UNIVERSITY OF ARIZONA RECORD

Graduate Catalogue

1955 = 1956

1956 = 1957

Published by

THE UNIVERSITY OF ARIZONA . . . TUCSON

UNIVERSITY OF ARIZONA RECORD

VOL. XLVIII, No. 5 JULY, 1955

DIRECTIONS FOR CORRESPONDENCE

Prospective graduate students are asked to correspond with officials of the University as follows:

Dean of the Graduate College concerning admission to the regular and summer sessions, intention to apply for fellowships and scholarships.

Head of Department for further information on departmental course offerings, degree programs, graduate assistantships.

Dean of the Summer Session for announcements of summer session.

Dean of the College of Education for guidance relative to course offerings in Education, requrements for certification of teachers.

Director of Placement Service for information on part-time employment, teaching positions.

Director of Residence for information on living accommodations.

Director of the University Extension Division concerning extension courses and registration for extension and correspondence work.

Registrar and Director of Admissions concerning transcripts, progress of pending admission applications.

STATEMENT OF MAILING PRIVILEGE

The *University of Arizona Record* is issued seven times a year. Published monthly during July, August, and October, and semimonthly during April and June.

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THE UNIVERSITY OF ARIZONA RECORD...

GRADUATE CATALOGUE
1955-56 • 1956-57

Published by

THE UNIVERSITY OF ARIZONA TUCSON, ARIZONA

CALENDAR

1955

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GRADUATE CALENDAR

1955-56, 1956-57

	1955-56	1956-57
Dormitories open at 8:00 a.m.	Sept. 11, Su.	Sept. 9, Su.
University Faculty Meeting	Sept. 12, M.	Sept. 10, M.
Registration	Sept. 16, F. Sept. 17, Sa.	Sept. 14, F. Sept. 15, Sa.
Classes begin	Sept. 19, M.	Sept. 17, M.
Homecoming — no classroom exercises	**Oct. 22, Sa.**	
Veterans Day — no classroom exercises	**Nov. 11, F.**	**Nov. 11 (12), M.**
Thanksgiving recess	**Nov. 23, W., 10:00 p.m. to Nov. 28, M., 7:40 a.m.**	**Nov. 21, W., 10:00 p.m. to Nov. 26, M., 7:40 a.m.**
Christmas recess	**Dec. 21, W., 10:00 p.m. to Jan. 5, Th., 7:40 a.m.**	**Dec. 19, W., 10:00 p.m. to Jan. 3, Th., 7:40 a.m.**
Class and laboratory sessions end	Jan. 19, Th.	Jan. 17, Th.
Semester examinations begin	Jan. 20, F., 1:30 p.m.	Jan. 18, F., 1:30 p.m.
Semester examinations end	Jan. 28, Sa.	Jan. 26, Sa.

SECOND SEMESTER	**1955-56**	**1956-57**
Registration	Jan. 30, M. Jan. 31, Tu.	Jan. 28, M. Jan. 29, Tu.
Classes begin	Feb. 1, W.	Jan. 30, W.
Washington's Birthday — no classroom exercises	**Feb. 22, W.**	**Feb. 22, F.**
Easter recess	**Mar. 29, Th., 10:00 p.m. to Apr. 9, M., 7:40 a.m.**	**Apr. 18, Th., 10:00 p.m. to Apr. 29, M., 7:40 a.m.**
Classwork, including final examinations in courses, ends for advanced degree candidates	May 16, W.	May 15, W.
Records close for all students completing requirements for degrees	May 23, W.	May 22, W.
Class and laboratory sessions end	May 23, W.	May 22, W.
Semester examinations begin	May 24, Th., 1:30 p.m.	May 23, Th. 1:30 p.m.
Baccalaureate Sunday	May 27, Su.	May 26, Su.
Commencement	May 30, W.	May 29, W.
Semester examinations end	June 2, Sa.	June 1, Sa.

SUMMER SESSION		
First Term	June 11, M., to July 14, Sa.	June 10, M., to July 13, Sa.
Second Term	July 16, M., to Aug. 18, Sa.	July 15, M., to Aug. 17, Sa.

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THE UNIVERSITY OF ARIZONA

Tucson

THE BOARD OF REGENTS OF THE
UNIVERSITY AND STATE COLLEGES

EX OFFICIO

ERNEST W. MCFARLAND, A.B., A.M., J.D., LL.D.....Governor of Arizona
CLIFTON L. HARKINS, B.A., M.A.
State Superintendent of Public Instruction

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	Term Expires
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MICHAEL B. HODGES, President	Term Expires Jan., 1957
JOHN M. JACOBS, Secretary	Term Expires Jan., 1959
EVELYN JONES KIRMSE, A.B., A.M.	Term Expires Jan., 1959
ALEXANDER G. JACOME, B.S., Treasurer	Term Expires Jan., 1961
WILLIAM R. MATHEWS, A.B.	Term Expires Jan., 1961
LYNN M. LANEY, B.S., J.D.	Term Expires Jan., 1963
SAMUEL H. MORRIS, A.B., J.D., LL.D.	Term Expires Jan., 1963

GENERAL INFORMATION

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ROBERT LOGAN NUGENT, Ph.D., *Vice President of the University*

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FRANCIS ALBERT ROY, Ph.D., *Dean of the College of Liberal Arts*

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A. LOUIS SLONAKER, M.A., *Dean of Men*

KAREN L. CARLSON, Ph.D., *Dean of Women*

FLEMING BENNETT, B.S.L.S., *Librarian*

CHARLES ZANER LESHER, M.S., *Registrar and Director of Admissions*

HOWARD NEWTON TENCH, B.S., *Comptroller*

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FREDERIC W. GALBRAITH, Ph.D., *Professor of Geology*

ARTHUR R. KEMMERER, Ph.D., *Professor of Nutrition*

KLONDA LYNN, Ph.D., *Professor of Speech*

CURTIS B. MERRITT, Ph.D., *Professor of Education*

DAVID LYALL PATRICK, Ph.D., *Chairman*

HERBERT DAWSON RHODES, Ph.D., *Professor of Chemistry*

EDWARD H. SPICER, Ph.D., *Professor of Anthropology*

CHARLES F. WALLRAFF, Ph.D., *Professor of Philosophy and Psychology*

THE GRADUATE COLLEGE

Administration of graduate studies, which have been in progress continuously since the academic year 1898-1899, was organized independenly in 1934 with the founding of the Graduate College, under direction of a dean, assisted by a Committee on Graduate Study representative of the various fields in which advanced studies are carried on.

Pursuit of truth and the extension of the boundaries of knowledge, in addition to undergraduate teaching, are recognized as well-established and distinctly important functions of most American universities. The Graduate College is the chief organized agency in the University through which the energies and efforts are mobilized to achieve these purposes. Graduates receiving higher degrees should have a well-balanced general education upon whch to construct a comprehensive and thorough understanding of a limited field of knowledge. The work of the Graduate College ought by its nature and methodology to stimulate and encourage the refinement and development in the student of the spirit of independent investigation in the chosen field of specialization.

GRADUATE WORK. Students entering the Graduate College should realize that their status is different from that of the undergraduate. Although administrative machinery cannot be wholly dispensed with, the primary aim of the graduate student should not be merely to meet requirements. Students should see in their graduate experience the opportunity to enlarge their knowledge and make themselves independent workers. To realize these ends, personal interest should carry beyond the bounds of requirements. A mere accumulation of units or grades is not sufficient. Achievement should be limited only by the time, energy, and ability at the student's command.

GRADUATE DEGREES

The University offers graduate instruction in such departments as are adequately equipped for advanced work. Major work leading to the master's degree is offered in each of the following fields, and that leading to the degree of Doctor of Philosophy (Ph.D.) is offered in the fields starred (*):

FINE ARTS. Art, cello, clarinet, composition, dramatic art, music education, music, organ, piano, speech, theory, trombone, viola, violin and voice.

HUMANITIES. English, French, German, philosophy, Spanish.

SOCIAL SCIENCE. Agricultural education, *anthropology, business administration, economics, *education, history, home economics, education, household economics, political science, psychology, sociology.

BIOLOGICAL SCIENCES. Agronomy, animal science, bacteriology, *biochemistry and nutrition, botany, entomology, food and nutrition, horticulture, plant pathology, *plant sciences (permitted fields of specialization are agricultural chemistry and soils, agronomy, botany, entomology.

horticulture, plant pathology, range management, wildlife management, zoölogy.

PHYSICAL SCIENCES. Agricultural chemistry and soils, astronomy, *chemistry, civil engineering, electrical engineering, *geology (including mineralogy and paleontology), mathematics, physics, mechanical engineering, metallurgical engineering, mining engineering, pharmacy.

ADDITIONAL DEPARTMENTS. Certain other departments in the College of Agriculture whose work is principally research will offer the master's degree to specially prepared students in cases where the interest of the student corresponds to research in progress in the department. The following departments are in this category: dairy husbandry, poulty husbandry, agricultural engineering, and agricultural economics.

The degrees offered by departments in the University which have been approved for graduate work are as follows:

Master of Agricultural Education (M.Ag.Ed.)
Master of Arts (M.A.)
Master of Business Administration (M.B.A.)
Master of Education (M.Ed.)
Master of Electrical Engineering (M.E.E.)
Master of Home Economics Education (M.H.Ec.Ed.)
Master of Music (M.M.)
Master of Music Education (M.Mus.Ed.)
Master of Science (M.S.)
Doctor of Education (Ed.D.)
Doctor of Philosophy (Ph.D.)

FEES

Nonresident tuition fee,* for each semester hour (maximum $175)	$15.00
Registration fees, each semester (less than 6 units *in absentia* $2 a unit; thesis only, $5)	15.00
Incidental fees (enumerated in general catalogue), each semester	20.75
Graduation fee ($5.00 for graduates of the University)	15.00
Thesis binding fee	5.00
Absence from Commencement (second-semester students)	10.00
Dissertation fee (microfilm of doctoral dissertations)	25.00
Late registration	5.00
Change of schedule	1.00
Music major fee (if applicable), each semester	40.00
Oral examination, if candidate is not registered	5.00
Transcript fee (extra copy)	1.00
Alumni Association fee, each semester (6 units or more)	1.25

**Students holding fellowship or scholarship appointments are exempted from payment of the tuition fee; fellows are not required to pay laboratory, music, or field trip fees or deposits.*

HOUSING

Graduate students assume responsibility for their own living arrangements and will be assisted in finding accommodations by the Residence Department. Available only to married veterans are a limited number of Quonset Huts and temporary dwelling units rented furnished or unfurnished at $18 to $24 a month. Rooms in the dormitories are available if there are vacancies after all applications from undergraduates have been processed. When graduate students are given accommodations in the dormitory system they conform to all regulations for senior students. Dormitory space for unmarried graduate students is available for summer sessions.

A Head Resident is in charge of each dormitory. The Head Residents have student assistants who receive a room in exchange for their services. Graduate students interested in an appointment as a student assistant to Head Residents may obtain additional information by writing to the Dean of Men or to the Dean of Women.

DINING HALL

The University Dining Hall, located in the Student Union Memorial Building, is operated on a self-sustaining basis for the convenience of students. The cost of food for the average student is approximately $45 to $50 a month.

GRADUATE APPOINTMENTS

TUITION AND FEES. Students appointed to fellowships (both non-service and teaching fellowships) are exempted from the nonresident tuition fees and from laboratory, music, and field trip deposits and fees. Students appointed to University graduate scholarships are exempted from payment of nonresident tuition fees. Applicants for research assistantships may apply also for graduate scholarships. Fellowships may be held only by graduate students who carry at least 7 units of graduate credit each semester.

TEACHING FELLOWSHIPS. Approximately fifty appointments in this category are available annually—most of them being open to first-year graduate students. Stipends vary, but first-year graduate students carrying a full course load may expect to receive approximately $900 a year for service requiring 12 hours a week. Larger stipends with additional work on a reduced schedule are offered by some departments. The following departments offer one or more teaching fellowships:

Agronomy
Anthropology
Astronomy
Bacteriology
Botany
Business Administration
Chemistry
Economics
Education
English
Entomology
Geology
History and Political Science
Home Economics
Mathematics
Metallurgy
Music
Physics
Plant Pathology
Spanish
Zoölogy

RESEARCH ASSISTANTSHIPS AND GRANTS. Appointments as research assistants are open in several departments engaged in sponsored research projects. Stipends are determined by the type and amount of work required and run for the academic or the calendar year. In most cases research performed may be counted as part of the thesis or dissertation requirement for advanced degrees. Several departments administer funds which provide grants-in-aid, with or without required duties.

RESIDENT ASSISTANTSHIPS. A number of appointments provide rooms and wages for supervisory services in the dormitories. Students interested may write to the Dean of Men or the Dean of Women.

ARIZONA BANKERS' ASSOCIATION FELLOWSHIP. A fellowship of $500 for the academic year to be awarded to a qualified graduate student in either the College of Agriculture or the College of Business and Public Administration whose research problem will be concerned with commercial bank loans to farmers and/or ranchers.

ARIZONA COTTON GROWERS ASSOCIATION FELLOWSHIP. A fellowship of $2,000 with an additional $500 for equipment and travel is offered to a graduate student for research in the field of cotton breeding. The applicant will be selected by the Plant Science Graduate Committee and a representative of the Arizona Cotton Growers Association.

