a, b.) Prerequisite: Mathematics 205a.

*3 units, winter, (Miller), MWF 10*

230b. **Advanced Probability** — Continuation of 230a.

*3 units, spring, (Miller), MWF 10*

236a. **Mathematical Statistics** — A survey of classical and modern statistics from an advanced mathematical point of view. Probability, games and decision theory, estimation, testing hypotheses, confidence intervals, Neyman-Pearson theory, large sample theory, non-parametric inference, sequential analysis, design of experiments. Prerequisites: 220; completion of, or concurrent registration in 221 and Mathematics 205a.

*3 units, autumn, (Johns), MWF 9*

236b. **Mathematical Statistics** — Continuation of 236a.

*3 units, winter, (Johns), MWF 9*

236c. **Mathematical Statistics** — Continuation of 236b.

*3 units, spring, (Johns), MWF 9*
242. Introduction to Time Series Analysis—Model fitting and prediction theory, correlation analysis, spectral analysis, and regression analysis of univariate and multivariate time series. Applications to communication theory (extraction and detection of signals in noise), statistical control theory, and economic time series. Prerequisites: 217a, and 219.

3 units, to be given in 1965-66

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. (Same as I.E. 252). Prerequisites: Calculus and Statistics 27 or 110 or 116.

4 units, autumn, (Veinott), MWF 4:15-5:20

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. (Same as I.E. 253.) Prerequisites: At least two courses in operations research.

3 units, spring, (Veinott), MW 4:15-5:30


3 units, winter, (Veinott), MWF 10

255. Linear Programming—Fundamental theorems; variations of the simplex method; parametric programming; standard model formulations; quadratic programming; discussion of current developments. (Same as Economics 286.) Prerequisite: Mathematics 114 or equivalent.

3 units, winter, (Veinott), MWF 3:15

256. Inventory and Production Control—General discussion of inventory models; costs; analysis of the one-stage model; the sequential inventory problem; time lags; operating characteristics; statistical considerations. Prerequisite: 116.

3 units, spring, ( ), MWF 2:15

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. (Same as I.E. 257.) Prerequisites: I.E. 141 and at least two courses in Operations Research.

3 units, spring, (—• ), 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. (Same as I.E. 258). Prerequisites: 217a, b or 116 and I.E. 252, or equivalent.

3 units, spring, (Hillier), MWF 9

260a. Workshop in Biostatistics—Techniques useful in biological applications including bioassay, quantal response, epidemiology. Informal training in medical science by medical school faculty.

2 to 5 units, autumn, (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

284. Nonlinear Programming and Welfare Economics—Necessary and sufficient conditions for optima under inequality constraints. Methods of solution. Applications to optimization in economics at the levels of the firm and of the economy. (Same as Economics 284.)

5 units, (Staff)

299. Literature of Statistics—Intensive study of literature of any special topic,
usually culminating in the preparation and presentation of reports upon topics studied.

Any quarter, (Staff), by arrangement

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

324a, b. Multivariate Analysis—Likelihood ratio tests for hypotheses involving the multivariate normal distribution. Derivation of generalized $T^2$ and Wishart distribution. Factor analysis and relation between sets of variates.

3 units, to be given in 1965-66

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 1965-66

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 1965-66


3 units, autumn, (Chernoff), TTh 10:30-11:45

332b. Large Sample Theory—Continuation of 332a.

3 units, winter, (Chernoff), TTh 10:30-11:45

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. Prerequisite: 236a, b, c.

3 units, winter, (Stein), MWF 10

336b. Decision Theory and Statistical Inference—Continuation of 336a.

3 units, spring, (Stein), MWF 10

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, autumn, (Van Ness), MWF 1:15

343b. Foundations of Time Series Analysis—Continuation of 343a.

3 units, winter, (Van Ness), MWF 1:15

345. Time Series Analysis Seminar—Discussion of current theoretical and empirical research on time series analysis.

3 units, spring, (———), by arrangement

381. Special Topics in Decision Theory.

3 units, to be given in 1965-66

384. Special Topics in Multivariate Analysis.

3 units, autumn, (Olkin), M 2:30-4:30

386a. Special Topics in Sequential Analysis.

3 units, winter, (Chernoff, Venter), by arrangement

386b. Special Topics in Sequential Analysis—Continuation of 386a.

3 units, spring, (Chernoff, Venter), by arrangement

392. Special Topics in Stochastic Processes.

3 units, autumn, (Schaufele), TTh 9:00-10:15

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 A. Manning

THE WORK OF THE LAW SCHOOL

The School of Law was established as a department of the University in 1893. Its purpose is to provide a thorough legal education for students who are fitted by their maturity and their previous academic training to pursue professional study under university methods of instruction. The curriculum leading to the first degree in law (LL.B.) constitutes an adequate preparation for the practice of law in any English-speaking jurisdiction. Graduate work leading to the degrees of Master of Laws and Doctor of the Science of Law is also offered. (For Law School Curriculum see the Law School Bulletin.)

NONPROFESSIONAL COURSE

The following nonprofessional course, open to juniors and seniors, as well as to graduate students in other departments, may be counted toward the A.B. degree but not toward professional degrees in law.

104. Law in Society—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, autumn, (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 seriously consider their usefulness.

The striking feature of the program is the provision of time equivalent to one academic year which the student may devote to work anywhere in the University. This time, designated “University time” for convenience of identification, is distributed through the first three years of the program in such a manner that its combination with the free time in the medical course per se results in half of each day being free for study or other activity outside the required medical course work. Students
entering the program with a baccalaureate degree may use the University time in formal course work in any department of the University (including those of the School of Medicine), in work toward an advanced degree, in research in any University department, or in programs of independent study tailored to individual interests and abilities. Those students who enter after three college years must use whatever portion of University time as may be necessary to fulfill requirements for a Bachelor's degree, after which the options open to those with degrees become available.

Student interest in research is encouraged. To this end there is ample free time within the medical course (in addition to the University time) and special physical facilities have been designed for student use. Fellowship support is available for matriculated students who wish to undertake such activities either in the summer or during free time.

For further details, see the separate School of Medicine Bulletin. Certain departments of the School of Medicine list work in this Bulletin because of its interest to students working for other degrees.

**ALLIED MEDICAL SCIENCES**

**SCHOOL OF NURSING**
The School of Nursing is a unit of the Department of Allied Medical Sciences of the School of Medicine. The curriculum leads to a Bachelor of Science degree and certification as a Public Health Nurse. See the separate School of Nursing Bulletin for details.

**DIVISION OF PHYSICAL THERAPY**

*Director:* Lucille Daniels  
*Associate Professors:* Lucille Daniels. *Clinical:* Herbert Browne, Helen Hardenbergh  
*Assistant Professors:* Sarah Semans. *Acting:* Edna Forward, Catharine Graham.  
*Clinical:* Ruth Cook, Maurice Grossman  
*Instructors:* Helen Blood, Barbara Kent. *Clinical:* Marguerite G. Dilley, Donna J. Jensen, Michael Keropian

**Offerings and Facilities**
The following programs in physical therapy are offered:

I. A four-year course leading to the Bachelor of Arts degree.  
II. A four-quarter, 12-month course for students with the Bachelor's degree and adequate background in the basic sciences.  
III. The Master of Arts degree.  
IV. A minor for the Doctor of Philosophy degree

Program I, plus an additional quarter of clinical training, and Program II conform to the standards of the Council on Medical Education and Hospitals of the American Medical Association and the American Physical Therapy Association. Both programs prepare students for the examination for registration in California and other states.

All prerequisite courses and the basic science courses that are a part of the physical therapy curriculum are given in the respective departments on the campus. Courses in medical science and physical therapy theory and technique are held in the Edwards Building of the new Medical Center which houses lecture, laboratory and research rooms, a library, and clinics.

Following initial directed clinical experience in the University's integrated 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 Information Bulletin. In addition, a number of special scholarships for physical therapy students are offered by such organizations as the United Cerebral Palsy Association, the National Society for Crippled Children and Adults, and the Elks National Foundation. Local chapters of these organizations and others in many parts of the country also offer assistance to students.

The 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 100, 101 and 102. Principles of Human Physiology.

Anatomy 114. Practical Anatomy.

Physical Therapy 150 to 195, and at least one third- or fourth-year course in psychology are required. Education 155, Elementary Analysis of Body Movement,
courses in health education, and additional courses in psychology should be included in this program.

**Twelve-Month Course**

Students applying for this course should present a Bachelor’s degree. They should have completed the biological science, physical science, and psychology courses listed under the first- and second-year undergraduate program and additional courses in human anatomy and social science including psychology.

Courses in this program include Physiology 101, 102, Anatomy 114, and Physical Therapy 150–200.

**Master of Arts**

Candidates should present a Bachelor’s degree in physical therapy, or a Bachelor’s degree and a credential of completion for a course in physical therapy approved by the Council on Medical Education and Hospitals of the American Medical Association and the American Physical Therapy Association.

Experience in the field is a prerequisite and the program will be planned with each individual on the basis of former training and present interest. A thesis satisfactory to the faculty adviser and the University Committee on the Graduate Division is required. Candidates must complete a minimum of 45 units of credit (including units for thesis).

**Minor for Ph.D.**

A qualified physical therapist may select, with the approval of the adviser, units from the courses numbered above 200.

**Basic Courses**

**50. Introduction to Physical Therapy**—General survey of history of the field, common physical disabilities, and current treatment procedures; observation of treatment and field trips to facilities in the area.

*2 units, winter, (Daniels), T 3:15-5:05*

**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**—Analysis of the principles underlying the use of hydrotherapy and massage; practice of essential techniques.

*3 units, autumn, (Staff), MWF 10:00-11:50*

**170. Clinical Medicine I**—Basic lectures in orthopedics, medicine, and surgery.

*3 units, winter, (Browne and 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 and Special Lecturers), Th 1:15-3:05*

**175. Electrotherapy and Light Therapy**—Principles underlying the use of high- and low-frequency currents, ultraviolet and infrared radiation in treatment of injury, disease; laboratory work included.

*4 units, winter, (Graham, Staff), lec. TF 1:15-2:05; lab. TTh 8:00-9:50*

**180. Advanced Kinesiology**—Joint motion, muscle function in relation to normal, abnormal conditions, biomechanics of motion, and neuroanatomy related to body movement.

*4 units, autumn, (Semans, Kent), MWF 8:00-9:50 and M 3:15-5:05*
188. Basic Therapeutic Exercise—Theory, practice of neuromuscular re-education. Posture, body mechanics, gait training and manual muscle testing.
4 units, winter, (Staff), lec. W 8:00-9:50; lab. Th 1:15-3:05, F 8:00-9:50 and 3:15-5:05

2 to 3 units, spring, (Staff), TTh 9:00-11:50

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, (Staff), by arrangement

200. Directed Clinical Experience in Physical Therapy — Students are assigned to treatment facilities at Stanford and in the Bay area for full-time work with patients.
3 to 8 units, any quarter, (Staff), by arrangement

Advanced Courses

Courses offered in the Division of Physical Therapy and in related areas of basic science, psychology, education, and speech pathology allow flexibility in individual programs for candidates with interests in administration, teaching, or research. A minimum of 30 units must be selected from the following:

220. Measurement and Analysis in Kinesiological Problems—Instrumental, including electromyography and dynamometry; practice with equipment; biomechanics in physical therapy; neuroanatomy related to body movement.
5 units, autumn, (Staff), M3:15-5:05 and TF 10:00-11:50

221. 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 prospected anatomical material.
5 units, winter, (Staff), TTh 10:00-11:50 and F 1:15-3:05

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

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

246. Individual Work.
1 to 8 units, any quarter, (Staff), by arrangement

280. Seminar in Research and Thesis Problems—Basic principles of research with emphasis on material applied to physical therapy. Biostatistics.
3 units, autumn, (Staff), 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

Director: Hayes A. Newby
Consulting: Grant Fairbanks
Associate Professor: Dorothy A. Huntington
Assistant Professors: Richard F. Dixon, John F. Font
Instructors: Virginia Puich, Ellen Seefeldt. Clinical: Lyman S. Barrett, Donald R. Calvert

Offerings and Facilities

The chief purpose of the Division of Speech Pathology and Audiology is to prepare students for professional careers in the fields of speech pathology, audiology, and the speech and hearing sciences. The rapid expansion of these fields in recent years has created many opportunities for properly trained individuals to work in hospital clinics, rehabilitation centers, in industry, and in various local, state, and federal agencies dealing with the handicapped. In addition, the curriculum prepares one for careers in public school speech and hearing work, for private practice, for teaching at various academic levels, and for research positions.

The program of the Division is so organized, however, as to make ample provision for electives outside of the major and minor, affording the student opportunity to gain a liberal education along with his professional preparation. It is hoped that a number of the courses will also prove useful as electives to majors and minors from other departments.

The Division is fortunate in having its own library, containing a highly selected core of books and journals, not only in the immediate fields of speech and hearing but also in the related areas of psychology, special education, the physical sciences, and certain aspects of medicine as well. A well-equipped speech and hearing clinic provides ample opportunity for the student to supplement course work with practical experience with a wide range of speech and hearing disorders, in the setting of a general
rehabilitation program. Modern research facilities enhance the student's training, not only in the speech and hearing sciences, but in speech pathology and audiology as well.

Three major areas of concentration are provided: speech pathology, audiology, and speech and hearing sciences. While a student may specialize in any one of the three, he is expected to have some background in the other two as well. Undergraduate programs provide specializations for the degree only in speech pathology and/or audiology.

The courses in the Division are numbered according to the following scheme:

- 0 to 9 on any level (0 to 9, 100 to 109, 200 to 209, etc.) are general
- 10 to 39, Speech Sciences
- 40 to 59, Speech Correction
- 60 to 79, Combined Speech and Hearing
- 80 to 99, Audiology (hearing)

Candidates for the A.M. and Ph.D. degrees are allowed credit toward graduation for only those courses in the Division numbered 200 and above.