BUREAU OF BUSINESS RESEARCH FELLOWSHIP. A fellowship of $850 for the academic year is granted to a graduate assistant in the Bureau of Business Research.

THE U.S. BUREAU OF MINES FELLOWSHIP. The U.S. Bureau of Mines, Tucson Station, in cooperation with the College of Mines, has established a graduate fellowship of approximately $1,500 to be awarded to a student for the Master's degree in Metallurgical Engineering. In addition to research work conducted in the laboratories of the U.S. Bureau of Mines on the campus during the academic year, the student is also required to conduct research during July and August.

THE PAUL STEERE BURGESS GRADUATE FELLOWSHIP. This fellowship of $900 was established in honor of Paul Steere Burgess, Dean of the College of Agriculture, and for a time President of the University. It will be awarded upon the recommendation of the Dean of the College of Agriculture for graduate study in any department of that College. Application should be received by April 1.

THE COMINS FELLOWSHIP FUND. By the terms of the will of Eben F. Comins a fund was established to encourage studies which will contribute to the cultural understanding of the American Indian. The Department of Anthropology makes awards from this fund for research in art and anthropology.

IRRIGATION-ENGINEERING FELLOWSHIP. Dr. G. E. P. Smith has established a fellowship which will amount to $600 a year. Applicants must be graduate students who have a foundation knowledge of irrigation principles and practices. The selection will be made upon the recommendation of the Head of the Department of Agricultural Engineering. It is required that approximately a third of the student's academic program be devoted to study and a report on a research problem of interest and importance to the State.

STEWARD OBSERVATORY FELLOWSHIP. A fellowship of $900 for the academic year is granted to a graduate student doing research in astronomy.

WILDLIFE MANAGEMENT FELLOWSHIPS. Four fellowships of $1,200 each are granted to first-year graduate students. The appointments are on a twelve-months' basis and may be renewed.

PHELPS DODGE SCHOLARSHIPS. The Phelps Dodge Corporation offers two scholarships for graduate students in the amount of $1,200 each plus tuition and fees. One of the graduate awards will be made to a male student chosen from the engineering student body of the University of Arizona for advanced study in mining, metallurgy, or other fields allied with or pertaining to the mineral industry. One graduate student will be chosen from the student body of the University of Arizona for advanced study in any field that the student may select and for which he or she may be qualified. Recipients of graduate scholarships may pursue their advanced studies at an institution other than the University of Arizona,

provided that the choice of institution is approved by the Committee on Scholarships and Awards.

UNIVERSITY GRADUATE SCHOLARSHIPS. A number of scholarships covering the fee for nonresident tuition were established in 1948 by the Board of Regents of the University of Arizona. In awarding these scholarships the Committee on Graduate Study will give preference to applicants who have superior undergraduate records and who are in need of this financial assistance.

THE ARIZONA CORRAL THEATRE FUND. The Arizona Corral Theatre has established a fund to aid worthy graduate students with a major in Dramatic Arts. Awards will be made upon recommendation of the Department of Dramatic Arts in varying amounts depending on scholarship, need, and/or the research project.

GENERAL REGULATIONS

ADMISSIONS. Admission to the Graduate College is open to persons who hold the bachelor's degree from the Universtiy of Arizona or from a college or university approved by the University of Arizona. Admission in any case is granted only after approval of the candidate's previous academic record by the Registrar, the Dean of the Graduate College, and the heads of the two departments in which the candidate proposes to do the greater portion of his work. An additional number of undergraduate courses may be required when previous work has not approximated the general requirements for the corresponding bachelor's degree at the University of Arizona or the special requirements for the field in which the candidate proposes to specialize; and prospective graduate students are urged to determine from the Dean their status in this regard. Students whose preparation is such that they are unable temporarily to elect any work for graduate credit must register in the appropriate undergraduate college.

APPLICATION FOR ADMISSION. Application for admission to the Graduate College must be made on the blanks furnished by the Dean of the Graduate College. An applicant from another institution should request that a complete transcript of all undergraduate and graduate work done and degrees received be sent directly by the institution concerned to the Registrar and Director of Admissions of the University of Arizona. Both the application and the transcript must be on file prior to registration.

GRADUATE RECORD EXAMINATION. As a means of supplementing other evidences of preparation for graduate work, the Committee on Graduate Study has authorized the use of Graduate Record Examinations. These examinations will not replace other records of achievement as a basis for admission to the Graduate College, but they will offer additional evidence concerning the qualifications of students desiring to undertake graduate work. Applicants who expect to major in geology or psychology are required to submit scores in aptitude and advanced tests; for doctoral work in education the aptitude test is required. It is suggested but not required that in addition to providing a transcript of record of undergraduate and graduate work, each applicant for admission to the Graduate College take the Graduate Record Examination and submit a transcript of his scores. Applications for the examination, which will be administered locally as well as in other centers, should be sent, together with an examining fee of $8 to $12, to Educational Testing Service, P. O. Box 9896, Los Feliz Station, Los Angeles 27, California, or P. O. Box 592, Princeton, New Jersey.

CANDIDACY FOR AN ADVANCED DEGREE. Admission to graduate study does not imply admission to candidacy for an advanced degree and gives no right or claim to be so admitted. Such candidacy is determined after the student has demonstrated by work done at the University of Arizona

the ability to do work of graduate character with originality and independence. Until admitted to candidacy a student should not count upon taking the final examination for a degree at any set time. Students seeking the master's degree usually apply for admission to candidacy after the first semester of residence.

GRADUATE CREDIT FOR SENIORS AND UNCLASSIFIED STUDENTS. A student of senior standing who is within 15 units of completing all requirements for graduation may register for graduate work if recommended by the head of the department and approved by the Dean of the Graduate College. For such registration a petition for graduate credit in excess of senior requirements must be filed with the Dean at the time of registration, or within 10 days thereafter, for the action of the Committee on Graduate Study. This petition must be endorsed by the professor in charge of the course and the student's major professor. The Committee will not approve a petition unless the senior has a grade average of 2.5 or better on all work already completed in the University; is proceeding toward graduation as directly as possible; and does not propose a total load to exceed 16 units. The maximum number of units of graduate credit that may be earned by a senior in any semester is equal to the difference between 16 and the number necessary to complete requirements for graduation.

A student who holds the bachelor's degree but who is not registered in the Graduate College may petition for permission to take courses for graduate credit. His petition must be filed within 10 days following registration, be recommended by the instructor of the course and the head of the department concerned, and be approved by the Committee on Graduate Study.

GENERAL PREREQUISITES FOR MAJOR AND MINOR GRADUATE CREDIT. The undergraduate major, or its equivalent, in any field of study is prerequisite to major graduate work in that field. In some cases a field of concentration in the undergraduate work different from but suitably related to the graduate major may be acceptable. The minimum requirement in education is 15 units, of which 3 may be in general psychology.

Supporting or minor courses have as a prerequisite for graduate credit a minimum of 12 units basic to the subject, including all prerequisites stated in the description of the course.

Deficiencies in undergraduate preparation must be satisfied by the completion of prescribed courses for undergraduate credit.

GRADUATE CREDIT COURSES. Courses numbered 300 or over are particularly intended for graduate students, while courses numbered 200 may be taken for graduate credit.

EXTENSION COURSES. Extension courses given by the University Extension Division will be accepted for graduate credit only when they are of recognized graduate character. Graduate credit for approved extension courses will be granted only to students who have secured graduate standing by formal application for admission to the Graduate College. A maxi-

mum of 7 units of graduate credit earned in extension courses at the University or at University extension centers in the state, or earned in residence at another accredited institution, may be counted in meeting requirements for the master's degree, except the degree of Master of Electrical Engineering. No extension course may be applied on course requirements for the Ph.D. degree.

CORRESPONDENCE COURSES. Correspondence courses will not be accepted for graduate credit.

TRANSFER OF GRADUATE CREDIT. The University of Arizona accepts graduate credit by transfer from institutions accredited for graduate work. Not more than 7 transferred units may be offered toward the master's degree. Such credit may be established to apply on an advanced degree only upon satisfactory completion of such additional courses as may be prescribed by the head of the corresponding department in the University. In any case, transfer will not be made until the student has completed satisfactorily 1 semester of work.

SCHOLARSHIP REQUIREMENTS. A high level of performance is expected of students enrolled for graduate credit. A student who does not appear to be making satisfactory progress in his graduate work may be required to withdraw from the University. No student will be recommended for the award of an advanced degree unless he has achieved a grade average of 2.0000 or higher on all course work taken in residence for graduate credit. The grade average will be computed on all work for which the student has enrolled for graduate credit, whether or not it is offered in satisfaction of requirements for an advanced degree. The grade of "4" does not carry graduate credit but is included in the general average.

MAXIMUM STUDY LOAD. The usual maximum load for students registered in the Graduate College is 16 units; this limit may be exceeded only by permission.

THESIS WORK IN ABSENTIA. Under conditions approved by the head of the major department and the dean, a portion of a student's thesis work may be done *in absentia.* If not registered at the time the thesis is submitted and the final oral examination is held, a candidate who has been doing thesis work *in absentia* must pay a special examination fee of $5. These regulations apply also to the dissertation for the Ph.D. degree.

ESTABLISHMENT OF RESIDENCE IN THE SUMMER SESSION. Residence during one summer session of 10 weeks is equivalent to a semester of residence.

AUDITING OF COURSES BY GRADUATE STUDENTS. With the consent of the dean and the instructors concerned, students enrolled in the Graduate College during the academic year may audit courses not included in their regular programs. It is not necessary to register for such courses.

GRADUATE STUDY IN SUMMER SESSION

The University of Arizona Summer Session gives particular attention to graduate study. All courses numbered 300 and above are definitely organized as graduate courses and carry graduate credit. Upper-division courses numbered 200-299 inclusive are acceptable for graduate credit.

Owing to the increasing demand for graduate work during the summer, several of the departments of the University have provided for individual research in their special fields. Such courses are listed under the respective departments. Students who wish to pursue any of these courses must obtain the consent of the respective instructors before registering for the courses.

In certain departments provision is made for teachers in service and others who are unable to attend the University during the regular year to complete the requirements for the master's degree by attendance at summer sessions only.

TUITION. The tuition required of all students registered for credit is $7.50 per unit (semester hour). There is no additional nonresident fee for out-of-state students.

REQUIREMENTS FOR MASTER'S DEGREES

MASTER OF ARTS AND MASTER OF SCIENCE

The degrees of Master of Arts and Master of Science will be conferred for advanced work done by students who have received the bachelor's degree from this institution or from one of similar standing. The master's degree implies advanced training gained through intensive study in a special field supplemented, if advisable, by study in supporting subjects. Thirty units of graduate work, including the thesis, and completion in a period of not more than 6 years are required. Not less than 15 units must be in a major field. Two or more closely allied subjects may be combined to form a major. Two semesters of residence, involving completion of not less than 23 semester hours of graduate credit, are required, except as thesis work *in absentia* may be approved; the remaining 7 units may be units either transferred from another accredited graduate school or earned in extension courses offered by the University of Arizona. (One summer session of 10 weeks is equivalent to a semester of residence.) On approval of the head of the department and the Committee on Graduate Study, thesis work may be done *in absentia* under the direct supervision and guidance of a member of the faculty.

TIME LIMITATION. Graduate credit to be applicable with full value toward a master's degree shall have been earned not more than 6 years prior to the completion of the requirements for the degree. Graduate courses taken more than 6 years and not more than 10 years prior to completion of degree requirements will be given only half credit toward the degree. Work more than 10 years old is not accepted as a part of degree requirements. Validation by examination is not permitted.

MAJOR PROFESSOR AND DIRECTOR OF THESIS. The head of the department in which the candidate's major work lies shall designate as his major professor and general adviser some member of the department, and as his director of thesis either this same person or some other member of the department. The major professor shall approve the program of study and the thesis and, with the approval of the dean, shall select at least two members to serve with him as an advisory and examining committee.

PRORGAM OF STUDY. Each applicant for a master's degree shall submit to the dean for approval, on a form provided for the purpose, a program of study for the work proposed, duly approved by the major professor.

ADVANCEMENT TO CANDIDACY. A petition for advancement to candidacy for the degree sought must be filed with the dean not later than the beginning of the last semester of work. Acceptance for candidacy shall be subject to final approval by the Committee on Graduate Study. Departments which so desire may require a preliminary comprehensive examination before officially approving any candidacy for the master's

degree. In any case, candidacy will not be granted before a program of studies and a thesis proposal have been approved.

THESIS. A thesis in the major field is required. (In the Department of Mathematics, the requirement of a thesis for the master's degree is made optional with the department.) The title and a brief outline of the thesis proposed, approved by the major professor and on a blank provided, shall be filed with the dean not later than the beginning of the semester during which the requirements for the degree are to be completed. Credit for the thesis shall be 2-8 units, inclusive of courses intended to aid in the preparation of the thesis. One copy of the completed thesis shall be submitted to the Committee on Graduate Study at least 1 week before the oral examination. Instructions relating to the form of the thesis may be obtained from the dean. Following the final oral examination, two copies of the thesis and two copies of an abstract of the thesis, the abstract to be 200 words or less in length, are filed with the dean for subsequent deposition in the University Library; and a fee of $5 is paid to the University Comptroller to cover the cost of binding.

FINAL EXAMINATION. A candidate for the master's degree must pass a final examination before a committee chosen by the major department with the approval of the dean. The time and place must be approved by the dean at least 1 week in advance. The examination shall be in part a defense of the thesis but in the main a general examination on subject matter related to the candidate's field of study. It shall be in part oral, or may be wholly so, at the option of the major professor. In case a written examination, in part, is deemed advisable, the departments of the candidate's field of study shall cooperate in preparing one set only of questions which will correlate as fully as possible the supporting subjects with the more important major field of study. At the final oral examination the Committee on Graduate Study shall be represented, and all members of the general faculty have the privilege of being present. Any candidate who fails in the final examination may, upon recommendation of the major professor and approval of the Committee on Graduate Study, be granted a second examination after a lapse of at least 1 semester. The second examination is final.

A certification that the thesis has been accepted and that an oral examination has been satisfactorily passed shall, together with the two duly approved copies of the thesis, be filed with the dean not later than 1 week before the conferring of the degree.

SPECIAL REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS WITH A MAJOR IN ART. The Art Department offers graduate courses leading to the degree of Master of Arts. The degree of Master of Arts will be conferred for advanced work done by students who have received the degree of Bachelor of Fine Arts from this institution or from one of similar standing. Candidates for the degree of Master of Arts who have received bachelors' degrees other than the Bachelor of Fine Arts are required to take enough undergraduate courses in art to make up the deficient units for the degree of Bachelor of Fine Arts as that deficiency

shall be determined by the major professor. Otherwise the requirements are the same as those outlined above for the degree of Master of Arts or Master of Science, with the exception that an original work of art must be offered in lieu of a thesis. The work of art submitted must be accompanied by all sketches, preliminary works, organized annotations of research and other materials connected with its accomplishment, together with a written essay setting forth the method of procedure and containing a reproduction or reproductions of the work. The art department reserves the right to retain the work submitted for its department collection.

The candidate is required to prepare a one-man exhibit of his work for exhibition during his last semester in residence.

The decision as to whether or not the requirements are satisfactorily met shall rest with a committee of the faculty of the Art Department, as selected by the head of the department, with the approval of the Dean of the Graduate College. Certification shall follow the procedure used in connection with the oral examination. Following this certification two copies of the essay and two copies of an abstract of the essay, the abstract to be 200 words or less in length, are filed with the dean for subsequent deposition in the University Library; and a fee of $5 is paid to the University Comptroller to cover the cost of binding.

SPECIAL REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS WITH A MAJOR IN DRAMATIC ARTS. The Department of Dramatic Arts offers courses leading to the degree of Master of Arts. Students are admitted for the advanced work who have received the Bachelor of Fine Arts degree or the Bachelor of Arts degree, with a major in Dramatic Arts from this institution or from one of similar standing. Upon evaluation, any deficient units for the above degrees shall be determined by the major professor. Otherwise, the requirements are the same as those outlined above for the Master of Arts, or Master of Science, except that an original work of playwriting, scenic art or performance may be offered in lieu of a thesis. Such original work, submitted or performed, must be accompanied by schematic diagrams, prompt books, organized annotations of research, subjective observation, together with a written report, setting forth the method of procedure. The University will retain the work submitted. If an original play is offered it must be produced in such form as is indicated by the department.

SPECIAL REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE WITH A MAJOR IN WILDLIFE MANAGEMENT IN THE DEPARTMENT OF ZOOLOGY. Candidates for this degree will be required to spend a minimum of one year on a field problem and one year on course work and the preparation of a thesis. The program of studies shall include at least 15 units of research work for the thesis and at least 15 units of course work.

FOREIGN LANGUAGE OPTION. At the option of the head of the department in which the major work is done, a reading and working knowledge of German, French, or Spanish may be required to complete the requirements for the master's degree.

MASTER OF AGRICULTURAL EDUCATION AND MASTER OF HOME ECONOMICS EDUCATION

The general regulations and requirements for the Master of Arts and Master of Science degrees apply to these degrees with the following exceptions. The candidate shall have completed a minimum of one year's successful teaching experience in either agriculture or home economics. The faculty of the Department of Agricultural and Home Economics Education shall be the judge for the acceptability of the candidate's experience record. A thesis is not required but all candidates for the degrees shall complete a research project incident to the work in Agricultural Education 311 or Home Economics Education 310.

A total of 32 units of course work shall be required for the degrees with a minimum of 20 units in a major field and the remainder in supporting subjects. The major fields of study shall include Agriculture and Agricultural Education or Home Economics and Home Economics Education. The additional course work shall be in education and other approved subjects appropriate to the candidate's needs as a teacher. In addition to the oral examination, a comprehensive written examination in the candidate's major field of study will be required.

MASTER OF BUSINESS ADMINISTRATION

The degree of Master of Business Administration is conferred upon satisfactory completion of a professional post-graduate program in business administration. This program is designed to give students comprehensive training to qualify them for eventually filling positions on the executive level in business. Those who wish to become specialists in one field of concentration in business administration should elect to pursue the program leading to the degree of Master of Science in Business Administration.

Admission to the M.B.A. program is limited to those who have received a bachelor's degree from an accredited four-year college and who have maintained a satisfactory grade average in their undergraduate work.

The program for the M.B.A. degree is divided into two parts: a one-year basic core curriculum corresponding roughly to the requirements of an undergraduate major in business administration, and a group of professional and research courses from which may be selected a well-balanced second-year program of courses with graduate credit amounting to not less than 30 hours. These 30 second-year units should include Business Administration 372, Report Writing; and Business Administration 371, Business Policies; and not more than 9 hours in any field of concentration.

It is possible for students to finish the M.B.A. program in two years even though they have had no previous work in the required fields of study. Students may finish the program in less than two years if they have completed with satisfactory grades a part of the program.

Requirements for the M.B.A. degree in regard to time limitation, scholarship requirements, approval of program of study, advancement

to candidacy, and residence requirements are the same as those for the M.S. degree.

No thesis is required for the M.B.A. degree, but an oral comprehensive examination at completion of the program is required.

CURRICULUM REQUIRED OF ALL STUDENTS WORKING FOR THE M.B.A. DEGREE

FIRST YEAR

Subject	Units	Subject	Units
Bus. Adm. 31a (Prin. of Acctg.)	3-4	Bus. Adm. 31b (Prin. of Acct.)	3-4
Bus. Adm. 271a (Bus. Org. & Mgmt.)	3	Bus. Adm. 261 (Prin. of Mkt.)	3
Bus. Adm. 220a (Bus. Law)	3	Bus. Adm. 271b (Bus. Org. & Mgmt.)	3
Bus. Adm. 255 (Statistics)	4	Bus. Adm. 220b (Bus. Law)	3
Econ. 291 (Intermed. Econ. Theory)	3	Econ. 248 (Money & Banking)	3
Total	16-17	Total	15-16

SECOND YEAR

Subject	Units
Econ. 308 (Managerial Econ.)	3
Bus. Adm. 241 (Business Finance)	3
Bus. Adm. 355 (Research Meth. in Bus.)	3
Bus. Adm. 371 (Business Policies)	3
Bus. Adm. 372 (Report Writing)	3
*Electives in Bus. Adm., Economics, or related fields	15
Total	30

MASTER OF EDUCATION

The degree of Master of Education will be conferred upon professional students in the field of education who have met the admission requirements of the Graduate College and who have completed the stipulated graduate studies and met all other requirements for the degree. All general regulations for graduate work and all requirements for Master of Arts and Master of Science degrees apply to this degree, except as they may be modified by the following requirements. (A thesis is not a part of the requirements for this degree.)

COURSE REQUIREMENT. Course work required shall be not less than 32 units. A minimum of 17 units must be in the major subjects.

SUPPORTING WORK. If the major is English, mathematics, or other subjects which are teaching fields in the public schools, the supporting work shall include not less than 12 semester hours in education. If the

Not more than 9 units of electives in any one of these fields.

(1) Students who have completed courses required in the first year with a grade of 3 or better may take graduate electives for graduate credit, but in no case more than 9 units in any one field.

(2) Any course completed with a grade of less than 3 is not acceptable in completion of degree requirements.

major is education, supporting work should be planned with a view to the student's special interests as a teacher or administrator.

PROGRAM OF STUDY. Not later than the beginning of the final semester or term, and preferably at the end of the first term of study, each student shall submit on a form provided by the Graduate College a program of study.

RESEARCH PROJECT. All candidates for the degree, whether the major or the minor is in Education, are required to complete a research project of a kind to warrant 2 units of credit. Students will register for Education 390 to receive credit for this project.

WRITTEN EXAMINATIONS. All candidates will be required to pass a comprehensive written examination in Education and, at the option of the department, a comprehensive written examination in the major field if other than education. Results of such examinations shall be certified to the Committee on Graduate Study by the departments.

ORAL EXAMINATION. An oral examination in the major and supporting subjects is required. A committee for the oral examination shall be appointed by the Dean of the Graduate College and shall include not fewer than two representatives of the major and one representative of the minor department. It is the student's responsibility to ascertain from the departments concerned the manner in which the examinations will be conducted. If the examination is unsatisfactory, a second examination may be scheduled after the lapse of one calendar year. No student will be permitted a third examination.

MASTER OF ELECTRICAL ENGINEERING

The degree of Master of Electrical Engineering will be conferred upon students pursuing their profession in industry or in government service who have met the admission requirements of the Graduate College and who have completed the stipulated graduate studies and met all other requirements for the degree. All general regulations for graduate work and all requirements for Master of Science degrees apply to this degree except as modified by the following requirements.

THESIS REQUIREMENT. The thesis is optional. The decision to include or omit the thesis will be made by the head of the Electrical Engineering Department after consultation with the student.

COURSE REQUIREMENTS. A minimum of 30 units of work, including the thesis is required. A minimum of 32 units of work is required if no thesis is submitted.

MASTER OF MUSIC AND MASTER OF MUSIC EDUCATION

The School of Music offers graduate courses leading to professional degrees of Master of Music, and Master of Music Education as well as the Degree of Master of Arts with a major in music.

The requirements for the degree of Master of Music are the same as those outlined above for the degree of Master of Arts or Master of Science, with the exception that 12 units of applied music constitutes a major in the applied field. An extended original composition may be offered in lieu of a thesis for those majoring in composition and a public recital during the last semester in residence for those majoring in applied music. The approval of the recital shall rest with a committee selected from the faculty of the School of Music by the head of the department with the consent of the Dean of the Graduate College. Certification of the results of the recital shall follow procedure used in connection with the oral examination.

The requirements for the degree of Master of Music Education are the completion of 32 units of approved graduate courses in music education and allied fields of study, including Music 399, in which a professional paper will be required.

A preliminary comprehensive examination is required before official approval of candidacy for the degree of Master of Music or Master of Music Education.

REQUIREMENTS FOR DOCTOR'S DEGREES

DOCTOR OF PHILOSOPHY

Departments which are properly equipped and which possess special advantages for original investigation may accept prospective candidates for the degree of Doctor of Philosophy. This degree requires distinguished attainment in a recognized field of learning, demonstrated in a dissertation which contributes to the general fund of knowledge. It is not granted as a certificate of faithful performance of a prescribed program of studies and research.

RESIDENCE AND CREDIT REQUIREMENTS. Not less than six semesters of essentially full-time graduate study are required. Graduate credit earned at approved institutions may be counted towards requirements for the higher degree, if accepted by the major department and the Committee on Graduate study. However, two regular semesters must be spent in actual residence at the University of Arizona, and at least 30 units must be completed at this university. Any semester during which a student is registered for at least 9 units of graduate course work or research will be counted as full residence, provided that the student's full time is devoted to graduate work. The dissertation is understood to require at least one year of full-time work. Research credit of not more than eighteen units is allowed for research on the dissertation problem. Arrangements for writing the dissertation *in absentia* must be made through petition to the Committee on Graduate Study with the favorable recommendation of the department supervising the work. All requirements for the degree, including work done for the Master's degree, must be met within a period of ten years.

MAJOR AND MINOR SUBJECTS. The student shall choose a major subject and either one or two supporting minor subjects. The minor subject or subjects must be taken outside the department of the major subject. Not less than 36 units of work must be in the department of the major subject.

QUALIFYING EXAMINATION. For the purpose of demonstrating his fitness to undertake work leading to candidacy for the doctorate, each prospective candidate must pass a qualifying examination covering work done previously in the proposed major and minor fields. The examination is waived at the discretion of the department in a field in which the candidate has done major work toward a completed master's degree at the University of Arizona. It must be taken during the first semester of residence, and preferably should be taken during the first 2 weeks of residence.

PROGRAM OF STUDY. A program of study recommended by the department or departments concerned, and an outline of the proposed dissertation, approved by the major department, must finally be approved by the Committee on Graduate Study. The program and the outline should be submitted on forms provided by the dean, the program at the beginning of the second year of graduate study, and the outline not later than October 1 of the last year of study.