**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>140</td>
<td>Speech Re-education</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></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>
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<tr>
<td>Electives</td>
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<tr>
<td>Speech and Drama 20. Public Speaking: Practice and Criticism</td>
<td>3</td>
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<tr>
<td>Speech and Drama 1. Characteristics of Spoken Language or</td>
<td>3</td>
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<tr>
<td>Speech and Drama 30. Oral Interpretation</td>
<td>3</td>
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Completion of either of the following programs:

a) 168. Clinical Methods ........................................... 3
b) 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).

While 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, while 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—but he is expected to acquire a substantial background in the other two as well.

The doctoral program cannot be laid out in advance in terms of specific courses routinely required, but it is planned individually with the needs and interests of the candidate in mind. The general University requirements for the doctorate are followed as they apply to residence, application for candidacy, etc. A reading knowledge of one foreign language is required.

All doctoral candidates must complete the following courses: 300 (Introduction to Graduate Study), 308 (Research Methods), and 400 (Doctoral Research) which is the formal course registration for the dissertation. Fifteen units of 400 must be included in the candidate's program. The candidate is expected to attend a special doctoral dissertation seminar during each quarter of his residence or until his dissertation has been completed. (See course 400 for days and hours.) Candidates for the doctorate may include a formal minor as a part of their total program. The minor is chosen in consultation with the candidate's major adviser, but the content and details of the minor program are specified and administered by the department in which the minor is taken.

Examinations—The doctoral candidate takes the same diagnostic examinations as described earlier for the Master's degree. He also takes an additional higher-level
examination covering these same five subjects to be used as a basis for program planning. Not later than the beginning of the quarter in which the candidate expects to take his University oral examination, he must pass written examinations administered by the Division covering the three fields: speech pathology, audiology, and speech and hearing sciences, with the major emphasis being placed upon the candidate's area of specialization. This is followed by an oral examination administered by the staff of the Division as a 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. The services of the Clinic are available without charge to students within the University by registering for Speech Pathology and Audiology 1. Clinical work with children and adults is performed on both an individual and a group basis. Adult stuttering and lipreading groups meet weekly. Information concerning any of the services of the Clinic can be obtained by calling the Clinic reception desk—321-1200, Local 5416.

**Scholarships and Assistantships**

The University has a number of scholarships and fellowships available. Particulars are to be found in the annual Information Bulletin distributed from the Registrar’s Office. In addition, the Phi Chapter of Kappa Alpha Theta Fund and the J. D. Zellerbach Fund provide scholarships specifically for graduate students in Speech Pathology and Audiology. Application for these special scholarships should be made directly to the Director of the Division of Speech Pathology and Audiology.

Some teaching, research, and clinical assistantships are available to students who have sufficient background of training and experience. Some of these involve employment in near-by medical and research facilities and hence offer valuable experience in addition to the financial remuneration. In addition, traineeships from the Vocational Rehabilitation Administration and fellowships from the Children’s Bureau are available for graduate students with the proper qualifications. A limited number of postdoctoral fellowships in audiology are available from the National Institute of Neurological Diseases and Blindness. Application for these traineeships and fellowships should be made directly to the Division of Speech Pathology and Audiology.

**Courses**

1. **Speech Clinic**—Remedial work in speech disorders, hearing problems. Open to all students in need of corrective treatment.  
   *No credit, any quarter, (-------, Staff), by arrangement*
60. **Introduction to Speech Therapy and Hearing**—Elective, to acquaint undergraduate student with subject matter, vocational opportunities, in fields of speech therapy and hearing. Lectures, demonstrations, films.
   2 units, spring, (Puich, Staff), Th 3:15-5:05

101. **Independent Study**—Individual study under direction in fields or subjects of special interest. Credit limited to 6 units.
   1 to 3 units, any quarter, (Staff), by arrangement

110. **Principles of Phonetics**—English phonetics as applied to articulation, standards of pronunciation, teaching of speech, speech correction.
   4 units, autumn, (Seefeldt), MTWF 1:15
   summer, (———), MTWThF 2:15

112. **Introduction to Phonetic Theory**—Descriptive and historical phonetics as applied to English. Prerequisite: some acquaintance with phonetic transcription.
   2 units, autumn, (Bush), MTWF 1:15

130. **Introduction to Speech Science**—Anatomy and physiology of voice and speech, with application to theories of voice production and vocal therapy.
   4 units, winter, (Bush), MTWF 2:15

140. **Speech Re-education**—Fundamental training in recognition, treatment of more common types of vocal, articulatory disorders.
   4 units, autumn, (Anderson), MTWF 9

141. **Speech Correction**—Classification, diagnosis, treatment of speech disorders. Supervised observation in Speech Clinic.
   5 units, winter, (Anderson), MTWF 10 and one hour by arrangement

168. **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

180. **Introduction to Audiology**—Anatomy, physiology, acoustics of hearing; survey of field of audiology.
   4 units, autumn, (Neivby), MTWF 8

**ADVANCED UNDERGRADUATE AND GRADUATE COURSES**

220. **The Psychology of Speech**—Origin, development of speech, semantics; relation of speech to thought, emotion, personality.
   4 units, winter, (Eisenson), MTWF 9

222. **Models for Communication**—A discussion of the various organizational structures imposed on language for the purpose of analyzing, controlling, or refining communication. Systematic patterns ranging from simple grammar to information theory are scrutinized and evaluated.
   4 units, summer, (Schubert), MTWThF 11

230. **Advanced Speech Science**—Acoustic characteristics of voice and speech.
   3 units, spring, (Huntington), MWF 1:15

232. **Principles of Voice Training**—Theories, methods of training speaking voice as applied to both normal, abnormal voice. Problems in teaching of diction. Prerequisites: some background in voice and a course in phonetics.
   3 units, spring, (Anderson), MTWF 2:15
   summer, (Anderson), MTWF 1:15

241. **Advanced Speech Correction**—Emphasis on more serious types of speech disorders. Unless otherwise arranged, the student is expected to register for one or more units of 270 concurrently with this course.
   4 units, spring, (Anderson), MTWF 10

250. **Stuttering**.
   3 units, winter, (Font), MWF 1:15
   summer, (———), MTWF 10

252. **Aphasia**—Historical survey, pathology; methods of testing, diagnosis, therapy.
   3 units, autumn, (Eisenson), MWF 9
253. **Aphasia in Children**—Language and related disorders. Registration by permission.
   3 units, spring, (Eisenson), MWF 9
   summer, (Eisenson), MTWF 9

254. **Speech Problems in Cerebral Palsy**.
   3 units, winter, (Puich), T 11:00-12:50 and W 11

255. **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

270. **Clinical Practice in Speech and Hearing**—Prerequisite: 141 or equivalent, or permission of instructor.
   1 to 4 units, any quarter, (Puich, 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, winter, (Dixon), MTWF 8 and one hour by arrangement

284. **Advanced Clinical Audiology**—Differential diagnostic procedures. Prerequisite: 281 or equivalent.
   4 units, spring, (Dixon), MTWF 8
   summer, (Dixon), MTWThF 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), T 2:15-4:05

289. **Aural Rehabilitation**—Speechreading, auditory training, and speech training for the acoustically handicapped.
   4 units, spring, (Seefeldt), MTWF 11
   summer, (———), MTWThF 10

290. **Language Training for the Deaf Child**—Unless otherwise arranged the student is expected to register for 1 unit of 270 concurrently with this course. Registration by permission.
   4 units, autumn, (Puich), MTWF 10

291. **Hearing Aids and Residual Hearing**—Amplification as a rehabilitative measure. Counseling and training the hearing-aid user. Registration by permission.
   3 units, autumn, (Dixon), MWF 8

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. Credit limited to total of 8 units.
   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), T 9-11 and two hours by arrangement

311. **Experimental Phonetics II**—Study of experimental work in acoustic characteristics of speech. Lectures, demonstrations, laboratory.
   4 units, winter, (Huntington), Th 9-11 and two hours by arrangement

320. **Psychoacoustics**—Study of the literature on nature of auditory stimuli, their perception. Special emphasis on speech. Lectures, demonstrations, laboratory.
   4 units, spring, (Huntington), T 9-11 and two hours by arrangement
330. Seminar in Speech Sciences—Material will vary from year to year; hence, may be repeated for credit.
4 units, 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, (Anderson), MW 3:15-5:05
winter, (Anderson), MF 3:15-5:05
3 units, summer, (Anderson), 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—Basic principles of electronic circuits. Description and application of instrumentation commonly used in speech and hearing sciences. Registration by permission.
3 units, autumn, (——), M 7-10 p.m.

370. Clinical Internship—In-service clinical practice and observation in selected speech and hearing centers. Registration by permission.
2 to 12 units, any quarter, (——, Staff), by arrangement

380. Seminar in Audiology—Material will vary from year to year; hence, may be repeated for credit.
4 units, winter, (Newby), MF 3:15-5:05
3 units, summer, (Newby), MW 3:15-5:05

3 units, spring, (——), MWF 10

4 units, summer, (Schubert), MTWThF 9

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: F. Thomas Algard, A. Kent Christensen
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, in so far as facilities permit, all of the courses are open
to other properly qualified third- and fourth-year undergraduate and graduate stud-
ents. Those who are not registered in medicine but wish to take work in the De-
partment 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 prob-
lems 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 sum-
marized 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 ex-
pected that an average grade of B will be maintained. Approval must also be obtained
by graduate students in other departments who wish to elect anatomy as a minor.

COURSES

112. Embryology — Lectures on normal and abnormal human development. For
medical, graduate, and senior undergraduate students. Enrollment by permission of
instructor.
  3 units, spring, (Algard), TThF 4:15-5:05

#114. Practical Anatomy—Brief survey of human body by dissection, study of
anatomical preparations. Lectures, demonstrations. For students of nursing, physio-
therapy, hygiene, physical education, or others similarly qualified. Cannot be sub-
stituted for any part of Anatomy 121.
  5 units, autumn, (Peckham), 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, Baba, Peckham), Th 1:15-4:05 and S 8:00-11:50
  5 units, spring, (Stillwell, Turner, Peckham), W 2:15-5:05 and ThF 1:15-4:05

122. Normal Histology and Microscopic Anatomy—Elementary structure, ac-
tivities of the animal cell; histology; development of tissues, their combination into
the organs of vertebrates, with special reference to man.
  2 units, autumn, (Kirkman, Algard, Christensen), S 9:00-11:50; W 2:15-5:05 (last
  2 weeks)
  1 unit, spring, (Kirkman, Algard, Hunter), S 8:00-10:50

145. Individual Work—When circumstances warrant, work not specifically pro-
vided for in scheduled courses may be carried on under supervision of one or more
members of staff.
  Any quarter, (Staff), by arrangement

201. Topographical Anatomy—Laboratory study of fetal, infantile, adult cadav-
ers; dissected and specially injected preparations, student reports relevant to this
material. Prerequisites: 121 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, prerequi-
sites: 121 and a course in embryology.
  Any quarter, (Gray, Algard), by arrangement

207. Histological and Cytological Technique—General principles of micro-
technique, practice in their application. Introduction to some of the more precise cytological techniques. Enrollment limited. For medical and graduate students only.

3 to 6 units, any quarter, (Kirkman), by arrangement

208. Special Cytology — Practical laboratory introduction to special phases of nuclear, cytoplasmic cytology. Chief emphasis on use of technical methods for study of cytoplasmic organoids, inclusions. Enrollment limited. Prerequisites: 122 and 207.

3 to 6 units, any quarter, (Kirkman), by arrangement

209. Fine Structure of Cells—Lectures on the structure and function of cells as revealed by the electron microscope. Prerequisites: Biology 103 or Anatomy 122, and permission of instructor.

3 units, autumn, (Christensen), TThF 4:15-5:05

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, Baba,———), 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, (Stilwell, Turner, Baba), S 9:00-11:50

222. Normal Histology and Microscopic Anatomy.

1 unit, autumn, (Kirkman, Algard, Hunter), F 9:00-11:50

2 units, winter, (Kirkman, Algard, Hunter), 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, Christensen), MWF 9:00-11:50

BIOCHEMISTRY

Executive Head: Arthur Kornberg
Professors: Paul Berg, Arthur Kornberg
Associate Professors: Robert L. Baldwin, David S. Hogness, A. Dale Kaiser, I. Robert Lehman
Assistant Professors: George R. Stark, Lubert Stryer

PROGRAMS OF STUDY

The Department offers a first-year course in modern biochemistry which is required of medical students and open to qualified graduate students and senior undergraduates. Also a series of advanced courses are given by the Department; these are open to medical and graduate students who have completed the first-year course. (Additional qualifications are necessary for certain courses.)

ADVANCED DEGREES

The degree of Doctor of Philosophy is given by the Department, but not the Master’s degree. Remission of fees and a personal stipend are available to those students accepted. For further information, applicants should write to Dr. A. D. Kaiser. A strong undergraduate background in chemistry (both physical and organic) is recommended. General University regulations about the Ph.D. degree are summarized in the section “Degrees” in this Bulletin; the requirements of the Biochemistry Department are tailored to fit the background and interests of the student. Graduate students in other departments who wish to choose Biochemistry as a minor must obtain the approval of the Department.
Postdoctoral research training is available to graduates holding a Ph.D. or M.D. degree. Several fellowships, carrying stipends at current national levels, are awarded by the Department. Qualified graduates may apply to the departmental executive for further information. At present the chief research interests of the Department are in nucleic acids and proteins: their enzymatic synthesis, chemical structure, and biochemical functions; and in the biochemistry of viral infection.

COURSES

101, 102. Biochemistry Lectures—These deal with basic biochemistry, and with special biochemical aspects of the various life processes. Required of medical students in Year I, and open to graduate and advanced undergraduate students.

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

201. Research and Special Advanced Work.

By arrangement


By arrangement

211. Biochemical Genetics—The structure of genes and chromosomes and viruses; the mechanisms of mutation and recombination; virus multiplication. Prerequisites: 101, 102, and a knowledge of elementary genetics.