FOREIGN LANGUAGE REQUIREMENT. Before the preliminary examination, the departments of French and German must certify that the student is proficient in these languages for the purposes of research. With the approval of the major department and the Committee on Graduate Study, proficiency in another language may be substituted for proficiency in one of these.

PRELIMINARY EXAMINATION. Before admission to candidacy for the degree, a general examination in the student's chosen field of study must be passed. This examination is intended to test the student's general fundamental knowledge of the fields of the major and minor subjects of study. It shall include written examinations covering the major and minor fields and, upon successful completion of these, an oral examination which shall be conducted before a committee of the faculty appointed by the dean upon consultation with the major and minor departments. This examination will be held toward the end of the second year of graduate work and in any case not later than February 15 of the last year. Except by special permission of the dean it may not be taken until the minor work has been completed.

ADVANCEMENT TO CANDIDACY. When the preliminary examination has been passed, the language requirements satisfied, and evidence shown of ability to carry on research work of a high grade, the student will be recommended to the Committee on Graduate Study for acceptance as a candidate for the doctorate. These regulations must be met on or before February 15 of the academic year in which the degree is to be conferred.

DISSERTATION. Two weeks prior to the final examination, one copy of the dissertation must be submitted to the Committee on Graduate Study. Two copies of the completed dissertation, approved and accepted by the major department, must be filed with the dean, following the final examination, and a library binding fee of $5 must be paid to the University Comptroller. At the same time, there must be filed two copies of an abstract of the dissertation approved by the major department and the dean.

PUBLICATION OF DISSERTATION. Ph.D. dissertations are published by University Microfilms, Ann Arbor, Michigan, and a fee of $25 is charged to cover this expense. Upon certification by the student's major professor, members of the committee for his final examination, and the Dean of the Graduate College, the typed first copy and an abstract of 700 words or less, is forwarded to University Microfilms. The manuscript is microfilmed, the negative inspected, and put in vault storage. The manuscript is catalogued and this information is sent to the Library of Congress for printing and distribution of cards to depositry catalogues and libraries. The abstract is printed in the forthcoming issue of Microfilm Abstracts and distributed to leading libraries here and abroad, and to a selected list of journals and abstracting services. The first copy with one positive microfilm is then returned to the University Library.

Publication by microfilm does not preclude publication by other methods later, and successful candidates are urged to submit dissertation material for publication in a journal of its field. Suitable acknowledgment must

always indicate the publication to be a dissertation, or portion of a dissertation, submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Arizona.

FINAL EXAMINATION. When the required standards of scholarship have been met and the required ability in research has been shown, the candidate shall submit to an oral examination in defense of his dissertation, as well as any general questioning related to his field of study which may develop therefrom. This examination shall be conducted before a committee of the faculty appointed by the dean upon consultation with the major and minor departments, the exact time and place to be announced at least 1 week in advance, and shall be open to the public.

OTHER EXAMINATIONS. Before admittance to the final examination and in addition to the preliminary examination and the regular scheduled course examinations, the candidate may be required to take any other examinations, oral or written, that are thought proper by the departments concerned.

SPECIAL REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE WITH A MAJOR IN PLANT SCIENCE

Study and investigation leading to the degree, Doctor of Philosophy, may be conducted with a major in plant science. The candidate will undertake advanced study and conduct research in one of the following fields of specialization: agricultural chemistry and soils, agronomy, botany, entomology, horticulture, plant pathology or range management. Supporting studies will be undertaken in these or related fields fundamental to the basic training of the candidate.

The plant science doctoral program will be coordinated by a Plant Science graduate committee consisting of one representative from each of the above-mentioned fields. The duties of this committee shall be (1) to advise the student as to the objectives and requirements of the plant science doctoral program; (2) to make recommendations pertaining to adequacy of courses or research required for this degree; (3) to assist on a broader scale in making research facilities available; and (4) to approve the student's formal program of study and outline of proposed research.

Each candidate admitted to the Graduate College under this program shall be under the immediate direction of a guidance committee. The duties of the guidance commitee shall be: (1) to familiarize itself with the academic background and objectives of the student; (2) to advise the student as to a broad and well-balanced course of graduate study; (3) to be available for consultation and advice; and (4) upon approval of the Committee on Graduate Study to serve on the examining committee and give the qualifying, preliminary and final examinations.

The personnel of the guidance committee will be determined by the candidate's individual fields of interest. This committee shall consist of nor less than three individuals: the thesis director, who shall be the chairman, and two or more additional members. When the committee consists of only three persons, each shall represent a separate department.

The major department shall select the chairman and other members of the guidance committee, subject to approval of the Committee on Graduate Study. The guidance committee shall serve until the candidate has completed his graduate work.

DOCTOR OF EDUCATION

The Department of Education of the Graduate College accepts prospective candidates for the degree of Doctor of Education. The degree is granted only to those who demonstrate a high degree of proficiency in Education and who present a dissertation of a professional nature.

RESIDENCE AND CREDIT REQUIREMENTS. Not less than six semesters of full-time graduate study are required. At least one regular semester in residence, not including work offered in meeting requirements for the master's degree, is required. During this semester the student must be registered for twelve or more semester hours of credit. The minimum hour requirement is seventy semester hours at the graduate level. Research for the dissertation, for which no credit is given, usually requires the equivalent of one academic year of full-time work, exclusive of any work accomplished in connection with a master's thesis. All requirements for the degree must be met within a period of six calendar years after the qualifying examination.

QUALIFYING EXAMINATION. For the purpose of demonstrating fitness to undertake work leading to candidacy for the doctorate, each applicant must pass a qualifying examination. It is expected that this examination will be taken after thirty hours and before forty-five hours of graduate work have been completed. The examination will be either oral or written, or both, at the discretion of the department. In addition a personal interview, a review of the applicant's college record, and evidence of the applicant's ability to write in a scholarly manner are required. Applicants may offer the master's thesis or an equivalent paper to the examining committee for its use in evaluating the student's ability to write in acceptable fashion.

TEACHING EXPERIENCE. Candidates for the degree of Doctor of Education are required to furnish evidence of at least three years of successful teaching or administrative experience in the public schools.

PROGRAM OF STUDY. A program of study, recommended by the Dean of the College of Education, must be submitted for the approval of the Committee on Graduate Study at the beginning of the second year of graduate study. The student will major in Education but must have a minor in a department other than Education. Not less than forty-six units of work must be in Education. An outline of the proposed dissertation, approved by the Dean of the College of Education, must be submitted for the approval of the Committee on Graduate Study not later than October 1 of the last year of study. The appropriate forms are available in the office of the Dean of the Graduate College.

FOREIGN LANGUAGE REQUIREMENT. A reading knowledge of a foreign language will be required when such knowledge is necessary for the successful completion of the dissertation.

PRELIMINARY EXAMINATION. Before admission to candidacy for the degree, a comprehensive examination must be passed. This examination shall be both written and oral and will cover work which the applicant has taken in Education and in minor fields. The examination will be held toward the end of the second year of graduate work or not later than February 15 of the last year.

ADVISORY COMMITTEE. When the student has successfully passed the qualifying examination and has outlined a tentative dissertation problem, the Dean of the Graduate College, after consultation with the Dean of the College of Education, will appoint an advisory committee. Two members from the student's major field of study and one from his minor field of study will constitute the committee. The chairman will be the student's major professor and dissertation director. The duties of this committee are to review the proposed dissertation problem, to evaluate the student's program of study, to make recommendations to the Dean of the College of Education concerning the dissertation problem and the program of study, and to be available to the student when guidance is necessary.

ADVANCEMENT TO CANDIDACY. When the preliminary examination has been passed and evidence shown of ability to carry on professional studies at the highest level, the student will be recommended to the Committee on Graduate Study for acceptance as a candidate for the doctorate. These requirements must be met on or before November 1 of the academic year in which the degree is to be conferred.

FINAL EXAMINATION. When the required standards of scholarship have been met and the required ability in research has been shown, the candidate shall submit to an oral examination in defense of his dissertation, as well as to any general questioning related to his field of study which may develop therefrom. This examination shall be conducted before a committee appointed by the Dean of the Graduate College, upon consultation with the Dean of the College of Education, the exact time and place to be announced at least one week in advance, and shall be open to the public.

DISSERTATION. Two weeks prior to the final examination, one copy of the dissertation must be submitted to the Committee on Graduate Study. Two copies of the completed dissertation, approved and accepted by the major department, must be filed with the Dean, following the final examination, and a library binding fee of $5 must be paid to the University Comptroller. At the same time, there must be filed two copies of an abstract of the dissertation approved by the Dean of the College of Education and the Dean of the Graduate College.

PUBLICATION OF DISSERTATION. Dissertations are published by University Microfilms, Ann Arbor, Michigan, and a fee of $25 is charged to cover this expense. Upon certification by the student's major professor,

members of the committee for his final examination, and the Dean of the Graduate College, the typed first copy and an abstract of 700 words or less is forwarded to University Microfilms. The manuscript is microfilmed, the negative inspected, and put in vault storage. The manuscript is catalogued and this information is sent to the Library of Congress for printing and distribution of cards to depository catalogues and libraries. The abstract is included in the forthcoming issue of Microfilm Abstracts, which is distributed to leading libraries here and abroad, and to a selected list of journals and abstracting services. The first copy with one positive microfilm is then returned to the University Library.

Publication by microfilm does not preclude publication by other methods later, and successful candidates are urged to submit dissertation material for publication in a journal of its field. Suitable acknowledgment must always indicate the publication to be a dissertation or portion of a dissertation, submitted in partial fulfilment of the requirements for the degree of Doctor of Education at the University of Arizona.

COURSES OF INSTRUCTION

EXPLANATORY NOTES

Descriptions of all courses carrying graduate credit may be found on the following pages. Departments are arranged alphbetically rather than with respect to college organization, except for Agriculture and Engineering.

CLASSIFICATION OF COURSES. The number by which a course is designated is intended to indicate the relative advancement of the course. Courses numbered 200-299 inclusive are upper-division courses primarily for juniors and seniors, but courses in this group may be carried for graduate credit under arrangements approved by the instructor, the head of the department, and the Dean of the Graduate College and are not open to lower-division students. Courses numbered 300-399 are primarily for graduate students, but may be taken by qualified seniors. Courses numbered 400 and above are exclusively for graduate students.

Courses in the College of Law numbered 100-199 may be carried for graduate credit with the consent of the Dean of the College of Law and the Dean of the Graduate College.

YEAR COURSES (DOUBLE NUMBERS). A course designated by a double number (as Economics 1a-1b) is continued through two successive half years, the work of the first semester being prerequisite to that of the second semester unless otherwise indicated in the statement of prerequisites. The student will use the first number in registering for the course during the first semester and the second number in registering for the course during the second semester. A final report will be made by the instructor at the end of each semester, with final credit for the first half of the course except as otherwise noted.

SEMESTER COURSES (SINGLE NUMBERS). A course designated by a single number (as Economics 148) is one semester in length.

PREREQUISITES. A student registering for a course must meet the prerequisites or otherwise satisfy the instructor of his ability to take the course.

CANCELLATION OF COURSES. The faculty reserves the right to cancel any course not elected by an adequate number of students.

KEY TO SYMBOLS

( ) Indicates the unit value of the course for each semester by the number in parenthesis following the course title. Each unit usually represents one lecture or recitation, or 3 hours of laboratory work, per week for a semester.

I, II. Indicates the half year during which a semester course is offered (i.e., "I," first semester; "II," second semester; "I, II," both semesters).

Yr. Indicates the course is given throughout the year, the first half of the course being offered in the first semester, the second half in the second semester. Where one or both halves of a year course are offered each semester, this is indicated in the course description.

1955-56, 1956-57 Indicates that the course is an alternate-year course, to be offered during the year designated.

R, L. Indicates "recitation" and "laboratory." For those courses which include laboratory work, the number of hours of recitation and of laboratory work is listed on the basis of hours per week (i.e., "2R, 3L"). For courses consisting of lecture and recitation periods only, the number of class hours per week is the same as the unit value of the course.

P. Indicates "prerequisite."

CR. Indicates "concurrent registration."

AGRICULTURE

Study leading to the Master of Science degree is available in agricultural chemistry and soils, agronomy and range management, animal science, animal nutrition, botany, entomology, horticulture, nutrition, and plant pathology. The degree of Master of Agricultural Education is offered by the Department of Agricultural Education.

Certain other departments in the College of Agriculture whose work is principally research will offer the master's degree to specially prepared students in cases where the interest of the student corresponds to research in progress in the department. The following departments are in this category: Dairy Husbandry, Poultry Husbandry, Agricultural Engineering, and Agricultural Economics.

Study leading to the degree of Doctor of Philosophy is available in agricultural chemistry and soils, botany, plant pathology, and research for the doctoral dissertation may also be undertaken in agronomy and horticulture.

In addition to the usual classroom and laboratory facilities, there is available to the graduate student in agriculture the opportunity of participating in actual agricultural research in progress in the Agricultural Experiment Station. Each student is normally assigned to a staff member of the Agricultural Experiment Station, under whose direction he conducts his research necessary to the writing of an acceptable thesis.

The Bachelor of Science degree in the undergraduate major, or its equivalent, is normally required for admission to graduate work in that field. By special permission, a field of concentration in the undergraduate work different from, but related to, the graduate major may be acceptable.