2 units, winter, (Kaiser), offered triennially, to be given in 1966–67

212. Recent Advances in Electron Transport and Oxidative Phosphorylation—An examination of attempts to define the composition and sequence of the enzymes and electron carriers in mitochondrial electron transport systems; a review of current investigations of the mechanism of oxidative phosphorylation. Prerequisites: 101, 102, and three quarters of organic chemistry.

2 units, autumn, (Lehman), offered triennially, to be given in 1964–65

213. Biosynthesis of Proteins—Aspects of peptide bond formation; the factors determining amino acid sequence, secondary and tertiary structure; induction and repression of protein synthesis. Prerequisites: 101, 102 and consent of the instructor.

2 units, winter, (Hogness), offered triennially, to be given in 1964–65

214. Physical Chemistry of Proteins and Nucleic Acids—Theory and interpretation of physical measurements on macromolecules; structures of nucleic acids. Prerequisites: 101, 102, first-year physical chemistry, and knowledge of calculus. Consent of instructor required both for auditors and students enrolling for credit.

2 units, autumn, (Baldwin), offered triennially, to be given in 1965–66

215. Problems of Current Interest in Biochemistry—Detailed analyses of subjects of current interest in biochemistry and related fields. Will include discussions on such subjects as biosynthetic mechanisms, mechanism of enzyme action, and enzyme kinetics. Prerequisites: 101, 102 and three quarters of organic chemistry; first-year physical chemistry recommended also. Consent of instructor required both for auditors and students enrolling for credit.

2 units, winter, (Berg), offered triennially, to be given in 1965–66

217. Physical Chemistry of Proteins—Theory and interpretation of optical and x-ray diffraction methods. Structures of proteins. Prerequisites: 101, 102, introductory physical chemistry, and knowledge of calculus. Consent of instructor required both for auditors and students enrolling for credit.

2 units, spring, (Stryer), offered triennially, to be given in 1964–65

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, spring, (Stark), offered triennially, to be given in 1965–66
GENETICS

Executive Head: Joshua Lederberg*
Professor: Joshua Lederberg
Associate Professor: Eric M. Shooter
Assistant Professors: Walter F. Bodmer, Leonard A. Herzenberg
Research Physicist: Elliott C. Levinthal

* Director, Lt. Joseph P. Kennedy, Jr. Laboratories for Molecular Medicine.

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, 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, in particular, Biology 25.

COURSES

199. Supervised Study.
200. Individual Research.
201. Medical Genetics—Topics in general genetics and their application to human biology and pathology. Nonmedical students who wish to enroll in this course must obtain special permission from the Department of Genetics.

2 units, spring, (Staff), ThF 8
301. Medical Genetics—Continuation of 201.  
2 units, spring, (Staff), TW 8

302. Genetics Seminar.  
(Staff), alternate F 4:15, (alternating with Biochemistry 202)

306. Genetics of Somatic Cells and Tissues—Genetic studies of somatic cells in vivo and in culture. Genetics of transplantation. Prerequisite: Biology 25 or equivalent, or consent of the instructor.  
2 units, winter, (Herzenberg), T 4:15, alternate years, to be given in 1965-66

307. Epigenetics—Developmental genetics, gene-cytoplasm relationships and cytoplasmic inheritance. Prerequisite: Biology 25 or equivalent, or consent of the instructor.  
2 units, winter, (Bodmer), by arrangement, alternate years, to be given in 1964-65

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 Professors: Robert J. Roantree. Clinical: Emmett L. Durrum
Assistant Professors: Leon T. Rosenberg. Preclinical: William Dudley Moore

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 25, 29, 124, 148a and b; Biochemistry 101 and 102; completion of the foreign language requirement (one language). The following courses are recommended depending upon the field of major interest of the candidate: Anatomy 112, 122 (or Biology 103); Biochemistry 102a; Chemistry 171, 173, 175, 246; Mathematics 10, 11, 21, 22, 23; General Human Pathology (autumn, winter and spring quarters, Wednesday 9-12); and Psychology 60 or Statistics 50.

A grade average of B in Departmental and related subjects is required for admission to research work. In addition to this, the student is expected to pass an oral examination covering the fundamentals of general and medical microbiology, immunology and virology toward the end of his first year of graduate work. Students who enter the Department with advanced standing in microbiology from other institutions are expected to take the final examination in Course 225, and in such other courses as may be stipulated, at the earliest time these examinations are regularly scheduled. In addition, such students are also required to pass the oral examination during their first year of residence.

COURSES

101. General Bacteriology—Survey of fundamental aspects of bacteriology. Prerequisites: Biology 1, 2, 3, and Chemistry 1, 2, 3.
   5 units, autumn, (Clifton, Staff), MWF 11; lab. MW 1:15-4:05

221. 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 or 221.
   5 units, spring, (Staff), M 8-12 and WF 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, Green), 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, Rosenberg, Raffel, Roantree, Schwerdt), by arrangement

300. Research—Students who have satisfactorily completed necessary foundation courses may elect research work in: (a) general bacteriology, including bacterial physiology; (b) pathogenic bacteriology; (c) immunology and serology; or (d) virology. Grade average of B in bacteriological subjects required for admission to research or thesis work.

5 to 10 units, any quarter, (Clifton, ——, Rosenberg, Raffel, Roantree, Schwerdt), by arrangement

315. Seminar—Reports, discussions on selected topics. Required of all graduate students.

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

316. Literature Reviews—Review of literature on special topics assigned by instructor.

3 to 5 units, any quarter, (Clifton, ——, Rosenberg, Raffel, Roantree, Schwerdt), by arrangement

333. Current Topics in Immunology—An intensive review of the current literature in one or a few selected areas of interest chosen from among the following: specificity, immunogenicity, genetic variants of serum proteins, tissue specific antigens. Prerequisite: permission of the instructor.

2 units, winter, (Rosenberg, Raffel, Roantree), by arrangement

**OBSTETRICS AND GYNECOLOGY**

*Executive Head:* Charles E. McLennan

*Professor:* Charles E. McLennan

*Assistant Professors:* Robert C. Goodlin, Emmet J. Lamb, Eugene C. Sandberg

*Research Associates:* Allen H. Gates, Margaret T. McLennan

**PROGRAMS OF STUDY**

While the principal instruction in the Department is for students in medicine, candidates for the degree Master of Arts in Medical Sciences may major in Physiology of Reproduction. Candidates will be expected to have completed 45 quarter units, at least 15 units of which shall be from the following courses (or their equivalents): Anatomy 122, 145, 204, 222; Biochemistry 101, 102; Biology 103, 105, 142, 143, 152, 168; Physiology 102, 207, 208; Statistics 50, 151; and 30 units of research in reproduction (Obstetrics-Gynecology 400). Each candidate will be expected to pass an oral examination covering the fundamentals of mammalian reproduction, and submit an acceptable thesis. In addition the University requirements regarding the Master's degree, as given in the section "Degrees" of this Bulletin, must be fulfilled.

**COURSES**

400. Research in Reproduction—Advanced course for graduate students registered in the School of Medicine, or for students working toward the degree of Master of Arts in Medical Sciences, or toward the Ph.D. under the Graduate Division Special Programs. Detailed study of particular topics in reproduction planned for the individual student by the appropriate staff member, supervised laboratory experiments, weekly 1-hour seminar. Prerequisites: Biology 12, 16, and 25 or their equivalent.

(Staff), by arrangement
401. Physiology of Reproduction—Open to first-, second-, and third-year medical students, upper division students majoring in biology, and graduate students. Limited to 8 students per quarter. Project research using experimental animals in the laboratory. One or two students and a preceptor select and complete a particular project each quarter, or may continue project in subsequent quarters. One 2-hour laboratory period and seminar.

2 units, (Staff), by arrangement

PATHOLOGY

Executive Head: Alvin J. Cox, Jr.
Professors: Alvin J. Cox, Jr., David Glick, Lelland J. Rather
Associate Professors: Stanton L. Eversole, Bruno Gerstl
Assistant Professors: Robert C. Rosan, P. Richard Ruffolo, Alexander M. Saunders
Instructors: Jon Craig Kosek, Lloyd Silverman
Teaching Assistant: George B. Reed

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
Instructor: Ernest F. Zimmerman

PROGRAMS OF STUDY

The principal instruction offered by the Department of Pharmacology is for students in medicine. However, the required courses for medical students (Pharmacology 101, 201, 301) and elective courses are also open to qualified graduate students not registered in medicine. Programs leading to the degree of Doctor of Philosophy must be worked out by each student with the Department faculty. Candidates for the degree of Master of Arts are not accepted. Research opportunities are available
for qualified students and for post doctoral fellows. Prospective candidates for an advanced degree should consult the University's general requirements described in the section "Degrees" in this Bulletin. Consult Time Schedule for additional elective courses.

COURSES

101, 201, 301—In the curriculum for medical students pharmacology is taught over a three-year period in the interdepartmental course in the Basic Medical Sciences. Students not enrolled in the School of Medicine may take these courses for credit, by special arrangement. For details see the School of Medicine Bulletin.

202. 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, spring, (Kalman), T 4:15-6:05

203. Cellular Regulatory Mechanisms in Carbohydrate Metabolism—A course of lectures and discussions on the different regulatory processes which keep the carbohydrate catabolic reactions in the cell in pace with its energy requirement; the effect of different hormones on the carbohydrate metabolism on cellular and subcellular level. Prerequisite: Biochemistry 101 (first quarter) or equivalent.
   1 unit, winter, (Mansour), T 4:15, to be given in 1965-66

204. Recent Advances in Molecular Pharmacology—Assigned readings and discussion of selected topics in the recent literature. Students should be conversant with modern biochemistry and genetics, and should have taken (or be taking) courses in physiology and general pharmacology.
   1 unit, spring, (Goldstein), T 4:15, to be given in 1965-66

205. Regulation of Calcium Transfer in Biological Systems.
   1 unit, autumn, (Dreisbach), T 4:15, to be given in 1965-66

206. 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

207. The Anti-Cancer Drugs—The biochemical mechanism of action of the important cancer chemotherapeutic agents will be discussed, with special emphasis on the problem of drug resistance. The clinical use of these drugs will not be included.
   1 unit, winter, (Aronow), T 4:15

208. Neuropharmacology—Fundamental considerations in the study of drug action on the central nervous system.
   1 unit, spring, (Killam), T 4:15

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

210. 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

211. Introduction to the Scientific Literature—Assigned readings and oral reports. Limited to graduate students in pharmacology.
   1 unit, autumn, (Goldstein), by arrangement

212. Research Methods in Pharmacology—Training in laboratory techniques applicable to pharmacological research. Primarily for graduate students in pharmacology.
   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
PROGRAMS OF STUDY

The Department of Physiology offers (1) Required and elective courses for students in the School of Medicine, open also to qualified graduate students in other Schools (See School of Medicine Bulletin); (2) Introductory courses for undergraduate students fulfilling General Studies, Physical Education major and School of Nursing requirements; (3) Undergraduate courses leading to the degree of B.S. in Physiology, open also to qualified undergraduate and graduate students in other disciplines; (4) Graduate courses intended primarily for students preparing for the M.S. or Ph.D. degree in Physiology but open to qualified students in other disciplines; (5) Laboratory research training leading to the degrees of M.S. and Ph.D. in Physiology.

Bachelor of Science

Students working for the degree of B.S. (Physiology) are expected to acquire (1) the basic knowledge of mathematics, physics, chemistry and biology essential for understanding of modern physiological research; (2) basic knowledge of the main aspects of physiology, including mammalian, general and comparative physiology. Minimum requirements under (1) are usually completion of Mathematics 41, 42, and 43; Physics 21, 23, and 29; Chemistry 1, 2, 3, 121, and 123; Biology 10, 11, and 12. Minimum requirements under (2) are satisfactory completion of courses Physiology 100, 101, and 102, also 103 or Biology 14 and at least one quarter of Physiology 201. Specific curricula will be designed in consultation with department advisers considering the needs and interests of individual students. Work in statistics, computer science, and electrical engineering is encouraged. It is highly desirable that students electing the physiology major should declare this intention as early as possible, i.e. during their sophomore year, so that a course of study may be planned that combines orderly completion of specific requirements with maximum utilization of general educational opportunities.

GRADUATE STUDY

Priority is given to students who have a declared intention to complete requirements for the degree of Ph.D. in Physiology but candidates for the degree of M.S. in Physiology and students without aspirations toward an advanced degree in Physiology may be accepted when the proposed program of study meets a sound educational objective. Undergraduate training in physiology is not a prerequisite. Applicants with backgrounds in the physical sciences and engineering are considered especially appropriate. Both M.S. and Ph.D. programs require acquisition of substantial skill in laboratory techniques and significant accomplishment in independently conducted research, the results of which are to be submitted in the form of a Thesis (M.S.) or Dissertation (Ph.D.). Opportunities for participation in teaching are offered to advanced graduate students. Medical students with adequate basic training who choose
to devote most of their "free time" to research should find it possible to complete Ph.D. requirements within 12 to 15 months after completion of formal medical training. Students accepted as candidates for the degree of Ph.D. in Neurological Sciences may elect to conduct their research in the Department of Physiology.

The objective of the Department in graduate training is to train professional physiologists who will contribute notably to the advancement of basic research in physiology and to the training of future physiologists. Ability to use mathematical methods, including application of analog and digital computing techniques to the analysis of complex systems, has become essential in many areas of physiological research and basic training in these subjects is therefore required for the Ph.D. The Department accepts graduate students with strong undergraduate backgrounds in either the biological sciences or the physical sciences (including engineering), with the intention of ensuring that these backgrounds are complemented by additional course work in appropriate areas plus intensive laboratory training in one or more areas of physiological investigation. The "Degrees" section of this Bulletin should be consulted for information on general University requirements for the M.S. and Ph.D. degrees. The duration of training necessary for completion of Departmental requirements varies considerably depending upon the extent and nature of prior training. Minimum registration is 3 quarters for the M.S. and 9 quarters for the Ph.D., but completion of all requirements usually involves 6 and 9 to 12 quarters of work respectively. Of this time, 50 to 70 per cent will usually be devoted to laboratory research.