See page 20 for M.Ed. degree major or minor in this department.

AGRICULTURAL AND HOME ECONOMICS EDUCATION

Professor Russell W. Cline, Ph.D., *Head;* Assistant Professor Wallace A. Schafer, M.Agr.Ed.; Assistant Professor June B. Wall.

The department offers opportunities for graduate students to plan and conduct studies on professional problems in agricultural and home economics education.

Applicants for admission to graduate study in the department should have the B.S. degree from an approved college for the training of vocational teachers with a major in agricultural education or home economics education. The undergraduate course work of the applicant should be the equivalent of that required of undergraduate students in this department and should include a minimum of 18 semester credits in psychology, educational psychology, vocational education, special methods of teaching, and directed teaching.

The department offers programs leading to the degrees Master of Science, Master of Agricultural Education and Master of Home Economics Education. The major fields of study for these degrees shall include a minimum of 20 units in agriculture and agricultural education or home economics and home economics education.

The additional supporting course work shall be in education and other approved subjects appropriate to the student's teaching field. A total of 30 credits including a thesis is required for the Master of Science degree.

A total of 32 units of course work is required for the Master of Agricultural Education and Master of Home Economics Education degrees. A thesis is not required, but candidates for these degrees must complete a research problem. Graduate courses are offered each summer session to aid students in completing degree requirements.

301. ADVANCED AGRICULTURAL EDUCATION. (2) I, II. Cline

Advanced problems in organizing and conducting programs of instruction in agriculture. P, 189.

310. INVESTIGATIONS AND STUDIES IN AGRICULTURAL EDUCATION. (2) I. Cline
A study of research procedure and a review of the findings of studies. Selecting a problem, planning and completing a study. P, 6 units of graduate study in student's major field including 2 units in agricultural education. (Identical with Home Economics Education 310)

399. SEMINAR. (2) II. Staff
Study of selected topics and current developments in agricultural education. P, 189.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (2 to 6) I, II. Staff

PHILOSOPHY OF VOCATIONAL EDUCATION. (2) II. Cline
See Education 209.

290. HUMAN RELATIONSHIPS IN TEACHING HOME ECONOMICS. (2) II. Wall
Analysis of the teacher's job in furthering desirable human relationships. Study of methods used by groups and individuals in relating themselves to others. The effectiveness of various methods in the development of personality. P, Ed. 197g.

298. PROBLEMS IN TEACHING HOME ECONOMICS. (2) II. Wall
A study of the responsibilities of teachers of homemaking. Emphasis on curriculum planning to meet the needs of high school students. Selection and use of materials and teaching aids for instruction at various age levels. P, Ed. 139h or CR therein.

310. INVESTIGATIONS AND STUDIES IN HOME ECONOMICS EDUCATION. (2) I. Cline-Wall
Selecting a problem, developing procedures, and completing a study. P, 399 and 6 additional units of graduate study in student's major field, including 2 units of home economics education. (Identical with Agricultural Education 310)

399. SEMINAR. (2) I. Wall
Study and reports on recent developments in curriculum, administration, evaluation, and other phases of the program. P, Education 139h.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (2 to 6) I, II. Staff

AGRICULTURAL CHEMISTY AND SOILS

Professor Theophil F. Buehrer, Ph.D., *Head;* Associate Professors Howard V. Smith, M.S., Wallace H. Fuller, Ph.D.

The Department of Agricultural Chemistry and Soils offers graduate work leading to the M.S. and Ph.D. degrees in the broad fields of agricultural chemistry and soil science. Opportunity is provided for study in the fields of soil fertility, soil chemistry, physics, microbiology, conservation and survey. The Ph.D. degree is offered with soil science as a field of specialization under the Plant Sciences program (see p. 6).

Students with a bachelor's degree who are well grounded in chemistry, physics, and mathematics, or who have specialized in the plant sciences will be considered for graduate work in the department. Qualifying examinations may be required of transfer students. A foreign language is desirable for M.S. students and two foreign languages are required of Ph.D. candidates.

Majors in the department may minor either in physical sciences (chemistry, physics, and irrigation) or in plant sciences (agronomy, botany, ecology, horticulture, plant nutrition, and range management.)

202. FERTILIZERS. (3) I. Buehrer

A study of the organic and inorganic fertilizer materials and principles underlying their intelligent use. P, one course in soils, preferably 1 or 211.

207. SOIL PHYSICS. (4) I. Smith

Soil formation, texture, structure, moisture relations, and other physical properties which determine tillage practices. 3R, 3L. P, Chemistry 1b or 2b, Physics 2a or 5 or CR. Fee, $6.

211. SOIL CHEMISTRY. (4) II. Buehrer

The chemical reactions in soils involving the clay minerals, exchangeable bases, acidity, alkalinity, soluble salts, and organic matter which affect plant food availability. 3R, 3L. P, Chemistry 20 or 22, and 40 or 140a. Fee, $6.

221. SOIL MICROBIOLOGY. (4) I. Fuller

The nature of the soil microflora and its influence on soil fertility. 3R, 3L. P, 211 or Chemistry 40 or 140a, and Bacteriology 107. Fee, $6.

241. SOIL SURVEY. (3) I. 1956-57. Smith

Genesis and morphology of the soils of the Great Soil Groups, soil survey, mapping and classification, rating indices of productivity and land utilization. 2R, 3L. Part of the laboratory work consists of field mapping. P, 207 or 211. Fee, $6.

251. AGRICULTURAL CHEMICAL ANALYSIS. (4) I. 1955-56. Fuller

The analysis of fertilizers, insecticides, agricultural chemicals and the major plant constituents by the official chemical, colorimetric, chromatographic, and spectrophotometric methods. 2R, 6L. P, Chemistry 20 or 22. Fee, $7.

261. SOIL CONSERVATION. (3) I. 1955-56. Smith

Physical and chemical factors affecting soil erosion. Soil conservation practices conducive to a permanent agriculture. 3R. P, 1 or 207 or 211. Three-day field trip and occasional half-day field trips. Fee, $6.

306. ADVANCED SOIL CHEMISTRY. (3) II. 1955-56. Buehrer

The fundamental principles and theories underlying structure and chemical behavior of the clay minerals, the laws of ionic exchange, measurement and interpretation of soil *p*H, and the phenomena of soil colloidal behavior. P, 207, 211, and either Chemistry 182 or 284a.

321. RADIOACTIVE TRACER TECHNIQUES IN AGRICULTURE. (3) I. 1956-57. Fuller

Principles and methods employed in the use of such tracers as P^{32}, Sr^{89}, Ca^{45} and I^{131} in agricultural research. 2R, 3L. P, 211 and Chemistry 22. Physics 218a-218b is desirable. Fee, $6.

399. SEMINAR. (1) II. Staff

Student reports on current topics based on recent literature. Open to qualified seniors.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

AGRICULTURAL ECONOMICS

Professor George W. Barr, Ed.D., *Head;* Professor Raymond E. Seltzer, M.S.; Associate Professor Jimmye S. Hillman, Ph.D.; Assistant Professor Andrew Vanvig, Ph.D.

The Department of Agricultural Economics offers work leading to the Master of Science degree. The student may specialize in one of three fields: marketing, farm management, or agricultural prices. Each graduate student in this department is assigned to a staff member who is currently working on research in the field of the student's interest.

A bachelor's degree in agriculture, plus Economics 1a and 1b or their equivalent, constitute the minimum requirements for graduate work in this department.

201. AGRICULTURAL PRICES. (3) II. St. Clair
Trends in prices, price determinants, and price estimation. P, 1 or Economics 1a.

203. MARKETING FARM AND RANCH PRODUCTS. (3) I. Hillman
Marketing functions, services, costs, and regulatory measures in the movement of agricultural products from the producer to the consumer. P, 1 or Economics 1a. Fee, $4.

205. FARM AND RANCH MANAGEMENT. (3) II. Barr
Land appraisal, purchasing and financing methods, and measures of efficiency in management. P, 1 or Economics 1a. Fee, $5.

206. CO-OPERATIVE MARKETING. (2) II. 1955-56. Seltzer
History, legal status, organization, and business operation of co-operative agricultural purchasing and sales associations.

207. FARM AND RANCH ACCOUNTING. (3) I. 1955-56. Vanvig
Objectives and methods in keeping farm and ranch accounts and methods of analyzing records. 2R, 3L. P, 1 or Economics 1a.

208. FARM AND RANCH FINANCE. (2) I. 1956-57. Vanvig
Procedures in the securing and use of credit. P, junior standing.

210. AGRICULTURAL POLICY. (3) II. 1955-56. Seltzer
Development of our agricultural policy; various types of program and the place of such programs in our present-day agricultural economy. P, 1 or Economics 1a.

399. SEMINAR. (2) II. 1956-57. Barr

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

AGRICULTURAL ENGINEERING

Professor Harold C. Schwalen, M.S., C.E., *Head;* Assistant Professors Kenneth R. Frost, M.S.A.E., Wallace A. Schafer, M.Agr.Ed.

206. GROUNDWATER SUPPLIES. (2) II. 1955-56. Schwalen
The occurrences, sources, movement, and safe yield of groundwater, well drilling and development, pumping equipment. 1R, 3L. P, 105, Geology 51, Physics 5. Fee, $3.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

AGRONOMY AND RANGE MANAGEMENT

Professor Dean F. McAlister, Ph.D., *Head;* Associate Professors Warner D. Fisher, Ph.D., Robert R. Humphrey, Ph.D.; Assistant Professors Arden D. Day, Ph.D., Keith C. Hamilton, Ph.D., Kenneth O. Rachie, Ph.D.; Instructors Ronald B. Foster, M.S., Raymond M. Turner, Ph.D., David G. Wilson, M.S.

The Department of Agronomy and Range Management offers graduate work leading to the M.S. and Ph.D. degrees in either agronomy or range management. The Ph.D. degree is offered with either agronomy or range management as the field of specialization under the Plant Sciences program (see p. 6).

Agronomic research may be conducted in one of several phases of crop production such as field crop interrelationships with soil, water and climatic factors; crop sequence and its effects on production; or crop physiology. Research may be on cotton, oil crops, forage and pasture plants, cereals or weed control. Special facilities in the Department of Agronomy and Range Management consist of laboratory and greenhouse space, experimental farms located in the main agricultural areas of Arizona, a completely equipped cotton fiber-testing laboratory, the University Soil Conservation Nursery, the Page-Trowbridge experimental ranch, and numerous cooperative ranch projects. In addition, studies may be conducted in cooperation with the U. S. Forest Service at the nearby Santa Rita Research Center.

Acceptance for graduate work in agronomy is dependent upon the candidate's having a Bachelor of Science degree in agriculture, including 16 semester hours or more in agronomy or an allied field.

Research in range management may be conducted in any of the various phases of the field. These include range management practices, range condition analysis, noxious plant control, range revegetation, range fertilization, forage utilization, relation between big game animals and domestic livestock, poisonous plants, nutritive value of range plants, and physiology and ecology of range plants.

Acceptance for graduate work in range management is dependent upon the candidate's having a Bachelor of Science degree in agriculture or wildlife management, with 16 semester hours or more in range management, wild life management, animal science or related fields.

AGRONOMY

201. FORAGE AND PASTURE CROPS. (3) II. Rachie
A study of the principal forage and pasture crops of the United States, emphasizing alfalfa adaptations in the Southwest. 3R. P, Bot. 1. One 1-day field trip. Fee, $3.

202. GRAIN AND CEREAL CROPS. (3) I. Day
Problems involved in growing and harvesting such crops as corn, sorghums, barley, wheat, and oats. 3 lecture-demonstrations and discussion. P, Bot. 1.

203. FIBER AND OIL CROPS. (3) I. Fisher
Problems involved in growing and harvesting such crops as cotton, soybean, peanuts, and hemp. 3 lecture-demonstrations and discussions. One 1-day field trip. P, Bot. 1. Fee, $4.

205. WEED CONTROL. (3) I. ———
A study of various methods of controlling weeds in agronomic crops. Also information on herbicides, spray equipment and its calibration. 3R. P, Bot. 103. Fee, $4.

207. CROP ECOLOGY AND GEOGRAPHY. (3) II. 1955-56. McAlister
A study of environmental factors affecting agronomic crop distribution and geography throughout the world. 3R. P, Bot. 103.

399. SEMINAR. (1) I, II. Staff
Special problems relating to field crop production. Conferences and discussions.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

RANGE MANAGEMENT

205. RANGE MANAGEMENT. (3) I. Wilson
Interrelationship of range uses, range administration, technical field problems, range reconnaissance, management plans. 2R, 3L. P, 226. Fee, $6.

216. RANGE ECOLOGY. (4) I. Humphrey
The ecology of forage plants, range weeds, poisonous plants, and forage production; ecological principles related to range management. 3R, 3L. P, 226 and Bot. 103. Fee, $5.

226. RANGE FORAGE PLANTS. (4) I. Wilson
Forage values and proper management of range plants — grasses, forbs and shrubs; poisonous plant identification and control. 3R, 3L. P, Bot. 1. Fee, $5.

235. FOREST INFLUENCES. (3) II. Turner
Factors of site, their influence on tree and forage growth and their reciprocal effect on site, cutting systems, cultural operations and the characteristics of important commercial species of the Southwest. 2R, 3L. P, 35, Bot. 66. Fee, $5.