Master of Science

Basic requirements in subjects other than Physiology are similar to those for the Bachelor's degree (see above). Additional work in physical chemistry and medical biochemistry is desirable. Required courses in Physiology are 103, 150, 250, and 350 plus Physiology 201 in all quarters of registration. Students may be allowed to substitute parts of the undergraduate sequence 100-102 for parts of the 150-350 sequence when scheduling problems prevent the completion of the latter: B performance is required in all undergraduate courses. A satisfactory protosthesis, reviewing the area of proposed research, must be completed by the end of the third quarter of registration (preferably sooner) and an acceptable thesis, based on original laboratory research performed by the candidate, must be completed before the student is recommended for graduation.

Doctor of Philosophy

"Basic training" for the Ph.D. in Physiology is considered to include satisfactory completion of courses (or equivalent work) in Mathematics 130, 131, and 132; Statistics 110 and 116; Computer Science 136 and 137; Chemistry, including Organic Chemistry 121 and 123, Physical Chemistry 171 and 173 and Medical Biochemistry 101 and 102; Physics 51, 53, 55, and 57; Biology 10 to 14 inclusive and selected courses in electrical engineering, including control systems analysis. Specific requirements in Physiology are as follows: 103, 150, 250, and 350 with B performance in all required examinations; Physiology 201 to be taken in all quarters of registration (except terminal registration); all advanced courses (course numbers above 200) that are offered during the period of registration, also Biology 166 (Nervous System and Sense Organs).

Qualifying Examination—Satisfactory performance in a qualifying examination in Physiology is required as a condition for formal admission to candidacy for the Ph.D. This is a comprehensive written examination divided into six or more sections, each of which must be passed at the same examination period. The Department may, in case of doubt, ask the candidate to appear for oral examination also but the candidate may decline such examination and elect to be reexamined in the written mode.
at a later date to be determined by the Department. Qualifying examinations are usually given once a year in spring quarter. Students are expected to complete their qualifying examinations not later than the end of the seventh quarter of graduate work.

Language Examinations—Ph.D. candidates must, prior to formal application for admission to candidacy, pass an appropriate examination in the German language. A similar examination in a second foreign language that is, in the opinion of the Departmental committee on graduate study, pertinent to physiological research, must be passed before the student requests scheduling of his University oral examination. A student may petition to substitute another major foreign language for German if he is prepared to show that such language is of equal or greater importance to the area of research in which he is working. A student may also petition to substitute for a second foreign language evidence of proficiency in a technique, not otherwise required of Ph.D. candidates in Physiology, that is nevertheless of major importance to physiological research. A proposed course of studies leading to acquisition of such skill must be approved by the Department.

Dissertation and University Oral Examination—Candidates must complete a research project in Physiology that constitutes a substantial contribution to knowledge and represents the independent work of the candidate. This work may be carried out under the guidance of one or more members of the Department of Physiology (Plan A) or of an interdepartmental group appointed by the Dean of the Graduate Division (Plan B). The results of this research are to be incorporated in a dissertation, no fewer than five draft copies of which must be submitted to the principal research adviser for distribution to the members of the oral examining committee at least 21 days before the scheduled date of the examination. These draft copies must be typewritten, complete in all respects and essentially in the final form. Illustrations (if any) are to be included. The oral examination will be mainly a “defense of the dissertation” and the candidate will be expected to demonstrate that he is thoroughly familiar with previous and current work in the area of his research, to defend his work against legitimate criticism and to satisfy the committee that he has the qualities of a research scholar. The examination is of not more than three hours duration and is carried out by a committee appointed by the University Committee on the Graduate Division. Finally the candidate must submit a completed dissertation in the prescribed form that is satisfactory in form and substance to the reading committee appointed by the University Committee on the Graduate Division (if Plan A). The composition of this committee is not the same as that of the oral examining committee. The completed dissertation should be submitted no more than three months after the oral examination.

FINANCIAL AIDS

For details of scholarships and fellowships administered by the University consult the Information Bulletin. Some research assistantships and teaching assistantships are available to graduate students who have completed substantial work in physiology. Completion of 100, 101, and 102 or equivalent is considered minimum. Tuition aid may be awarded to students holding research assistantships.

Predoctoral fellowships from the National Science Foundation, the U.S. Public Health Service and other organizations are available to qualified students. Undergraduate students in their senior year are eligible to apply for support to become effective on admission to graduate school. Details of these fellowships may be sought in the Department, from the Graduate Study office or by writing to the awarding agencies.

COURSES

#90. Elementary Human Physiology—Survey of human physiology for undergraduate students, including those in nursing and physical education.

3 units, winter, (Davidson, Lindsley), MWF 9
#91. Elementary Human Physiology Laboratory—Limited enrollment. Concurrent registration in 90 required.

2 units, winter, (Davidson, Lindsley), TTh 1:15-4:05

100. Principles of Human Physiology—The first quarter of a three-quarter sequence open to students in the biological, physical, social and medical sciences with sufficient background in cognate sciences. Subject matter: control mechanisms, the cell and its environment, body fluids, circulation, and respiration. Prerequisites: completion of one year each of college chemistry and college biology. College courses in physics or mathematics may be substituted in part for the above.

3 units, autumn, (Grant, Staff), MW 10; lab. W 1:15-4:05

101. Principles of Human Physiology—Intended to follow 100 but students in physical therapy and psychology (also other students with consent of the instructor) may register without having completed 100. Subject matter: the neuromuscular system, autonomic nervous system, sensory system, and central nervous system. Prerequisites as for 100.

5 units, winter, (Grant, Staff), MWF 10; lab. MW 1:15-4:05

102. Principles of Human Physiology—Intended to follow 100-101; students may register without this preparation only with consent of instructor. Subject matter: gastrointestinal physiology, metabolism, nutrition, temperature regulation, kidney function, endocrinology, and reproduction. Prerequisites as for 100.

4 units, spring, (Grant, Staff), MWF 10; lab. W 1:15-4:05

103. General Physiology—Applications of physical chemistry to basic physiological phenomena. Lectures on elementary thermodynamics and chemical kinetics, demonstrations and analysis of results by mathematical methods. Topics include colligative properties, pH, ion transport in relation to bioelectric phenomena and hemolysis, surface phenomena, blood coagulation, and muscular contraction. Open to all students with adequate preparation: required of Physiology majors. Prerequisites: one year of college chemistry and physics, Mathematics 10 or equivalent.

3 units, winter, (Feigen), MWF 9

167. Undergraduate Problems—Advanced exercises in physiology, including both laboratory and literature research problems. May be taken before completion of the 100–102 sequence with appropriate choice of problems and may be repeated for credit.

Any quarter, (Staff), by arrangement

201. Colloquium in Physiology—Reports on current research activities in the Department and on current literature. Presentations by students: discussion by students and faculty. Required of all graduate students in Physiology during all quarters of registration and recommended for undergraduate students who have completed 100–102. May be repeated for credit.

1 unit, autumn, winter, spring, (Staff), T 4:15-6:05

203. Isotopic Analyses in Physiology—Theory and application of isotopes to biophysical and metabolic problems in physiology. Lectures and laboratory.

3 units, spring, (Terres), Th 1:15-5:05 and by arrangement

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

208. Medical Physics—Discussion of some basic physical principles applied to physiological problems, e.g., thermal transfer, transduction of energy by sense organs, hemodynamics, bioelectric phenomena, diffusion, osmosis and tissue clearance. Minimum registration 8 students.

2 units, spring, (Yates, Thompson), by arrangement

301. Physiology of Water and Electrolytes—Metabolism of water and electrolytes especially in mammals. Detailed consideration of mechanisms of water and electrolyte economy and distribution.

2 units, autumn, (Crismon, Aschheim), M 1:15-3:05, alternate years, to be given in 1964–65
302. **Physiological Control Systems**—A lecture course for biologists on the mathematical approach to comparative mechanical, electrical and biological systems. Includes treatment of first and second order linear systems, special forcing functions, Laplace transform in the solution of certain linear differential equations, stability analysis by Bode, Nyquist and root-locus diagrams, feedback. Prerequisites: Mathematics 41 or 42 or equivalent knowledge of calculus.

*3 units, winter, (Thompson, Yates), W 4:15-6:05 and F 4:15-5:05*

303. **Physiological Control Systems**—Continuation of 302. Systems analysis approach to the characteristics of selected physiological systems under negative feedback control. Examples for detailed analysis include regulation of arterial pressure, alveolar ventilation, adrenocortical function, pupillary area and hand position. The course will include introduction to the use of analog computers in the study of physiological systems. Students in the course will have experience with the computer. Prerequisite: 302 or equivalent.

*3 units, spring, (Thompson, Yates), W 4:15-6:05 and F 4:15-5:05*

304. **Immune Reactions**—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 and tissue anaphylaxis. Limited to 15 students. Prerequisite: Biology 105 or consent of instructor.

*4 units, autumn, (Feigen, Terruc), M 4:15-5:05; lab. Th 9:00-4:05*

305. **Advanced General Physiology**—A continuation of 103 with emphasis on experimental design and suitability of instrumental and mathematical methods. Prerequisite: 103 or equivalent.

*2 units, spring, (Feigen), by arrangement, alternate years, to be given in 1964-65*

306. **Current Problems in Muscle Physiology**—Discussion of selected biophysical, pharmacological and immunological aspects of muscle contraction; evaluation of modern theories of contractility.

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

307. **Current Problems in Neurophysiology**—A seminar on recent research in neurophysiology, including biophysical and behavioral aspects. Open to qualified students in Psychology. Prerequisite: 350 or consent of instructor.

*2 units, spring, (Grant, Lindsley), two hours, evening, by arrangement*

308. **Current Problems in Neuroendocrinology**—Detailed study of certain aspects of nervous and endocrine system relationships with special emphasis on mechanisms for control of anterior pituitary function. Lectures, student presentations and discussions.

*2 units, autumn, (Davidson), by arrangement, alternate years, to be given in 1964-65*

309. **Special Topics**—Advanced discussion courses in specific areas of Physiology not covered by the advanced courses listed above may be organized on the basis of a request from a group of 8 or more students to the appropriate staff member.

350. **Neurophysiology**—Physiology of the mammalian central nervous system. Taught in conjunction with the Departments of Pharmacology and Medicine (Neurology) as part of a conjoint course in Neural Sciences.

*6 units, spring, (Grant, Lindsley), WS 8-12*

**Human Physiology**—150, 250. Medical School “core” courses open to qualified graduate students. See Medical School Bulletin for details.
BIOPHYSICS LABORATORY

Acting Director: Marsden S. Blois, Jr.
Assistant Professors: Kendric C. Smith (Radiobiology), Mitchel Weissbluth (Radiologic Physics)
Research Associates: Mary Cox, 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.

PROGRAMS OF STUDY

The program is designed for graduate students only, and leads to the degree of Doctor of Philosophy in Biophysics. The requirements for the degree are as follows:

1. Training in physics equivalent to that of an undergraduate physics major. At Stanford the minimum requirements are Physics 51, 52, 61, 100, 101, 110, 111, 120, 121, 122, 130, 131, 132, 172, 200, 201. Students with a comparable background will automatically satisfy this requirement; others will need to take only those courses in which deficiencies exist.

2. A 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:

   Minors in physics must take either Physics 210, 211, and 212 or Physics 130, 131, and 132, with the appropriate prerequisites. All physics minors must pass the comprehensive examination given to physics majors, but need take this examination only when they feel prepared for it.

   Minors in chemistry must complete, with a grade point average of 3.00 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, 271, 273, or 275.

   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) Physical chemistry (Chemistry 171, 173, 175)
   b) Biochemistry (Biochemistry 101, 102, 102a)
   c) Cell physiology (Biology 14) and Genetics (Biology 25)
   d) Biophysics 200, 210, 220, 230, 231, 232, 240, 245, 255
   e) Four units of any other life science courses which include laboratory work.
4. After fulfilling requirements (1), (2) and (3) the student will normally be advanced to candidacy and will concentrate on his research. Upon substantial completion of his research, the student will take the Departmental examination to be followed within a period of three months by the University oral examination.

5. Students must satisfy the University requirements for the Ph.D. degree (see "Degrees" section in this Bulletin), including reading ability in one language selected from French, German, or Russian.

6. The satisfactory completion of research and acceptance of the resulting dissertation conclude the requirements.

COURSES

200. Introductory Molecular Biophysics—Lectures, assigned readings, discussions, and problems relating to the application of physical methods and viewpoints to the understanding of living systems. Classical considerations of molecular biology (structural and energetic aspects of living systems) and physical properties of biological materials. Prerequisites: familiarity with basic physics, and one year each of general chemistry and biology.

2 units, autumn, (Blois), TTh 10

210. Cellular Biophysics—Physical and mathematical approaches to an understanding of the function and regulation of the cell and its component processes. Metabolic control systems in cells, application of chemical kinetics and absolute rate theory to cellular processes, application of theories developed for (mechanical) communication and control systems such as cybernetics, information theory, transfer function theory, etc. Prerequisites: 200 or permission of instructor.

2 units, winter, (Burns), TTh 10

220. 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.

3 units, spring, (Jacobs), by arrangement

230, 231, 232. Advanced Molecular Biophysics—Application of quantum mechanics to the properties and structure of biomolecules. Molecular orbital theory, energy 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 11
231. 2 units, winter, (Weissbluth), TTh 11
232. 2 units, spring, (Weissbluth), TTh 11


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, winter, (Hanawalt, Smith), F 11-1
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

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
COMPUTATION CENTER

Director: George E. Forsythe
Associate Directors: R. Wade Cole (Operations), Robert J. Langle (Administration)
Research Associates: R. Wade Cole, Donald D. Fisher, Roger W. Hockney
Affiliated Faculty
Professors: George E. Forsythe, John G. Herriot, John McCarthy, Robert V. Oakford, Daniel Teichroew
Assistant Professors: Gene H. Golub, Niklaus Wirth

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. Additional equipment is located in the East Wing basement of Encina Hall and in room 128B of the Graduate School of Business. Equipment currently maintained by the Center includes the IBM 7090/1401 system, the Burroughs B5000 and B220 computers 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 and 136.
Introduction to Electronic Data Processing—See Industrial Engineering 141 or Business 367.
FOOD RESEARCH INSTITUTE

Emeriti: Merrill Kelley Bennett, Karl Brandt, Joseph Stancliffe Davis, E. Louise Peffer, Vladimir P. Timoshenko, Vernon D. Wickizer, Holbrook Working (Professors)

Director: To be announced

Professors: Helen Cherington Farnsworth, Roger Winks Gray, Richard James Hammond, Bruce Foster Johnston, William Orville Jones, S. Daniel Neumark

Assistant Professor: Charles O. Meiburg

Research Associates: James O. Bray, Jacques J. Dumont, John A. Jamison, Philippe P. Leurquin, Klaus Poser, Arndt Uhlig

Associate Statistician: Rosamond H. Peirce

OFFERINGS AND FACILITIES

The Food Research Institute, founded in 1921, is concerned with problems of food supply, distribution, and consumption in their economic, social, and political aspects on a world-wide scale. The range of its investigations comprises world agriculture, international trade in primary products, rural development and economic growth, food-consumption levels, and marketing questions. Its research staff includes members trained in agricultural economics and agricultural policy, economics, and economic history.

The Institute's specialized library contains some 50,000 items, including up-to-date series of rare periodicals from over fifty countries, and is open for reference to students and others.

The Institute publishes a journal, Food Research Institute Studies, three times a year, which serves primarily as an outlet for staff research in progress. It has produced or sponsored over the years a large number of specialized books, as well as articles in professional journals.

PROGRAMS OF STUDY

As a joint product along with its research activities, the Institute offers a number of specialized courses of instruction, some of them unique in character. With one or two exceptions, these are addressed to graduate students. The Institute does not undertake supervision of studies leading to a Bachelor's degree, though certain of its courses may be counted toward a major in economics and in some special programs in other social sciences.

Students presenting evidence of high ability together with appropriate training, such as a Bachelor's degree or better, in economics or agricultural economics, may be accepted for graduate study in the Institute, leading to the degrees of Master of Arts and Doctor of Philosophy. Such students may expect to fulfill the requirements for the Master's degree within one year, and those for the Doctorate in a minimum of three years after having received an A.M. degree.

Master of Arts

The requirement for the Master's degree is the satisfactory completion of an approved program of study amounting to not less than 45 units of credit.

Doctor of Philosophy

Doctoral candidates are required to offer a minor in economics, statistics, or an approved equivalent.

A candidate must demonstrate a reading knowledge of two approved languages,
other than English, or he must demonstrate a reading knowledge of one language and offer an approved 15-unit program in mathematics, statistics, or other area in lieu of the second foreign language.

Inquiries from seriously interested advanced students wishing to pursue research in the Institute's field are welcomed.

FELLOWSHIPS AND SCHOLARSHIPS

The Food Research Institute has available a limited number of fellowships and scholarships for qualified students. University fellowships, in addition, are open to all students. Applications for all fellowships and scholarships should be made to the Office of Financial Aids, 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. Tropical African Economies—Traditional organization of production and distribution, economic achievements under European rule, economic problems of political independence. Food and agricultural economies, internal and external trade, levels and standards of living, national accounts, development plans, and capital formation.

3 units, winter, (Jones), MWF 11

170. Economic History of Agriculture in the United States—A survey of agricultural development in the United States from colonial times to the present, with special emphasis on factors contributing to increased productivity.

3 units, winter, (Meiburg), MW 2:15-4:05

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, (Neumark), by arrangement

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, spring, (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
261. Seminar: Economics of Tropical Agriculture — For graduate students only. To be taken with Food Research 160.
   2 units, winter, (Jones), by arrangement
270. Seminar: United States Agricultural Development—For graduate students only. To be taken with Food Research 170.
   2 units, winter, (Meiburg), by arrangement
   4 units, spring, (Poser), MW 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
The Graduate Division Special Programs make provision for students whose plans for study toward the Ph.D. degree do not fall within the province of any one department. Such programs are individually planned for unusually well-qualified students.

A graduate student with a well-considered program not now provided for in the existing departments or special programs of the University may approach a professor qualified to give him guidance. The professor, if he believes the program desirable, will gather a special committee consisting of at least three other members of the Academic Council who represent the student's various fields of interest. Included in the advisory committee must be professors from at least two departments of the University. Before the student embarks on the program, this committee will address a Declaration of Intention (Form G54) to the University Committee on the Graduate Division:

1. defining the area of the special program, showing that the University is qualified to offer it, and proposing a title for the degree;
2. outlining the program of study and research contemplated;
3. indicating, if possible, the nature of the dissertation contemplated.

If this Declaration is approved by the University Committee on the Graduate Division, the special committee will supervise the candidate's work and sign the forms ordinarily transmitted by major departments. The chairman of the special committee will normally direct the dissertation.

COURSES FOR GRADUATE STUDENTS OF ALL DEPARTMENTS

As part of breadth of training at the graduate level, the following special courses are provided. There are no specific prerequisites for any of these courses:

287. Minerals in World Affairs—Mineral resources of the world; their political, economic effects.
   3 units, winter, (Park), MWF 9

308. Introduction to American Higher Education—For those planning careers in teaching, research, or administration in American higher education. Explores European, American historical backgrounds, to the end of comprehending the current scene, and planning for the future.
   4 units, autumn, (——), TTh 2:15-4:05
   spring, (——), MW 2:15-4:05

   2 units, spring, (LaPiere), T 4:15-6:05

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
See also the courses listed by the Hoover Institution. The Food Research Institute, the School of Law, and many departments offer non-prerequisite courses and seminars that are open to graduate students.

COURSES FOR PH.D. CANDIDATES IN GRADUATE DIVISION SPECIAL PROGRAMS

400. Research.
   By arrangement

   By arrangement

COMMITTEE ON EAST ASIAN RESEARCH

The Committee on East Asian Research is an interdepartmental body which has as one of its functions the advising of graduate students who have particular interests in the study of China or Japan. The usual graduate degree program is worked out by the student's departmental adviser. This Committee can assist such a student in planning a supporting program with a regional concentration in Eastern Asia. The Committee also stands ready to advise the exceptional student in the development of an interdepartmental program leading to the Ph.D. under Graduate Division Special Programs. The Committee sponsors a regular research seminar on East Asian Thought and Society.

Inquiries concerning Stanford's resources for the graduate study of China or Japan may be directed to the Chairman of the Committee on East Asian Research, c/o Graduate Overseas and Special Programs, Room 207, Building 10A, Stanford University, Stanford, California.
HOOVER INSTITUTION
on WAR, REVOLUTION, and PEACE

Emeriti: Harold H. Fisher (Chairman); Nina Almond (Librarian and Consultant in Research); Joseph S. Davis, Edgar E. Robinson, Graham H. Stuart (Coun-
ciliors).

Director: W. Glenn Campbell
Assistant Director and Associate Professor: Witold S. Sworakowski
Executive Secretary: Peter Duignan
International Political Studies Program Director: Stefan T. Possony
Senior Staff Members: Milorad M. Drachkovitch, Roger A. Freeman
Research Fellows: Theodore Draper, Philip A. Ray
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 (Nico-
laevsky Collection), Agnes F. Peterson (Western European Collection), George W. Rentz (Middle East Collection), Eugene Wu (East Asian Col-
lection)
Deputy Curators: Anna M. Bourguina (Nicolaevsky Collection), Kenneth M. Glazier (Africa Collection), Tamotsu Takase (East Asian Collection)
Archivist, Herbert Hoover Archives: Rita R. Campbell
Librarian: Philip T. McLean
Assistant Librarian for Technical Services: Joseph Bingaman
Head, Catalog Department: Boris Dubensky
Head, Reference Department: Arline B. Paul

Since its founding by Herbert Hoover in 1919 as a special collection dealing with the causes and consequences of World War I, the Institution has become a national and international center of documentation and research on problems of political, eco-

nomic, 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 under-
ground movements, and the publications and records of national and international bodies, both official and unofficial, as well as books and pamphlets, many of them rare and irreplaceable.

The Institution has its own resident research staff of historians, economists, and political scientists as well as persons broadly trained and experienced in international law and the social sciences generally. The research program is concerned primarily
with promoting basic research and documentary studies, which provide the foundation upon which new knowledge is built. The Institution is, however, concerned with dynamic rather than static research, that is, with studying problems where the findings can make important contributions to national policy. Over the years 68 volumes have been published by the Institution and several major new projects are under way; for example, a history of the Communist International, studies of Communist activity in Africa, and monographs on Communist China as an economic power.

In addition to its own research staff, the Institution has been used continually by American and foreign scholars. Considering the value of the collections, every effort will be made to increase the use of Institution resources by providing more funds for predoctoral and postdoctoral fellowships.

In these ways, by acquisitions, by research, by publications, and by fellowships, the Institution carries out its functions of collecting the living documents of 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, 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)

299. Directed Reading and/or Special Research in Hoover Institution Fields—Advanced individual work by arrangement.
Any quarter, (Staff or authorized faculty member)

See also Senior Colloquia.
The Committee on Hydrology which includes faculty from the Departments of Civil Engineering and Geology administers a program of graduate studies leading to degrees of M.S. in Hydrology and Ph.D. in Hydrology. This program is available to students having the Bachelor's Degree in Civil Engineering, Geology, Agronomy, Forestry, and related fields. In order to earn the M.S. degree in one year, the student should have completed basic courses in physics, chemistry, mathematics through an introduction to differential equations, and introduction to geology and preferably elementary fluid mechanics.

**Master of Science**

The M.S. program will consist of the following courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E.260</td>
<td>Advanced Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>C.E.261</td>
<td>Advanced Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>C.E.263</td>
<td>Sedimentation Problems</td>
<td>2</td>
</tr>
<tr>
<td>Geol.185</td>
<td>Hydro-geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol.286</td>
<td>Development of Groundwater</td>
<td>3</td>
</tr>
<tr>
<td>Stat.110</td>
<td>Statistical Methods in Engineering</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>

In addition, the M.S. program will include 17 units of restricted electives from the following list and 6 units of free electives.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E.206</td>
<td>Advanced Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>C.E.209</td>
<td>Hydraulics of Open Channels</td>
<td>3</td>
</tr>
<tr>
<td>C.E.262</td>
<td>Advanced Hydraulic Engineering</td>
<td>4</td>
</tr>
<tr>
<td>C.E.265</td>
<td>Flow in Permeable Media</td>
<td>3</td>
</tr>
<tr>
<td>C.E.273</td>
<td>Water Resources Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>C.E.274</td>
<td>Water Resources Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>Geol.70</td>
<td>Introduction to Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Geol.116</td>
<td>Physical Oceanography</td>
<td>4</td>
</tr>
<tr>
<td>Geol.133</td>
<td>Principles of Geomorphology</td>
<td>4</td>
</tr>
<tr>
<td>Geol.179</td>
<td>Physics of Underground Fluids</td>
<td>5</td>
</tr>
<tr>
<td>Geol.361</td>
<td>Permafrost</td>
<td>2</td>
</tr>
<tr>
<td>Biol.176</td>
<td>Limnology</td>
<td>4</td>
</tr>
<tr>
<td>C.S.136</td>
<td>Use of Digital Computers</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E.150a,b. Formation Evaluation</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

**Doctor of Philosophy**

Ph.D. programs will be determined by discussion with the Committee on Hydrology but will normally include all the required and most of the suggested electives of the M.S. program plus additional course work totaling at least 90 units. To become a Ph.D. candidate the student must demonstrate proficiency in one foreign language,
pass a qualifying exam specified by the Committee and have a grade point average in graduate work of at least 3.00. 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 under the sponsorship of ten major institutions in the United States and Canada with Stanford University as the administrative agency. The Center is open to both qualified undergraduates and graduates. In addition to specialized work in the language, advanced students will be given opportunities for research. Language study constitutes the main part of the normal program, and is carried on in small classes or in individual tutorial sessions by Japanese instructors.

Any student may apply for admission to the Center 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 a minimum of two years of Japanese or its equivalent at the college level; and (c) he passes a written and oral examination in the Japanese language.

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 oral-aural language instruction, as well as to further the student's familiarity with Chinese texts and materials preparatory or leading to research in given disciplinary or professional fields.

Undergraduate, graduate, or postdoctoral candidates are eligible for acceptance 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, William Owens, Minna Stillman (Associate Librarians); Alice Charlton (Chief Catalog Librarian); Jeannette M. Hitchcock (Chief of Division of Special Collections); Margaret Wells (Education Librarian); Grace E. Stillson (Assistant Chief Catalog Librarian); Ruth Scibird (Curator of the Stanford Collection)

UNIVERSITY LIBRARIES:
Director: Rutherford David 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); Wolfgang M. Freitag (Undergraduate Book Selection); Jennette E. Hitchcock (Catalog); Mary Elizabeth Hughes (Government Documents); Richard D. Johnson (Acquisition); Jack Plotkin (Circulation); Jack Pooler (Science)
Curator of the Frederick E. Brasch Collection on Sir Isaac Newton: Frederick E. Brasch
Honorary Curators: George T. Keating (Music Bibliography); Irving Whitmore Robbins, Jr. (Rare Books and Manuscripts); Elmer E. Robinson (Americana); Albert Sperisen (Typography)

FOOD RESEARCH LIBRARY:
Librarian: To be announced

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

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; and Food Research Institute. Special regulations are in force for high school, college, or university students from other institutions, who may consult the Circulation Service Desk attendant or their own school librarians for 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, 85,000 microtext sheets, and considerable other material. A principal part of the Libraries’ collections is concentrated in the stack of the Main Library, which houses about 700,000 volumes on its seven levels. The various library units are described in the following paragraphs; the Library of the Hoover Institution on War, Revolution, and Peace is described elsewhere in this catalog.