256. RANGE RESOURCES. (3) II. Turner
Plan communities of western United States; their ecological relationships and value for grazing. 3R. P, 216.

286. RANGE FORAGE EVALUATION. (3) I. Wilson
Concepts and techniques of range-survey, forage-utilization and range-condition analysis. 2R, 3L. P, 205, 216. Fee, $8.

346. RANGE RESEARCH METHODS. (3) I. Humphrey
Detailed studies of selected habitats; measurement of the various factors that affect plant growth; analysis of various forage measurement techniques, experimental design; scientific writing. 2R, 3L. P, 216, 226, Bot. 66. Fee, $5.

399. SEMINAR. (1) II. Staff
Special problems relating to applied and technical range management, assigned reading and discussion.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

ANIMAL PATHOLOGY

Professor William J. Pistor, D.V.M., *Head;* Assistant Professor Raymond E. Reed, D.V.M.

205. ANIMAL DISEASES. (3) I. Pistor
Animal hygiene and disease prevention, errors in feeding and care of animals. P, Bacteriology 107.

399. SEMINAR. (1) I, II. Staff
Offered jointly with the departments of Animal Science and Dairy Science.

ANIMAL SCIENCE

Professor Ernest B. Stanley, M.S., *Head;* Assistant Professor O. Floyd Pahnish, M.S.; Assistant Professor Robert M. Richard, Ph.D.; Professor Carl B. Roubicek, Ph.D.; Assistant Professor Carl E. Safley, M.S.

The department is prepared to provide the requisite training and laboratory facilities for the Master of Science degree in animal nutrition. This is the only subject matter offering in animal science at this time.

Acceptance for graduate work will be granted holders of the B.S. degree from agricultural colleges of acceptable standing, provided the undergraduate program represents the usual college course of four years including subject matter courses in animal science, the scholarship record is satisfactory, and the student can be accommodated in the field he wishes to study.

The Doctor of Philosophy degree in animal science is offered through the Committee on Biochemistry and Nutrition.

202. RANGE LIVESTOCK PRODUCTION. (3) I. Stanley
Ranch organization and methods of management, land tenure, production costs, and problems of the range livestock industry in the Southwest.

204. PRINCIPLES OF ANIMAL NUTRITION. (4) I Richard
Digestion, assimilation, and metabolism of food by domestic livestock; the chemistry and physiology of minerals, vitamins and hormones. 3R, 3L. P, Animal Pathology 116, Chemistry 40. Fee, $7.50.

213. ANIMAL BREEDING. (3) II. Safley
Practical application of the principles of genetics to methods of animal breeding. P, Botany 132.

304. CHEMISTRY OF ENZYMES. (2) II. 1956-57. ———
Classification, sources, methods of study, physiochemical properties and mechanism of action of enzymes. P, Bacteriology 107, Zoölogy 144, Animal Science 204 or Chemistry 260.

399. SEMINAR. (1) I, II. Staff
Offered jointly with the departments of Animal Pathology and Dairy Science.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

BOTANY

Professor Walter S. Phillips, Ph.D., *Head;* Assistant Professors Robert W. Hoshaw, Ph.D., Edwin B. Kurtz, Ph.D., Charles T. Mason, Ph.D., Robert M. Harris, Ph.D.

Graduate work for the M.S. and Ph.D. degrees is offered in anatomy, cytology, ecology, genetics, morphology, plant physiology and biochemistry, and taxonomy. The Ph.D. degree is offered with botany as a field of specialization under the Plant Science program (see p. 6).

Candidates may select their own research problems or join groups now active in research on mineral nutrition, cytotaxonomy, metabolism, pollen analysis and geochronology, chemical genetics, and taxonomy and anatomy of Southwestern plants.

Research facilities and equipment include radioisotope instruments, Warburg respirometer, Avena equipment, hydroponic apparatus, high-speed centrifuges, colorimeters and spectrophotometers, radiation equipment, greenhouse, herbarium of 200,000 sheets, darkroom, and research laboratories.

A student in any field of botany is required to present for the degree a well-rounded program of study. Course work in various departments other than Botany

is desirable. Work for the minor may be chosen from the following departments: Agricultural Chemistry and Soils, Agricultural Economics, Agronomy and Range Management, Animal Husbandry, Bacteriology, Chemistry, Dendrochronology, Entomology, Geology, Horticulture, Agriculture Biochemistry, Plant Breeding, Plant Pathology, Zoölogy (including Wildlife).

Departmental fellowships are available for qualified students.

See page 20 for M.Ed. degree major or minor in this department.

202. PLANT ANATOMY. (4) I. Phillips
Origin, development, and maturation of the structures of the vascular plants. 2R, 6L. P, 1. Fee, $5.

204. SYSTEMATIC BOTANY. (4) II. Mason
A study of the orders and families of the Spermatophytes according to their evolutionary relationships; systems of classification; nomenclature; laboratory and field work; collection and identification of local flora. 2R, 6L. P, 1, 2 or Range Management 226 or Zoölogy 238. Fee, $5.

213. PLANT-WATER RELATIONSHIPS. (3) II. Hoshaw
A study of the role of water in the physiology of higher plants with special emphasis on arid-land problems. 3R. P, 103 and Ag. Chemistry 1.

224. ADVANCED SYSTEMATIC BOTANY. (4) I. Mason
A study of taxonomic ideas and technics with special emphasis on their application to the grass, composite, and legume families; collection and identification of Arizona representatives of these families. 2R, 6L. P, 1, 204. Fee, $5.

242. METHODS IN PLANT HISTOLOGY. (4) II. Phillips
Principles and methods of killing, fixing, imbedding, sectioning, staining, mounting, and analyzing plant materials. 1R, 9L. P, 202. Fee, $7.

303. ADVANCED PLANT PHYSIOLOGY. (4) I. Kurtz
A study of the biochemistry of plant nutrition, metabolism, and growth and its application to current problems, such as growth regulators and effect of climate; methods in plant physiology. 2R, 6L. P, 103; Chemistry 140ab. Fee, $5.

323. METHODS IN PLANT NUTRITION. (2) II. Kurtz
Special problems in hydroponics, tissue culture and other methods used for the study of plant nutrition. 6L. P, 303. Fee, $5.

332. CYTOGENETICS. (3) II. Harris
The study of cell structure including the cytoplasmic and nuclear constituents. Laboratory experiments demonstrating the role of chromosomes in the differentiation and development of organisms. 2R, 3L. P, 1, or Zoöl. 4a, Botany 132 or Zoöl. 212. Fee, $5.

399. SEMINAR. (1) I., II. Staff
Literature review and discussions concerning current problems in plant science.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

Related courses which may be taken for credit in Botany:

GEO-DENDROCHRONOLOGY 275. (2) I. Smiley & Staff
GEO-DENDROCHRONOLOGY 276. (2) II. Smiley & Staff
GEO-DENDROCHRONOLOGY 311. (2) II. Schulman
GEO-DENDROCHRONOLOGY 312. (2) II. Schulman

DAIRY SCIENCE

Professor Richard N. Davis, M.S., *Head;* Assistant Professor John W. Stull, Ph.D.; Instructor Frederick G. Harland, M.S.

The Department of Dairy Science offers the Master of Science degree in either of two fields—dairy manufacturing or dairy production. In addition to study in the Department, students are expected to take certain courses in bacteriology, chemistry, or nutrition. Courses in these latter fields may be applied to the major.

The Department cooperates with the Nutrition Committee in offering a graduate major in nutrition with course work leading to the Master of Science and Doctor of Philosophy degrees.

306. DAIRY CHEMISTRY. (3) II. 1956-57. Stull

The chemical composition and the biological significance of the constituents of milk; some technical problems associated with the physiochemical properties of the milk constituents. 3R. P, Chem. 260 and 261 or equivalent.

399. SEMINAR. (1) I, II. Staff

Offered jointly with the departments of Animal Science and Animal Pathology.

400. RESEARCH. (2 to 8) I, II. Staff

Open to students admited to candidacy for advanced degree.

410. THESIS. (2 to 8) I, II. Staff

ENTOMOLOGY

Professor Laurence A. Carruth, Ph.D., *Head;* Assistant Professors George D. Butler, Jr., Ph.D., and Floyd G. Werner, Ph.D.

The Department of Entomology offers graduate work leading to the M.S. and Ph.D. degrees. The Ph.D. degree is offered with entomology as a field of specialization under the Plant Sciences program (see p. 6).

The Department maintains teaching laboratories and offices on the University campus, research laboratories at the Campbell Avenue Farm (located four miles north of the main campus), and field laboratories at Mesa and Yuma. The facilities of these laboratories are available to qualified graduate students and provide exceptional opportunities for individual research in both fundamental and applied branches of entomology. The Department maintains a large and growing reference collection of Arizona insects. The University library contains an excellent working collection of important serials and reference books in the field of entomology. In addition to guidance by the members of the teaching faculty listed above, graduate students in entomology may receive aid and counsel from other experienced entomologists engaged in research work in Arizona for the University of Arizona Agricultural Experiment Station and for the United States Department of Agriculture.

Candidates for the degree of Master of Science in the field of entomology must have completed at least one undergraduate course in entomology and, in addition, must have fulfilled the requirements for an undergraduate major in entomology, zoölogy, or (after a study of each individual case) some other acceptable field in the biological or agricultural sciences. Candidates should have completed, as undergraduates, a broad group of foundation courses in the physical sciences, in the plant and animal sciences, and in general cultural subjects.

Candidates for the degree of Master of Science in entomology are required to complete courses 203, 204, 205, and 206, or their equivalents, if such courses have not been taken on the upper division undergraduate level. Additional supporting courses in entomology and related departments may also be required as may be desirable after individual conferences. Qualified students may enroll for from two to four units of work per semester under course 400—Research—for special individual studies in phases of entomology not included in the four courses mentioned above. All students are required to enroll for from two to eight units of thesis

work under course 410. All graduate students majoring in entomology are normally expected to devote at least one summer to actual field experience in entomology in Arizona.

Acceptable fields of minor study for students majoring in entomology include agricultural chemistry and soils, agronomy, bacteriology, botany, range management, plant pathology, and zoölogy. Minor work may be arranged in other departments after individual conferences and with the approval of the Department of Entomology and the Dean of the Graduate College.

203. *PRINCIPLES OF INSECT CONTROL. (4) I. 1956-57. Carruth
Properties, formulation, and application of insecticides; non-chemical control methods; research methods; literature of economic entomology; field trips. 2R, 3L. P, 1. Fee, $10.

204. INSECT ANATOMY. (4) I. 1956-57. Werner
Insect structure as related to phylogeny, function, and identification; recognition of principal types of immature insects; preparation of insects for microscopic study and identification. 2R, 6L. P, 1. Fee, $7.

205. DESTRUCTIVE AND USEFUL INSECTS. (4) II. Butler-Carruth
Recognition, economic importance, life history, habits, and control of the more important types of destructive insects, including those of particular interest to the Southwest; recognition and uses of beneficial insects; field trips. 2R, 6L. P, 1. Fee, $10.

206. TAXONOMY OF INSECTS. (4) I. 1955-56. Werner
A comprehensive study of the orders and families of insects and certain related arthropods with emphasis on the recognition, identification, and biology of groups of scientific and economic importance; principles of classification; entomological literature; field trips. 2R, 6L. P, 1. Fee, $7.

207. INSECT PHYSIOLOGY. (3) I. 1955-56. Werner
A consideration of special problems of physiology as related to insects, including a consideration of the physiological effects of certain insecticides. P, 1.

399. SEMINAR. (1) I, II. Staff
Special topics and current developments in entomology.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

HORTICULTURE

Professor Leland Burkhart, Ph.D., *Head;* Assistant Professors Joseph S. Folkner, M.S., Steve Fazio, M.S.; Lecturer Albert Lee Schrader, Ph.D.

The Department of Horticulture offers graduate work leading to the M.S. and Ph.D. degrees. The Ph.D. degree is offered with horticulture as a field of specialization under the Plant Sciences program (see p. 6).

The Department of Horticulture has facilities for graduate work in the following fields: vegetable breeding; physiology and technology; fruit physiology and technology; and ornamental horticulture, landscaping, and plant propagation. Candidates in horticulture are expected to have a basic knowledge of botany, plant physiology, chemistry, physics, genetics, bacteriology, soil science and mathematics including statistics.

At least 22 semester units of graduate credit courses are required for the M.S. degree in addition to the thesis (6 to 8 semester units, depending on the subject and results obtained). The candidates' program will be guided by the major

**Entomology 203 and 207 alternate yearly with 204 and 206. Either pair of courses may be taken during the first semester of the junior or senior year.*

department concerned in conjunction with at least one related department. The opportunity is offered in the Plant Sciences program, for a doctoral candidate to undertake research in horticulture. Course work in various departments other than horticulture is desirable in connection with the advanced degrees. Acceptable related fields are: agronomy, botany, entomology, plant pathology and soils.

208. CITRICULTURE. (3) II. Burkhart
Climatic requirements, varieties, rootstocks, orchard management, physiology and quality of citrus. 3R. Botany 103. Fee, $3.