**MAIN LIBRARY**

When school is in session, the Main Library is open Monday through Friday from 8:00 a.m. to 11:00 p.m. On Saturday the hours are 8:00 a.m. to 5:00 p.m., and on Sunday from 1:00 p.m. to 11:00 p.m. The Reserve Book Room is open Monday through Friday from 8:00 a.m. to 11:00 p.m., Saturday from 8:00 a.m. to 5:00 p.m., and Sunday from 1:00 to 11:00 p.m. Hours of opening for other rooms and other libraries on the campus are listed in *Your Libraries at Stanford University*. The Main Library provides quarters for the following:

- The Humanities and Social Sciences rooms, the center for reference service in the Main Library, contain reference and subject collections totaling about 34,000 volumes and current issues of more than 1,400 periodicals. The Library’s Central Map Collection is located in the Shainwald Room for the social sciences. The Microtext and Newspaper Reading Room is in the basement.

- The Listening Room provides facilities for the study of foreign languages and contains recordings used in several of the introductory music courses. The Reserve Book Room houses the books recommended and required for undergraduate courses. (The Western Civilization Library performs a similar function for the History of Western Civilization courses.)

- The Government Documents Library brings together most of the Library’s 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, letters, and association items); the Hopkins Transportation Library, dealing with the economic problems of transportation; the Memorial Library of Music, devoted to musical manuscripts and first issues of important and rare musical scores; the Elmer E. Robinson Collection on American History and Constitutional Law; the Timoshenko Collection on engineering mechanics; and the 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, Hispanic American Studies, Jones Collection in Creative Writing, Memorial Church, Modern European Languages, Physical Education for Women, Tanner Memorial Library of Philosophy, and Victor J. West Memorial (political science).

**Special Libraries in the Sciences**

The Library's collections in science and engineering are assembled in five major groups of departmental libraries—biology, chemistry, engineering, geology, and physics-mathematics-statistics.

The Frederic M. Falconer Biology Library, located on the first floor of Jordan Hall, houses general publications in botany and zoology as well as specialized materials in the experimental fields of biology. Branches are the Division of Systematic Biology Library which includes systematics, natural history and entomology, and specializes in distributional studies of the flora of western North America; and the Hopkins Marine Station Library at Pacific Grove which provides a working collection in marine biology.

The Swain Chemistry Library, located in Room One in the Chemistry Building, contains the major works in the field of Chemistry. Its branch, the Chemical Engineering Library, contains materials related to the chemical and petroleum industries.

The Engineering Library, located on the first floor of the Main Library, contains most of the library materials in the field of engineering. Its specialized branches include the Electronics Research Laboratory Library, the Guggenheim Aeronautics Library, the Radioscience Laboratory Library, the Ryan Nuclear Technology Library, the Solid State Library, and the Engineering Economic Planning Library.

The Branner Geological Library, located in Room 333 of the Outer Quadrangle, houses collections on geology, mineralogy, paleontology, geophysics, mining and metallurgy, as well as geological maps and the U.S. Geological Survey topographical sheets. Specialized branch libraries include the Conchology Library, the Geophysics Library, the Micropaleontology Library, the Mineralogy Library, and the Permafrost Library.

The Physics-Mathematics-Statistics Library is located in Room 301 of the Varian Physics Laboratory. Its branches are the Hansen Microwave Laboratory Library, specializing in microwave physics and engineering, and the Computer Science Library, Room 170, Polya Hall.

**Business**

The Jackson Library of Business, located in Room 135, Outer Quadrangle, is primarily a working laboratory available to students in the Graduate School of Business in the daily preparation of their 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 L. Lieberman
Professors: Kenneth J. Arrow (Economics and Statistics), Samuel Karlin (Mathematics), Gerald J. Lieberman (Industrial Engineering and Statistics), Alan S. Manne, Daniel Teichroew (Graduate School of Business), Harvey M. Wagner (Graduate School of Business and Industrial Engineering)
Associate Professors: James E. Howell, Peter R. Winters (Graduate School of Business), Fred Hillier, Arthur F. Veinott, Jr. (Industrial Engineering)
Assistant Professors: Charles P. Bonini (Graduate School of Business), Roy E. Murphy (Economics)
Affiliated Faculty: Alex Bavelas, Henry B. Eyring, John Haldi, Yuji Ijiri, Robert K. Jaedicke, Ferdinand K. Levy, 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. There will be distinguished visitors appointed to the Committee.

PROGRAMS OF STUDY

A program leading to the degree of Doctor of Philosophy in Operations Research is offered. The curriculum recognizes the need for advanced training in quantitative methods as well as specialization in one or more subject areas including Business, Economics, Engineering, Mathematics, Psychology, and Statistics. Required courses will be drawn from these departments. In addition, the student must fulfill the University's basic requirements for the doctorate (residence, dissertation, examination, etc.), which are discussed in the section "Degrees" in this Bulletin. 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>
<td>4</td>
</tr>
<tr>
<td>Statistics 119. Elementary Statistical Inference</td>
<td>4</td>
</tr>
<tr>
<td>Statistics 120. Statistical Inference</td>
<td>4</td>
</tr>
<tr>
<td>Mathematics 44. Advanced Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 45. Advanced Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 46. Advanced Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>Economics 106. Price Theory and Policy</td>
<td>5</td>
</tr>
<tr>
<td>Economics 109. Income and Employment</td>
<td>5</td>
</tr>
<tr>
<td>Accounting. Elementary Accounting</td>
<td>3–5</td>
</tr>
</tbody>
</table>

## Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics 217a. Introduction to Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 217b. Introduction to Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 255. Linear Programming</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 256. Inventory and Production Control</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 114a. Linear Algebra and Matrix Theory</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 114b. Linear Algebra and Matrix Theory</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 115. Fundamental Concepts of Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 116. Fundamental Concepts of Analysis</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 254. Dynamic Programming and Network Flows</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 258. Queueing Theory</td>
<td>3</td>
</tr>
<tr>
<td>Economics 284. Nonlinear Programming and Welfare Economics</td>
<td>3</td>
</tr>
<tr>
<td>Business 469. Management Science Workshop</td>
<td>12</td>
</tr>
</tbody>
</table>

Either of the following two courses:
- I.E. 257. Data Processing in Operations Research
- Business 368. Seminar in Business Decision Theory

One course from the following five:
- Business 366. Introduction to Electronic Data Processing
- I.E. 141. Utilization of Computers
- Computer Science 136. Use of Automatic Digital Computers
- Computer Science 137. Numerical Analysis
- Computer Science 138. Numerical Analysis

Integrated courses in one or more related subject fields

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.
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

Directors: Howard Dallmar (Basketball), William Paul Fehring (Baseball and Football), Charles Finger (Golf), James Gaughran (Swimming and Water Polo), Joseph Higgins (Intramurals and Aquatics), Payton Jordan (Track), Raymond E. Lunny, Jr. (Boxing and Weight Training), John Ralston (Football), Robert Renker (Tennis), Wesley K. Ruff (Gymnastics), Colonel A. Sysin (Equitation)

Assistant Directors: Carmen Jess Bova (Track), Robert Gambold (Football), Peter Kmetovic (Rugby), William Leland (Wrestling), Leon McLaughlin (Football), Rodney Rust (Football), William T. Turner (Basketball), William Walsh (Football), Michael White (Football), Ray J. Young (Baseball)

Professor: John E. Nixon
Associate Professor: Wesley K. Ruff
Assistant: Clyde F. Devine (Swimming and Diving), Fred J. Priddle (Soccer)

OFFERINGS AND FACILITIES

Athletics

Stanford University is a member of the National Collegiate Athletic Association, and as such competes with other major universities and colleges in most generally recognized collegiate sports. It is also a member of the United States Golf Association, the Pacific Association of the Amateur Athletic Union, the Northern California Rugby Union, the Northern California Intercollegiate Soccer Association, the Northern California Tennis Association, the Northern California Golf Association, the California Intercollegiate Baseball Association, and the Pacific Coast Intercollegiate Wrestling Association. Sports, for which the University grants the Stanford sport award, are football, basketball, track and field, baseball, swimming, golf, tennis, boxing, wrestling, gymnastics, rugby, soccer, water polo, and cross-country running. University teams also compete on a scheduled basis in crew, skiing, volleyball, and rifleshooting.

Physical Education

Activity courses for men, the men's intramural sports program, and intercollegiate competition for men are administered by the Department of Athletics and Physical Education. The intramural program for men includes seven-man touch football, two-man volleyball, six-man volleyball, bowling, table tennis, horseshoes, handball, wrestling, basketball, softball, tennis, swimming, boxing, gymnastics, and track and field. Instruction is given by the Department in swimming, diving, golf, tennis, equitation, boxing, wrestling, basketball, baseball, gymnastics, weight lifting, track and field, water safety, life saving, bowling, water polo, conditioning, crew, soccer, rugby football, rifle marksmanship, officiating methods for various sports, and several courses in physical education theory.
Women's activities are conducted by the Department of Physical Education for Women. Activity courses, such as equitation, folk and square dancing, riflery, ski conditioning, and archery are offered coeducationally.

**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 members, 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. Wesley Ruff or Dr. John Nixon 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.
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 such as chorus, band, choir, orchestra, dramatic productions, and others, as authorized by the General Studies Committee.

3. All six non-credit group activities may be taken in physical education.

4. Not more than one non-credit physical education course 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 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 Director of Physical Education and Athletics.

   1 unit, autumn, winter, spring, (Staff), three periods a week

11a. Basketball, Freshmen.
   1 unit, autumn, winter, spring, (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, summer, (Finger), MF or TTh 1:15, and nine holes additional

15a. Golf, Freshmen.
   1 unit, autumn, winter, spring, (Finger), MTWThF 3:15-5:30

   1 unit, autumn, winter, spring, (Ruff), MWF 3:15

17. Volleyball.
   1 unit, autumn, winter, spring, (Staff), MWF 11 or 2:15

17b. Volleyball and Team Games.
   1 unit, autumn, winter, spring, (Staff), MWF 2:15

   1 unit, autumn, winter, spring, (Staff), MW or TTh 1:15 or 2:15

   1 unit, autumn, winter, spring, (Staff), MWF 11

   1 unit, autumn, winter, spring, (Gaughran), MTWThF 4:15

21. Tennis Elementary.
   1 unit, autumn, winter, spring, summer, (Staff), MWF 10, 11, 1:15 or 2:15, or TTh 3:15
21a. Tennis, Freshmen.
   1 unit, autumn, winter, spring, (Renker), MTWThF 3:15–5:05
22. Track, Elementary.
   1 unit, autumn, winter, spring, (Bova), MWF 10 or TTh 10
23. Wrestling, Elementary.
   1 unit, autumn, winter (Staff), MWF 3:15
24. Diving, Elementary.
   1 unit, autumn, winter, spring, (Staff), MWF 11
27. Crew, Elementary.
   1 unit, autumn, winter, spring, (Staff), MTWThF 4:15 and S 9
29. Water Polo.
   1 unit, autumn, spring, (Higgins), TTh 2:15
30a. Baseball, Freshmen.
   1 unit, autumn, winter, spring, (Young), MTWThF 3:15–5:30
41. Physical Conditioning.
   1 unit, winter, spring, (Staff), MWF 4:15
111a. Basketball, Varsity.
   1 unit, autumn, winter, (Dallmar), MTWThF 4:15–6:05
112. Boxing, Advanced.
   1 unit, autumn, winter, spring, (Lunny), MTTh 4:15
114a. Football, Varsity.
   1 unit, autumn, (Ralston), MTWThF 3:15–5:30
115. Golf, Advanced.
   1 unit, autumn, winter, spring, (Finger), MTWThF and by arrangement
   1 unit, autumn, winter, spring, (Finger), MTWThF 3:15–5:30
   1 unit, autumn, winter, spring, (Ruff), MWF 4:15
118. Life Saving.
   1 unit, autumn, (Gaughran), TTh 2:15
   1 unit, autumn, winter, spring, (Staff), MWF 2:15
120. Swimming, Advanced.
   1 unit, autumn, winter, spring, (Staff), MWF 10, 11, or 3:15
120a. Swimming, Varsity.
   1 unit, autumn, winter, spring, (Gaughran), MTWThF 4:15
121. Tennis, Advanced.
   1 unit, autumn, winter, spring, (Staff), MWF 2:15, 3:15 or 4:15, or TTh 3:15
121a. Tennis, Varsity.
   1 unit, autumn, winter, spring, (Renker), MTWThF 3:15
122a. Track, Varsity.
   1 unit, autumn, winter, spring, (Jordan), MTWThF 3:15
123. Wrestling, Advanced.
   1 unit, autumn, winter, (Leland), MTTh 4:15
123a. Wrestling, Varsity.
   1 unit, autumn, winter, (Leland), MTWThF 4:15–6:05
124. Diving, Advanced.
   1 unit, autumn, winter, (Staff), MTTh 2:15, and by arrangement
124a. Diving, Varsity.
   1 unit, autumn, winter, (Devine), MTWThF 4:15
127. Crew, Varsity.
   1 unit, autumn, winter, spring, (Staff), MTWThF 4:15 and S 10
128. Water Safety Instruction.
   1 unit, spring, (Gaughran), 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 and Young), MTWThF 3:15–5:05
139. Soccer.
   1 unit, autumn, winter, spring, (Priddle), MWF 4:15
139a. Soccer, Advanced.
   1 unit, autumn, winter, spring, (Priddle), MWF 4:15
   1 unit, winter, (Kmetovic), MWThS 4:15

Co151. Rifle and Pistol Marksmanship—Open to all undergraduate students.
   1 unit, autumn, winter, spring, MTWThF by arrangement

153. Weight Training.
   1 unit, autumn, winter, spring, (Ruff, Staff), MWF 11, 1:15, 2:15, 3:15 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: Miriam B. Lidster, Marian S. Ruch, Pamela L. Strathairn
Instructors: Carroll Gordon, Inga Weiss-Lepnis, Georgia Williams
Assistant Director of Riding School: Margaret Sysin

OFFERINGS AND FACILITIES

The aims of the physical education program for women are threefold—to provide an opportunity for participation in a variety of physical activities; to afford specialization in one or more areas of activity; and to provide instruction for all levels of competency.