221. PLANT PROPAGATION. (3) II. Fazio
Propagation of woody and herbaceous plants, including ornamentals, by seeds, vegetatively, budding, and grafting. 2R, 3L. P, 102. Fee, $3.

222. TECHNOLOGY OF HORTICULTURE PRODUCTS. (3) I. 1955-56. Burkhart
Harvesting, grading, packing, storage, processing, preservation of fruits and vegetables. 2R, 3L. Fee, $3.

223. WORLD HORTICULTURE. (3) II. Schrader
World trends in production, consumption, breeding, and varieties of fruits, vegetables, and other horticultural plants. P, 102, or 103.

224. LANDSCAPE DESIGN. (3) II. 1955-56. Folkner
Principles of landscaping, composition, types of drafting work and development of layout plans. 1R, 6L. P, 119. Fee, $3.

225. NURSERY AND TURF MANAGEMENT. (3) I. 1955-56. Folkner
The nursery industry, management, plant materials, storage, protection and shipping; turf development. 2R, 3L. P, Botany 103. Fee, $3.

296. EXPERIMENTAL HORTICULTURE. (3) I. 1956-57. Burkhart-Staff
Current methods of experimenting with horticultural crops, using active experiment station projects for discussion; practice in handling experimental planting, controlling pollination, analytical procedures, assembling data. 1R, 6L. Fee, $3.

399. SEMINAR. (1) II. Staff

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

PLANT BREEDING

Professors Walker E. Bryan, M.S., *Head;* Elias Pressley, M.S.

228. PLANT BREEDING. (3) II. 1955-56. Bryan-Pressley
Critical examination of the various theories of heredity and their application to plant breeding. P, 108, Botany 103.

238. ELEMENTARY BIOMETRY. (2) II. Pressley
Problems of heredity and variation as applied to plant and animal breeding, of field experiments, of sampling and selection.

400. RESEARCH. (2) I, II. Staff

PLANT PATHOLOGY

Professor Rubert B. Streets, Ph.D., *Head;* Assistant Professors Paul D. Keener, Ph.D., Alice M. Boyle, Ph.D.

The department offers to qualified students work leading to the Master of Science and Doctor of Philosophy degrees with specialization in diseases of fruits, vegetable crops, field and forage crops, or ornamentals; forest pathology and mycology.

The Ph.D. degree is offered with plant pathology as a field of specialization under the Plant Sciences program (see p. 6).

Applications for admission may offer an undergraduate major in plant pathology, botany, horticulture, agronomy or plant breeding. Qualifying examinations may be required to determine preparation and aptitude of the candidate. Any deficiencies revealed must be removed by taking appropriate courses.

For the master's degree the requirements are not less than 15 units of plant pathology and the remaining units chosen from Botany 103, 132, 202, 204, 242, 323; Entomology 199, 203, 205; Agricultural Chemistry 207, 221; Plant Breeding 238. A reading knowledge of German or French is recommended.

245. DISEASES OF CEREAL, FIBER, AND FORAGE CROPS. (4) I. Streets, ————
Bacterial, fungus and virus diseases of cereal, fiber, oil, and forage crops. Special emphasis upon diseases of the Southwest. 2R, 6L. One 2-day field trip. Fee, $7.

255. DISEASES OF FRUITS, NUTS, AND SMALL FRUITS. (4) II. Streets, ————
Bacterial, fungus and virus diseases of deciduous, citrus and sub-tropical fruits, pecans, walnuts and small fruits. 2R, 6L. One 2-day field trip. Fee, $7.

260. DISEASES OF VEGETABLE CROPS. (4) II. Boyle, ————
Field, storage and transit diseases of vegetable crops; cause, prevention and control. 2R, 6L. One 2-day field trip. Fee, $7.

265. DISEASES OF SHADE TREES AND ORNAMENTALS. (4) II. 1955-56. Streets
A study of the causes of annual losses due to diseases of shade trees, windbreaks, shrubs, vines and flowers, 2R, 6L. Fee, $5.

270. DISEASES OF CITRUS. (4) I. 1955-56. Streets
Cause and control of maladies affecting citrus orchards and fruit in storage and transit. 2R, 6L. P, Horticulture 208. One 2-day field trip. Fee, $7.

275. METHODS IN PLANT PATHOLOGY. (4) I. 1956-57. Staff
Methods of direct examination and culturing of diseased plant materials, inoculation with and identification of pathogens. Laboratory, greenhouse, and field plot techniques. Preparation of specimens and illustrations. 2R, 6L. P, 11 units of plant pathology. Fee, $7.

285. IDENTIFICATION OF ECONOMIC FUNGI. (3) I. 1955-56. Streets
Training in the identification of fungi, with emphasis upon plant-parasitic forms of economic importance. 1R, 6L. Fee, $4.

320. VIRUS DISEASES OF PLANTS. (4) II. 1956-57. Keener
The nature of plant-disease viruses, symptoms they cause, their identification, and manner of transmission. 2R, 6L. P, 11 units of Plant Pathology; Botany 103, 202, Entomology 1; Plant Breeding 208. One 2-day field trip. Fee, $7.

325. PATHOLOGICAL HISTOLOGY AND CYTOLOGY. (4) II. 1956-57. Keener
Techniques in selecting and preparing diseased plant tissues for study; use of differential stains. 2R, 6L. P, 11 units of Plant Pathology; Botany 202, 242. Fee, $10.

350. FOREST PATHOLOGY. (4) II. 1955-56. Keener
Important diseases of forest trees, symptoms and control measures. 2R, 6L. P, 265, 303, 310. Two 1-day field trips. Fee, $7.

399. SEMINAR. (1-2) I, II. Staff
Reports and discussions based upon recent contributions and discoveries in the field of plant pathology.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

POULTRY SCIENCE

Professor M. W. Pasvogel, Ph.D., *Head;* Associate Professor H. B. Hinds, M.S.

The Department of Poultry Science offers graduate work leading to the M.S. degree. In addition the department cooperates with the Nutrition Committee and offers the Ph.D. degree in poultry nutrition. Excellent facilities are available for study and research. Students holding a Bachelor of Science degree from the University of Arizona or similarly rated institutions are eligible for graduate study in the department.

204. POULTRY NUTRITION. (3) I. 1956-57. Hinds
Fundamental principles of poultry nutrition; feed requirements and formulation of rations. 3R. P, Animal Path. 116, Chemistry 40.

208. POULTRY MANAGEMENT. (4) I. 1955-56. Pasvogel-Hinds
Economics of poultry production; problems involved in the management of the floor and cage systems, broiler production, and hatchery management. 3R, 3L. Fee, $2. P, Animal Industry 1.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

RANGE MANAGEMENT

(See AGRONOMY AND RANGE MANAGEMENT)

ANTHROPOLOGY

Professors Emil W. Haury, Ph.D., *Head,* Edward H. Spicer, Ph.D.; Associate Professors Harry T. Getty, Ph.D., Bertram S. Kraus, Ph.D.; Assistant Professors Clara L. Tanner, M.A., Edward B. Danson, Ph.D.; Lecturer William H. Kelly, Ph.D.

The Department of Anthropology offers graduate work in four fields (archaeology, cultural anthropology, linguistics, and physical anthropology) leading to the M.A. and Ph.D. degrees. Under the Department of Anthropology are the following research facilities: (a) The Bureau of Ethnic Research is an information and research center and is concerned presently with modern Indian groups and current Indian affairs. (b) The Carbon-14 Laboratory is specifically oriented to making age determinations of Southwestern archaeological materials. (c) The Laboratory of Physical Anthropology offers the student studies in comparative primate anatomy plus work on special problems in human biology and genetics. (d) The Department of Anthropology and the Arizona State Museum jointly operate an archaeological field school at Point of Pines on the San Carlos Indian Reservation, Arizona. Field training in archaeological techniques is offered on the graduate level. Arizona State Museum collections are readily available to students. These include extensive holdings in ethnology and archaeology. The recent acquisition of the vast collections of Gila Pueblo makes accessible an unmatched and representative stock of archaeological specimens. Also closely allied with departmental activities is the Laboratory of Tree-Ring Research which is concerned with climatological and tree-ring dating studies.

Students transferring to anthropology with the bachelor's or master's degree in other fields must meet, before being admitted to full graduate standing, the require-

ments for the bachelor's degree in anthropology, namely, 6 units each in general anthropology (1a-1b), physical anthropology (140a-140b), archaeology (30a-30b), and 12 units in cultural anthropology (20a-20b, 170a-170b), or must have had the equivalent thereof.

In addition to general requirements of the Graduate College, the master's applicant must take comprehensive examinations in the four fields of anthropology (archaeology, cultural anthropology, linguistics, and physical anthropology). These examinations are to be taken toward the end of the first full year of graduate work.

In addition to general requirements of the Graduate College, this department requires applicants for the Ph.D. degree to submit two ten-day research problems in two fields of anthropology other than in the student's major field of interest. Each applicant must pass a course in statistics, preferably early in the Ph.D. program. Students who are admitted to the department as Ph.D. applicants, and who do not hold a master's degree in anthropology, are required to take the departmental comprehensive examinations in the four fields of anthropology. The supporting minor may be taken within the department subject to approval of a petition to the Committee on Graduate Study.

212. PEOPLES OF MEXICO. (3) II. 1956-57. Spicer
Cultural background and present-day economic, social and religious life of Indian and mestizo groups in rural regions of Middle America; processes of acculturation and current trends in cultural development. P, 1a-1b.

215a-215b. ARCHAEOLOGY OF THE SOUTHWEST. (3-3) Yr. Danson
Pre-Spanish culture of the Southwest; emphasis on chronology. 2R, 3L. P, 30a-30b. Fee for 215b, $8.

220. MINORITY PEOPLES OF THE UNITED STATES. (3) I. Spicer
History, present status, and problems of racial and cultural minorities in the United States; American Indian, Negro, Oriental, Spanish-American, and Jewish groups. P, 1a-1b or Sociology 81. (Identical with Sociology 220.)

230a-230b. ETHNOLOGY OF THE SOUTHWEST. (3-3) Yr. Getty
Culture, history, economic and social institutions, religion, and mythology of the living Indians of the Southwest. P, 20a-20b. Fee for 230b, $8. 230a is not prerequisite to 230b.

235a-235b. SOUTHWESTERN INDIAN ARTS. (3-3) Yr. Tanner
235a: Survey of prehistoric utilitarian and aesthetic arts.
235b: Survey of the art of the modern Indians of the Southwest. P, 1a-1b or 6 units in art. 235a is not prerequisite to 235b. (Identical with Art 235a-235b.)

241. HUMAN GROWTH AND CONSTITUTION. (3) I. Kraus
Hereditary, physiologic and morphologic aspects of human growth. Constitutional studies and relation to anthropology. P, 140a-b or equivalent.

242. STATISTICAL METHODS IN ANTHROPOLOGICAL RESEARCH. (3) II. Kraus
Sampling, statistical tests and analytic methods, the logic of significance tests, the design of experiments. 2R, 3L. P, 140a,b.

245a-245b. COMPARATIVE PRIMATE ANATOMY. (3-3) Yr. Kraus
Demonstrations of regional gross anatomy of primates; comparison of human and lower primate anatomy on a structural and functional basis. 6L. P, 140b or Zoölogy 8 and 45.

250a-250b. INTRODUCTION TO THE STUDY OF LANGUAGE. (2-2) Yr. Gryting
250a: History of linguistic science and general survey of the field. P, 16 units of a foreign language or equivalent. (Identical with Classics 250a.)
250b: Phonetics, phonemics, morphology, syntax; theory of methodology of linguistic analysis. (Identical with Classics 250b.)

255. CULTURES OF AFRICA. (3) I. 1956-57. Getty
The cultures of Africa, with emphasis on those developed by Negroid peoples. P, 20a-20b.

256. CULTURES OF ASIA. (3) II. 1956-57. Getty
The cultures of non-literate peoples in Asia. P, 20a-20b.

258. CULTURES OF OCEANIA. (3) I. 1955-56. Getty
Examination of the racial aspects, material culture, and social and religious developments of the people of the Pacific. P, 20a-20b.

275. PRIMITIVE RELIGION. (2) II. 1955-56. Tanner
Religious phenomena among primitive groups; the beliefs in soul, spirits, gods; attempts made to influence supernatural powers. P, 20a-20b.

284. ECONOMIC LIFE OF PRIMITIVE PEOPLE. (3) II. 1955-56. Getty
A consideration of pertinent concepts in the fields of anthropology and economics, including the major categories of production, exchange, and distribution, consumption, property, economic surplus, inheritance, and types of economic structure. P, 20a-20b or 12 units in economics. (Identical with Economics 284.)

285. INTRODUCTION TO TREE-RING DATING FOR ARCHAEOLOGISTS. (3) I. Smiley
(Identical with Geo-dendrochronology 285.)

301. METHODS IN TREE-RING DATING FOR ARCHAEOLOGISTS. (3) II. Smiley
(Identical with Geo-dendrochronology 301.)

302. ANTHROPOLOGICAL THEORY. (2) II. 1955-56. Spicer
Historical development of concept and theory in cultural anthropology; concept of culture; evolutionary theory; diffusionism, functionalism; current developments. P, 170b. Open to qualified seniors.