The program is designed: (1) to increase understanding of the value and role of physical education activities in developing and maintaining total fitness throughout life; (2) to encourage continued participation, both during and after college, in physical activity appropriate to health status as well as interest; and, (3) to develop leadership skills which have particular application to community service, volunteer agencies, recreation groups, and domestic and foreign Peace Corps.

Each student is afforded the opportunity for developing interest in many kinds of physical activity and for developing competency in selected activities in order that future participation is more readily selected for recreational purposes. Instructional, recreational, creative, and several forms of competitive experiences are provided in the variety of aquatic, dance, sports, and other physical education activities. Homogeneous skill groupings for instruction in most activities enable the student, beginner through advanced performer, to achieve success within the limits of her capabilities. The program also includes instruction and recreation for 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 are offered in ballet, figure skating, folk and square dancing, modern dance, synchronized swimming, and trail rides.

The Department is affiliated with the Girls' and Women's Sports Division of the American and California Associations for Health, Physical Education and Recreation, the Women's National Officials Rating Committee, the National Association for Physical Education of College Women, and the Western Society for Physical Education of College Women. The Women's Recreation Association is a member of the National and Pacific Southwest Regional Athletic and Recreation Federation for College Women.

Policy governing women's participation in intercollegiate competition is formed by the Department and the Women's Recreation Association in keeping with policies of affiliated organizations and the National Joint Committee on Extramural Sports for College Women.
Facilities, Equipment, Costumes, and Fees

The Women's Gymnasium houses a basketball floor and area for other indoor activities, dance studio, posture studio, dance as well as physical education library, study rooms, offices, and shower and locker room.

The outdoor facilities include a heated 75-foot pool with one-meter springboard; two WRA tennis courts for recreation; six tennis courts used primarily for instruction; short fairway and green for golf practice; turfed field for archery, field hockey, golf, and softball.

In addition the Riding Stable and 18-hole championship Stanford Golf Course are used jointly by men and women.

All equipment, except badminton and tennis rackets, bowling balls and shoes and golf clubs, is provided by the Department. Golf clubs may be rented and bowling balls and shoes are included in the bowling fees.

Gym suits, leotards, swim suits, and towels are furnished and laundered. The student must provide her own white socks and tennis shoes, swimming cap, and appropriate riding clothes.

Fees are charged for enrollment in bowling and equitation classes. The bowling fee includes use of ball and shoes.

GENERAL STUDIES PROGRAM REQUIREMENTS

Participation in Group Activity to a total value of 6 non-credit units is required of all undergraduates. During the freshman and sophomore years at least 2 of these units, 1 each year, must be devoted to physical activity courses. All "Co" and "W" courses listed below may be used to fulfill the remaining 4 of the Group Activity requirements.

1. No more than 2 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, (———)

   autumn, spring, (———)

   autumn, winter, spring, (Staff)

Co49. Horsemanship I.
   autumn, (Systin), alternate years, to be given in 1965–66

   autumn, winter, spring, (Weiss-Lepnis)

Co63. Ballet, Elementary.
   autumn, winter, spring, (Weiss-Lepnis)

Co64. Ballet, Intermediate.
   autumn, winter, (Weiss-Lepnis)
Co68. Social Dance, Elementary.
   autumn, winter, spring, (Lidster)
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.
   autumn, winter, spring, (Lidster)
Co74. Square Dance, Elementary.
   winter, (Lidster)
Co75. Square Dance, Intermediate.
   spring, (Lidster)
Co140. Archery, Advanced.
   autumn, spring, (______)
   autumn, winter, spring, (Staff)
Co148. Equitation, Elementary—English and Western.
   Equitation, Intermediate—English and Western.
   Advanced—English.
   Jumping.
   autumn, winter, spring, (Sysin)
Co149. Horsemanship II.
   autumn, (Sysin), alternate years, to be given in 1964–65
Co151. Rifle and Pistol Marksmanship—(Enroll in Physical Education for Men
   Co151.)
Co161. Modern Dance, Advanced.
   autumn, winter, spring, (Weiss-Lepnis)
   spring, (Weiss-Lepnis)
Co165. Improvisation and Fundamentals of Composition.
   autumn, winter, spring, (Weiss-Lepnis)
Co166a. Choreography and Dance Forms.
   autumn, winter, spring, (Weiss-Lepnis)
Co166b. Choreography and Dance Forms.
   autumn, winter, spring, (Weiss-Lepnis)
Co167a. Choreography and Production.
   winter, spring, (Weiss-Lepnis)
Co167b. Choreography and Production.
   winter, spring, (Weiss-Lepnis)
Co167c. Choreography and Production.
   winter, spring, (Weiss-Lepnis)
Co167d. Choreography and Production.
   winter, spring, (Weiss-Lepnis)
Co168. Social Dance, Advanced.
   winter, spring, (Weiss-Lepnis)
Co172. Folk Dance, Advanced.
   autumn, winter, spring, (Lidster)
Co177. Historic Dance: Primitive and Ancient.
   autumn, (Lidster, Weiss-Lepnis)
Co178. Historic Dance: Court Forms.
   winter (Lidster, Weiss-Lepnis)
Co179. Contemporary Dance.
   spring, (Lidster, Weiss-Lepnis)
COURSES FOR WOMEN STUDENTS

The following courses are open to women students only. Normally these courses are given every quarter unless otherwise indicated. See the Time Schedule for pre-registration and registration procedures.

W1. Posture.
   autumn, winter, spring, (Ruch)

W2. Conditioning.
   autumn, winter, spring, (Staff)

   autumn, winter, spring, (———)

   autumn, winter, spring, (———)

W5. Tumbling Gymnastics.
   spring, (———)

   spring, (Strathairn)

    autumn, winter, spring, (Williams)

    autumn, winter, spring, (Williams)

    autumn, winter, (———)

    autumn, winter, (———)

W14. Tennis, Beginning.
    autumn, spring, (Strathairn, Williams)

W15. Tennis, Elementary.
    autumn, winter, spring, (Strathairn, Williams)

    autumn, winter, spring, (Strathairn, Williams)

    winter, (Strathairn)

W23. Field Hockey, Elementary.
    autumn, spring, (———)

    autumn, spring, (———)

W25. Softball.
    spring, (Strathairn, Williams)

W27. Volleyball.
    autumn, winter, spring, (Staff)

W30. Swimming, Beginning.
    autumn, spring, (Staff)

    autumn, spring, (Staff)

    autumn, spring, (Staff)

W33. Diving, Elementary.
    spring, (Strathairn)

W34. Diving, Intermediate.
    autumn, spring, (Strathairn)

W35. Lifesaving and Water Safety, A.R.C.
    winter, spring, (Strathairn)

W36. Aquatic Art, Elementary.
    autumn, spring, (Ruch)

W37. Aquatic Art, Intermediate.
    autumn, spring, (Ruch)
W42. Bowling, Elementary.
      autumn, winter, spring, (Staff)
      autumn, winter, spring, (Staff)
W44. Golf, Elementary.
      autumn, winter, spring, (Gordon)
      autumn, winter, spring, (Gordon)
W61. Modern Dance, Elementary.
      autumn, winter, spring, (———)
W110. Badminton, Advanced.
      winter, spring, (Williams)
W112. Fencing, Advanced.
      autumn, winter, spring, (Bugge)
W113. Fencing, Tournament.
      spring, (———)
W114. Tennis, Advanced.
      autumn, winter, spring, (Guthrie, Strathairn, Williams)
W115. Tennis, Tournament.
      autumn, winter, spring, (Guthrie)
W120. Basketball, Advanced.
      winter, (Strathairn)
W121. Basketball, Tournament.
      winter, spring, (Strathairn)
W123. Field Hockey, Tournament.
      autumn, (———)
W125. Softball, Tournament.
      spring, (Strathairn, Williams)
W127. Volleyball, Tournament.
      autumn, winter, (Staff)
W130. Swimming, Advanced.
      autumn, spring, (Strathairn)
W131. Swimming, Competitive.
      autumn, spring, (Strathairn)
W132. General Aquatics.
      summer, (Staff)
W133. Diving, Advanced.
      autumn, spring, (Strathairn)
W134. Diving, Competitive.
      autumn, spring, (Strathairn)
W136. Aquatic Art, Advanced.
      autumn, spring, (Ruch)
Archery, Advanced—(See Co40)
W142. Bowling, Advanced—(See Co42)
      autumn, winter, spring, (Staff)
W143. Bowling, Tournament.
      autumn, winter, spring, (Staff)
W144. Golf, Advanced.
      autumn, winter, spring, (Gordon)
W145. Golf, Tournament.
      autumn, winter, spring, (Gordon)
Archery, Elementary—See Co40
Archery, Intermediate—See Co41
Horsemanship I—See Co49
Modern Dance, Intermediate—See Co62
Ballet, Elementary—See Co63
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.

Co 116. Tennis Officiating.  
 spring, (Guthrie)

W122. Basketball Officiating.  
 winter, (Strathairn)

W124. Field Hockey Officiating.  
 autumn, (———)

W135. Water Safety Instructor's Course, A.R.C.  
 spring, (Strathairn)

Co 138. Aquatics Officiating.  
 autumn, spring, (Strathairn)

Co 180. Aquatic Leadership.  
 spring, (Strathairn)

Co 181. Golf Tournament Organization.  
 winter, spring, (Gordon)

Co 182. Tennis Tournament Organization.  
 winter, spring, (Guthrie, Williams)

Co 185. Social Recreation for Youth and Young Adults.  
 autumn, (Lidster)

 winter, (Guthrie)

Co 187. Recreational and Organized Camping.  
 spring, (———)
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.

The reading lists and additional listings can be found in the current General Studies Bulletin.

#SC1. The Mystery of Being.
2 units, autumn, (Reinhardt, Modern European Languages), W 2:15-4:05

#SC5. The Meaning of Death in Western Culture.
2 units, autumn, (Black, Counseling and Testing), W 7:30-9:30 p.m.

#SC7. Canada, Nation or State?
2 units, spring, (Allyn, Graduate School of Business), M 4:15-6:05

2 units, winter, (Peck, Communication), T 8-10 p.m.

#SC12. Shakespeare.
2 units, spring, (Rebholz, English), T 2:15-4:05

#SC13. Tax Reform and Expenditure Policy.
2 units, autumn, (Freeman, Hoover Institution), T 4:15-6:05

2 units, spring, (Feldman, Medical School), T 4:15-6:05

2 units, winter, (Cole, Speech and Drama), T 2:15-4:05

2 units, autumn, (Jones, Food Research), Th 4:15-6:05

#SC22. The Bernard De Voto Papers: Manuscript Sources as an Aid to Research.
2 units, winter, (Barclay, Library), T 4:15-6:05

#SC24. Population Pressure and Natural Resources.
2 units, winter, (Luck, Chemistry), W 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

#SC28. Theology and Literary Criticism—A study of such writers as St. Augustine, Luther, Pascal, Matthew Arnold, and T. S. Eliot.
2 units, spring, (Hyde, Modern European Languages), T 7-9 p.m.

#SC29. The Doctor's Dilemma—Discussion of a number of para-medical topics
such as: cost and distribution of medical care, socialized medicine, the doctor-patient relationship, religion and health, euthanasia and eugenics, certain physicians of history and fiction, and doctor and patient in other times. Individual students will be responsible for leading the discussion on assigned evenings.

2 units, autumn, (Creger, Medical School), Th 7:30–9:30 p.m.

#SC30. Nationalism in America, 1865 to the Present.
2 units, spring, (Minott, History), F 2:15–4:05

#SC31. The Individual in Soviet Society.
2 units, winter, (Blumenthal, Political Science), Th 2:15–4:05

#SC32. Trial by Jury as a Method of Settling Disputes.
2 units, winter, (Friedenthal, Law School), W 7:30–9:30 p.m.

2 units, spring, (Bark, History), W 2:15–4:05

#SC34. Contemporary Germany: Aspects of Its Culture.
2 units, spring, (Lohnes, Modern European Languages), W 2:15–4:05

#SC35. Theories of War.
2 units, autumn, (Holsti, Political Science), T 2:15–4:05

#SC37. Culture Cognition and Fantasy.
2 units, autumn, (D'Andrade, Anthropology), M 2:15–4:05

#SC39. Geographic Influence in the Growth of Nations—An exploration of physical and cultural elements which are major factors affecting the development of nations.
2 units, autumn, (Terry, Air Science), T 2:15–4:05

#SC40. Artist, Architect, and Engineer—An introduction to the problems of architectural acoustics and organ design. Field trips to local examples. No technical knowledge necessary.
2 units, winter, (Hyde, Modern European Languages), T 7–9 p.m.

#SC41. Landscape Architecture—Function and art in environmental design.
2 units, spring, (Rolfs, Planning Office), W 7–9 p.m.

#SC44. An Anthropocentric View of Evolution.
2 units, autumn, (Baxter, Biological Sciences), M 2:15–4:05

#SC46. The Place of Aircraft, Missiles, and Spacecraft in 20th Century Civilization—The topics to be discussed will include the history of human flight; some technical information on air flow, structural design, as well as engines and rockets; the air history of the two world wars; the impact of aviation on military strategy and warfare; the economics and the organization of air transportation; the effect of increased scientific knowledge resulting from aeronautical research in the fields of air flow, combustion, and light construction on technology; and some speculation on space travel and its effects on humanity.
2 units, winter, (Hoff, Aeronautics and Astronautics), Th 2:15–4:05

#SC51. Geography and Contemporary World Problems.
2 units, autumn, winter, spring, (Williams, Geography), M 4:15–6:05

#SC52. History of the Military in the West, 1789 to the Present.
2 units, summer, (Minott, History), Th 2:15–4:05

#SC56. Language and the Construction of Thought.
2 units, autumn, (Rolfe, Linguistics), Th 4:15–6:05

#SC60. The Literature and History of the Organ.
2 units, autumn, (Nanney, Music), W 2:15–4:05, to be given in 1965–66

#SC64. Existential Phenomenology and Existential Psychiatry.
2 units, winter, (Reinhardt, Modern European Languages), W 4:15–6:05

2 units, summer, (Reinhardt, Modern European Languages), W 4:15–6:05

#SC71. Plants and Their Relation to History—The Colloquium will explore the importance of plants in relation to the course of human history.
2 units, spring, (Thomas, Biological Sciences), Th 2:15–4:05
#SC72. Contemporary Music.
2 units, summer, (Kuhn, Music), W 2:15-4:05

#SC74. Sex Roles in American Culture.
2 units, winter, (Stolz, Psychology), T 2:15-4:05

#SC76. The Mind-Body Problem in Medical Thought—A study of ideas on the psychological causation of somatic disease in Greco-Roman, seventeenth and eighteenth century and modern times.
2 units, spring, (Rather, Pathology), Th 2:15-4:05

#SC77. Problems and Politics of Germany.
2 units, winter, (Sokol, Political Science), T 4:15-6:05

#SC79. Leisure in Modern Life.
2 units, winter, (Guthrie, Physical Education), Th 4:15-6:05

#SC80. Virgil: Free Will and Predestination.
2 units, spring, (Otis, Classics), T 8-10 p.m.

#SC82. Dance in Patterns of Culture.
2 units, autumn, (Lidster, Physical Education), W 2:15-4:05

#SC83. The Negro and the Law.
2 units, autumn, (Horn, Political Science), T 4:15-6:05

#SC85. The History of the Book.
2 units, spring, (Lenkey, Library), T 4:15-6:05

#SC86. Absurdity and Revolt: The Thought of Albert Camus.
2 units, summer, (Heimbeck, Speech and Drama), Th 2:15-4:05

#SC87. The Transmission of Recorded Information.
2 units, spring, (Weber, Library), Th 4:15-6:05

#SC88. Manuscripts, Archives, and Research.
2 units, autumn, (Hansen, Library), T 4:15-6:05

#SC91. Food and Hunger in Asia and Latin America.
2 units, spring, (Farnsworth, Food Research), W 2:15-4:05

#SC92. Bach and Bartok.
2 units, spring, (Salgo, Music), M 2:15-4:05

#SC93. The Tragic Sense of Life in Unamuno.
2 units, autumn, (Schervill, Modern European Languages), W 4:15-6:05

#SC95. A Case Study in Early American Policy Toward the Middle East.
2 units, spring, (Harris, Political Science), W 2:15-4:05

#SC97. Tradition and Social Change: The Case of Japan—Social change in urban and rural Japan as shown in community studies and as reflected in biographies and novels to be read in translation; an examination of attitudes to social change and of their political significance.
2 units, autumn, (Steiner, Political Science), T 4:15-6:05

#SC99. Ceremony and Symbol in Religion and Society—A discussion of the place of ceremonies, rites, and forms in religious and social life. The renewed interest in religious symbolism will be considered along with an attempt to understand accepted forms and usage in society.
2 units, spring, (Minto, Chaplain of the University), Th 2:15-4:05

#SC101. Problems and Politics of Southeast Asia.
2 units, autumn, (Sokol, Political Science), T 4:15-6:05

#SC103. The Nihilist Trend in Russian Ideology of the 1860's.
2 units, autumn, (Posin, Modern European Languages), T 2:15-4:05

#SC104. Organizational Behavior.
2 units, autumn, winter, (Laing, Political Science), T 4:15-6:05

#SC105. Organization Man.
2 units, winter, (Scott, Sociology), T 4:15-6:05

#SC106. Adolescent Society.
2 units, spring, (Cohen, Sociology), M 2:15-4:05

#SC107. Social Mobility in American Society.
2 units, spring, (Kimberly, Sociology), F 2:15-4:05
#SC108. Political Modernization in Mexico.
2 units, autumn, (Anderson, Sociology), M 2:15-4:05

#SC110. Man as a Factor in Evolution.
2 units, winter, (Holm, Biological Sciences), Th 2:15-4:05

#SC111. Topics in the Psychology of Human Learning.
2 units, spring, (Crothers, Psychology), T 2:15-4:05

#SC114. The Greek Historian Thucydides—A reading of Thucydides’ History (in English translation) with discussion of the major issues which it raises.
2 units, winter, (Raubitschek, Classics), Th 2:15-4:05

#SC115. Marxist Ethics—Ethical implications of current Soviet and Chinese theory as well as of classical Marxism.
2 units, spring, (Nivison, Philosophy), Th 2:15-4:05

#SC118. Alexander The Great—Various aspects of the character and career of Alexander and the consequences of his expedition will be discussed.
2 units, autumn, (Pearson, Classics), W 4:15-6:05

#SC120. Characterization, Self-Revelation, and Disguise in Biographical Writing—A study of the various forms of biographical writing (diaries and journals, autobiographies, biographies, letters), particularly those of the Restoration and Eighteenth Century, and their effectiveness in creating and revealing character and personality.
2 units, autumn, (Fifer, English), T 2:15-4:05

#SC122. William Faulkner.
2 units, winter, (Appel, English), W 4:15-6:05

#SC123. Voltaire and Johnson: Contrasting Spokesmen for the Enlightenment—Voltaire and Johnson occupy positions in the literary histories of their nations that are in many respects similar: they were, in their separate ways, the wisest and most articulate literary spokesmen respectively for the French and English Enlightenment. Alike in clarity and boldness of thought, if profoundly different in personality and in religious convictions, they were attracted to similar problems—the most important problems which men faced in the eighteenth century. This Colloquium will examine their parallel statements on religious, social, and literary issues. Students will be expected to write an essay in which they review a subject treated by both Voltaire and Johnson.
2 units, winter, (Loftis, English), W 2:15-4:05

#SC124. The Manipulation of Human Behavior.
2 units, autumn, (Cooper, Psychology), T 2:15-4:05

#SC127. Bernard Shaw—A brief survey of Shaw’s life and ideas; a discussion of ten principal Shaw plays.
2 units, spring, (Irvine, English), W 2:15-4:05

#SC138. Frank Lloyd Wright—Philosophy, writings, and design of this pioneer of modern architecture. Readings from Greenough, Whitman, and Sullivan.
2 units, spring, (Thompson, Architecture), F 2:15-4:05

#SC139. Modern French Painting—The aims and achievements of the major painters of the past one hundred years will be critically considered with emphasis on the ways in which different painters faced the problems of expression, communication, and composition. Among the painters to be discussed are Manet, Monet, Renoir, Seurat, Cézanne, Gauguin, van Gogh, Matisse, and Picasso.
2 units, autumn, (Faulkner, Art), Th 2:15-4:05

#SC141. Foreign Policies of the Soviet Union.
2 units, autumn, (Fisher, History), W 4:15-6:05

#SC142. Communism and the American Response.
2 units, spring, (Fisher, History), W 4:15-6:05

#SC143. Soviet-American Relations.
2 units, winter, (Fisher, History), W 4:15-6:05

#SC146. Mystics and Mysticism.
2 units, spring, (Watkins, Political Science), T 2:15-4:05
#SC148. Great Biographies—A study of the nature, methods, and content of biography from ancient times to the present. The work of such biographers as Plutarch, Suetonius, Aubrey, Boswell, Dr. Johnson, Lytton Strachey, and D. S. Freeman will be read and analyzed. The text will be John A. Garraty: The Nature of Biography.

2 units, winter, (Miller, History), W 2:15-4:05

#SC 149. Beverage Alcohol and Society—An exploration of the role of alcoholic beverage consumption in society, American and non-American, present and historical. Attention will be given to effects, patterns of drinking, religious attitudes, and alcoholism as a disease; overall attempt will be to determine the fundamental nature of the issue.

2 units, winter, (Russell, Health Education), T 2:15-4:05

#SC150. Creativity—Discussion of what creativity is for artist, thinker, scientist, and (especially) the Colloquium members. Reading, participation in discussion (frequently with specific preparation in the form of a short paper), and a Colloquium essay are required. (Open also to B.S. candidates by arrangement.)

2 units, autumn, (Tuttle, Electrical Engineering), W 2:15-4:05

#SC153. Freedom of Speech—Discussions on free speech and conformity, academic freedom, the right to editorialize on radio and television, access to the microfilm and television camera. Each class period begins with a tape recording, a film, or a kinescope recording or report on the topic which will be the basis of discussion to follow. An attempt is made to relate freedom of speech to the individual, his country, and to the larger community of the world.

2 units, winter, spring, (Donner, Communication), T 4:15-6:05

#SC154. Franz Kafka.

2 units, winter, (Mueller-Vollmer, Modern-European Languages), T 4:15-6:05

#SC159. The Pattern of Cities—A Colloquium on City Planning. A review of the history of cities; an analysis of how urban culture has followed the changing needs of man, and an evaluation of the techniques employed by city and regional planners to combat the problems of today and tomorrow.

2 units, winter, (Sanders, Planning and Architecture), W 7:30-9:30 p.m.

#SC160. Man and the State in Modern Drama—This is concerned with a discussion of the struggle between private conscience and public duty in man's relations to the social order.

2 units, spring, (Cole, Speech and Drama), T 2:15-4:05

#SC161. Science, Values, and Anti-Intellectualism.

2 units, spring, (Krauskopf, Geochemistry), T 2:15-4:05

#SC162. The Technological Order.

2 units, autumn, (Stover, Political Science), M 8-10 p.m.

#SC167. Music and Words.

2 units, autumn, (Crosten, Music), M 4:15-6:05

#SC168. The Great Novels of China—The aim of the Colloquium is to give the student an opportunity to read in English translation three of China's greatest novels, All Men Are Brothers, Chin P'ing Mei, and Dream of the Red Chamber, and to gain an adequate knowledge of Chinese life and thought in the periods during which these novels were written.

2 units, winter, (Chan, Asian Languages), T 2:15-4:05

#SC170. Deterrence, Arms Control, and Disarmament.

2 units, winter, (Holsti, Political Science), T 4:15-6:05

#SC171. Hypnosis and Personality.

2 units, spring, (Hilgard, Psychology), M 2:15-4:05

#SC172. The Psychology of Mark Twain.

2 units, spring, (Sears, Psychology), T 4:15-6:05

#SC174. Soren Kierkegaard.

2 units, spring, (Reinhardt, Modern European Languages), W 2:15-4:05

#SC176. Psychology and the Law.

2 units, spring, (Freedman, Psychology), M 2:15-4:05
#SC177. **An Introduction to Contemporary India.**

2 units, autumn, winter, (Wal, Communication), M 4:15-6:05

#SC178. **The Writing of Albert Camus.**

2 units, autumn, spring, (Cohn, French and Italian), W 4:15-6:05

#SC179. **The Artist and Society**—This Colloquium will explore the nature of the relationship between the literary artist and the society in which he creates. Questions of the reading public, levels of taste, critics, etc., will be examined in terms of a number of contemporary American and foreign writers.

2 units, spring, (Naughton, French and Italian), Th 2:15-4:05

#SC180. **International Communism**—Discussion of communist theory and tactics. Critical appraisal of their application in practice. Outline of activities of communist parties, the Comintern and Cominform. Discussion and analysis of writings of prominent communist dissenters.

2 units, winter, (Sworakowski, Hoover Institution), T 2:15-4:05

#SC183. **Christian Impact on Africa.**

2 units, winter, (Minto, Chaplain of the University), Th 2:15-4:05

#SC188. **Disarmament.**

2 units, autumn, winter, spring, (Leppert, Mechanical Engineering), M 7:45-9:45 p.m.

#SC190. **Cellular Psychology.**

2 units, winter, (Landauer, Psychology), time to be announced

#SC195. **Social Science Approaches to Music.**

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

#SC197. **Reason in Politics.**

2 units, winter, (Stover, Political Science), M 8-10 p.m.

#SC199. **The Political and Social Ideas of George Bernard Shaw**—A discussion of Shaw's political and social ideas, in relation to the conditions of his lifetime. A critical assessment of his leading ideas will be attempted, by comparing them with ideas put forward by contemporary social theorists.

2 units, spring, (Buck, Political Science), M 4:15-6:05
The Stanford Linear Accelerator Center (SLAC) is designing and constructing, under contract with the U. S. Atomic Energy Commission, a two-mile-long linear electron accelerator. When completed, the Center will be operated by Stanford as a national facility at which qualified scientists from Stanford and from all over the world will carry out very-high-energy physics research.

The Center is located on 480 acres of Stanford property, west of the campus, parallel to Sand Hill Road. Several buildings are complete and occupied. When finished, the building complex will house the staff required to operate and maintain the Center. The accelerator itself is under construction and will be operational in 1966-67, providing an electron beam of 20-Bev maximum energy. Facilities are being incorporated to permit later doubling of the beam energy.

Graduate students may participate in the work of the Center by arrangement with departments at Stanford or at other universities cooperating with the Center. Graduate students in the Stanford Department of Physics wishing to work toward the Ph.D. degree under the supervision of a member of the SLAC faculty should apply to the Committee on Graduate Studies of the Department of Physics for approval.

Current work at the Center deals with the design and construction of the accelerator and its ancillary facilities. In addition, work is in progress developing research equipment and methods as well as specific experiments for the use of the two-mile accelerator. The SLAC research staff also carries out theoretical studies in particle physics and collaborates with other accelerator centers in high-energy experimental physics.
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