303. CULTURAL CHANGE. (3) II. 1955-56. Spicer
Internal change in cultures: innovation, integration; contact change: diffusion, acculturation, social-cultural diffusion; cultural evolution. P, 170b. (Identical with Sociology 303.)

306a-306b. METHODS IN CULTURAL ANTHROPOLOGY. (3-3) Yr. Spicer
Field techniques; methods of analysis and interpretation of data. P, 170a-170b. May be repeated for credit with permission of instructor.

307a-307b. FIELD METHODS IN ARCHAEOLOGY. (2-2) Yr. 1956-57. Haury
Field and laboratory techniques in archaeology. P, 215a-215b.

322. APPLICATIONS OF ANTHROPOLOGY. (3) I. Spicer-Kelly
Methods and results in the application of cultural anthropology in colonial administration, industrial relations, Indian affairs, and resettlement programs. P, 170b.

345a-345b. HUMAN ORIGINS. (3-3) Yr. 1955-56. Kraus
Physiological bases and trends of evolution; detailed study of the fossil evidence for the evolution of *Homo sapiens* from a primitive generalized primate ancestor; evaluation of the theories pertaining to the line of ascent of mankind. P, 140a-140b.

350a-350b. AMERICAN INDIAN LANGUAGES. (2-2) Yr. 1955-56. ———
Distribution of American Indian languages; morphology; recording; and linguistic structure of an American Indian language. P, 250a-250b.

395a-395b. CURRENT PROBLEMS. (1-1) Yr. Staff
A student-faculty seminar on selected topics in all branches of anthropology. P, one year of graduate work in anthropology.

399. SEMINAR. (3) I, II. Staff
Problems in Southwestern anthropology. Offered in sections dealing with different topics. P, 215b or 230a-230b. Fee, $5, when field trips are involved.

400. RESEARCH. (1-4) II. Staff

410. THESIS. (4) I, II. Staff

Related courses which may be taken for credit in Anthropology:

GEO-DENDROCHRONOLOGY 275. (2) I. Smiley & Staff
GEO-DENDROCHRONOLOGY 276. (2) II. Smiley
GEO-DENDROCHRONOLOGY 311. (2) II. Schulman
GEO-DENDROCHRONOLOGY 312. (2) II. Schulman
GEO-DENDROCHRONOLOGY 400 (1-4) II. Staff

A R T

Professors Andreas S. Andersen, *Head,* James P. Scott; Assistant Professors Robert M. Quinn, B.A., Mark Voris; Instructor James G. Souden, B.F.A.

Graduate work in Art is open to students who have completed an undergraduate major in Art in the University or a comparable curriculum at other institutions. Special facilities for graduate work include the T. E. Hanley Fine Arts Collection of 25,000 volumes; the Arizona Collection of American Art, consisting of more than 100 contemporary American paintings; 25 Renaissance paintings on indefinite loan from the Samuel H. Kress Foundation; and the University Print Collection.

The Department offers courses at the graduate level leading to the degree of Master of Arts with a major in Art. In the major the student may undertake research and advanced problems in the various media of painting, drawing, and the intaglio print process.

See page 20 for M.Ed. degree major or minor in this department.

210a-210b. HISTORY OF MODERN ART. (3-3) Yr. 1956-57. Scott
Analytic study of the modern schools of art in Europe and America.

219. HISTORY OF MEDIEVAL ART. (3) I. 1956-57. Quinn
The architecture, sculpture and pictorial arts in western Europe from the beginning of the Christian era through the Gothic. P, 7a-7b, and 6 units of history or art history.

233. HISTORY OF ORIENTAL ART. (3) I. 1955-56. Quinn
Survey of the fine and decorative arts of India, China, and Japan; their influences on each other and on the arts of the West. P, 7a-7b, and 6 units of history or art history.

226. HISTORY OF AMERICAN ART. (3) II. 1955-56. Quinn
Survey of the fine and industrial arts of North America, Mexico, South America; influences of aboriginal and imported art tendencies on modern art and the development of American schools. P, 7a-7b, and 6 units of history or art history.

228. PRINCIPLES OF ESTHETICS. (3) I. Bretall
(Identical with Philosophy 228.)

230. HISTORY OF ARCHITECTURE AND SCULPTURE. (3) II. 1956-57. Quinn
The development of architecture and sculpture in Europe from the beginnings of the Renaissance to the end of the nineteenth century. P, 7a-7b and 6 units of history or art history.

235a-235b. SOUTHWESTERN INDIAN ART. (3-3) Yr. Tanner
(Identical with Anthropology 235a-235b.)

240a-240b. CRAFTS. (2-2) Yr. 1956-57. ———
A practical acquaintance with the design and technical essentials of the various craft media. 6L. P, 50b. Fee, $5 each semester.

242a,b,c,d. CERAMICS. (2) I, II. 1956-57. Staff
Exploratory course in the means of combining clays, glazes, and the various technics of decoration employed in the production of ceramics. 6L. P, 3b.

245a,b,c,d. LIFE DRAWING. (2) I, II. Scott
Study of the human figure from the model and from the work of the masters; emphasis on anatomical sequence and composition. 6L. Corequisite, 144a-144b. P, 3b, 6b. Fee, $6 each semester.

255a,b,c,d. PAINTING II. (2) I, II. Scott
Study of materials and composition in relation to the modern painter's problems. Exploration and specialization in water color, gouache, tempera, casein, encaustic, mixed techniques, and mural painting. 6L. P, 6b. Fee, $3 each semester.

260a,b,c,d. ETCHING. (2) I, II. Souden
Practice and exploration in etching, hard and soft ground textures, drypoint, acquatint, mezzotint, and combined techniques; development of the pictorial idea within the limitations of the medium. 6L. P, 6a-6b. Fee, $2 each semester.

265a,b,c,d. COMMERCIAL DESIGN. (2) I, II. Voris
Advanced study of design as related to commercial usage; practical approach to lettering, layout, the psychology of visual design, and the methods of graphic reproduction. 6L. P, 60a-60b. Fee, $1 each semester.

280a,b,c,d. PAINTING III. (2 to 4) I, II. Andersen
Advanced problems in painting. 6L to 12L. P, 55b or 155b. Fee, $6 each semester.

399. SEMNAR IN ART HISTORY. (2 to 4) I, II. Staff

340. PROBLEMS IN APPLIED ART. (2 to 4) I, II. Staff
May be repeated for credit.

400. RESEARCH. (1 to 4) I, II. Staff

410. THESIS. (3 to 6) I, II. Staff

ASTRONOMY

Professors Edwin F. Carpenter, Ph.D., *Head,* Andrew E. Douglass, D.Sc., John C. Duncan, Ph.D.; Assistant Professor Walter S. Fitch, Ph.D.

Largely through the generosity of several donors, the Steward Observatory offers exceptional opportunities for graduate instruction and research in Astronomy. In addition to equipment for undergraduate instruction, the principal instruments of the observatory are: 1. The 36-inch Steward Reflecting Telescope. This is a versatile instrument with three focal arrangements, Newtonian, Cassegrainian, and Coudé, respectively of 15, 45, and 110 feet focal length. The telescope is equipped for direct photography, for photoelectric photometry, and for low-dispersion spectroscopy of very faint objects. 2. The 12½-inch Calver Reflecting Telescope. Favorably located eight miles from the campus, this telescope carries a precise photoelectric photometer. 3. The 7-inch Bailey Photographic Refractor, which is primarily used for automatically following variable stars. 4. A recording microphotometer and other apparatus for photographic photometry.

Guest astronomers from other universities usually work with the Steward Reflector for several weeks each year. Principal areas of telescopic research have been: planetary surfaces, "white-dwarf" stars, variable and eclipsing stars, star clusters, and the galaxies. More than 18,000 photographs have been made with the Steward Reflector.

In view of the exceptional telescopic equipment, the work of the Department leans in the direction of observational rather than computational astronomy. It is therefore important that prospective graduate students should have an adequate background not only in mathematics but especially in physics. Specialized courses in the fields of optics, thermodynamics, electricity, and atomic physics are desirable. If these conditions are well met, then the undergraduate major may have been taken either in physics, or mathematics, or astronomy. Students planning for astronomical research should acquire a reading knowledge of French and German as early as practicable.

202. METHOD OF LEAST SQUARES AND THE THEORY OF INTERPOLATION. (3) I. Carpenter

Errors of observation and their propagation; adjustment of observations by the method of least squares; the theory of interpolation and its application to the use and construction of extensive tables. P, Mathematics 95b. (See note above.)

203. SPHERICAL ASTRONOMY. (3) II. Carpenter

The mathematical theory of precession, nutation, and related subjects; reduction of star places; measurement of astronomical photographs. P, Mathematics 95b. (See note above.)

205. INTRODUCTION TO CELESTIAL MECHANICS. (2) I. Fitch

Special reference to the problems of two bodies in the solar system. P, Mathematics 95b.

249. THE DETERMINATION OF ORBITS. (3) II. Duncan

The problem of two bodies; the determination of the orbits of planets and comets, with special reference to the classical methods of Olbers and Gauss.

304a-304b. ASTROPHYSICS AND STELLAR ASTRONOMY. (3-3) Yr. Carpenter

Solar and stellar physics; the application of radiation theory to astronomical problems; stellar motions and distribution; clusters and nebulae. P, 1a-1b or 100a-100b. Mathematics 95b, Physics 160. (See note above.)

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

BACTERIOLOGY

Professor Mary E. Caldwell, Ph.D., *Head;* Assistant Professor Adelaide E. Evenson, Ph.D.

Suitable apparatus, equipment, and animals are available for the usual types of investigations pursued in upper division and graduate courses. Library facilities are adequate.

For the master's degree, courses will be chosen according to the particular phase of microbiology of interest to the student. Acceptable minors may be chosen from the following departments: Agricultural Chemistry and Soils, Botany, Chemistry, Nutrition, and Zoölogy. The Department requires a preliminary comprehensive examination which covers basic courses in microbiology prior to admission to candidacy for the master's degree. This is given not later than the beginning of the last semester of work.

217. APPLIED BACTERIOLOGY. (4) I. 1956-57. Evenson
The important groups of microorganisms of significance in water, milk, and foods; methods in the bacteriological analysis of these products. 2R, 6L. P, 107. Fee, $10, plus $3 for field trip.

225. YEASTS, MOLDS, AND ACHINOMYCETES. (4) I. 1955-56. Evenson
Basic principles of taxonomy and classification; the biological activities of certain genera of importance in medicine and industry. 2R, 6L. P, 107, Chemistry 140b. Fee, $10, plus $1 for field trip.

237. INTRODUCTION TO PUBLIC HEALTH. (2) I. Caldwell
Environmental sanitation; certain communicable and noncommunicable diseases; other health problems which pertain to maternal and infant welfare, child health protection, adult health, and geriatrics. P, 107 or Zoölogy 4a. Fee, $1 for field trip.

257. PATHOGENIC BACTERIOLOGY. (4) II. Caldwell
Characteristics of pathogenic bacteria; principles of infection and immunity; laboratory studies of pure cultures and pathological material. 2R, 6L. P, 107, Zoölogy 8 or 45; Zoölogy 144 or Animal Pathology 116 or CR therein. Fee, $10.

267. PHYSIOLOGY OF THE BACTERIA. (2) II. Caldwell
The nutrition and metabolism of bacteria. P, 107, 4 additional units in bacteriolgy, Chemistry 260, 261.

280. IMMUNOLOGY. (4) I. Evenson
Problems of infection and resistance; the mechanisms involved in antigen-antibody reactions. 2R, 6L. P, 257, Chemistry 260, 261. Fee, $10.

285. SYSTEMATIC BACTERIOLOGY. (4) II. 1955-56. Evenson
Principles of taxonomy and nomenclature and their applications in the identification of bacteria isolated from various natural habitats. 2R, 6L. P, 107, one additional upper-division course in bacteriology or a related field. Fee, $10.

287. AN INTRODUCTION TO THE VIRUSES (2) II. Caldwell
The nature of viruses; techniques of cultivation, concentration, and purification. P, 257, or 107 and one additional upper-division course in a related field.

399. SEMINAR. (1) I, II. Staff.
Open to seniors.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

BUSINESS ADMINISTRATION

Professors Russell M. Howard, M.S., *Head,* Elwin G. Wood, Ph.D., George F. Herrick, M.B.A., Laurence R. Gray, Ph.D., Glen W. Strickler, M.A.; Associate Professors John H. Spencer, Ph.D., John H. Denton, LL.B.; Assistant Professors Fred O. Bogart, M.S., Joseph M. Gill, M.B.A., Lewis A. Myers, M.S., C.P.A., Kemper Merriam, M.S., C.P.A., Daniel Raaf, Ph.D.; Instructors Andrew W. Wilson, M.B.A., Elmer Theirman, B.S., C.P.A., Leahmae McCoy, Ph.D.; Lecturer Robert C. Parnell, B.S., LL.B.

The Department of Business Administration offers graduate work leading to either of two advanced degrees, the Master of Science degree with a major in business administration and the Master of Business Administration degree.

In addition to the facilities of this Department and of the University Library, graduate students in business administration have access to the research facilities and reference materials of the Bureau of Business Research in the College of Business and Public Administration. The Bureau's research interests are chiefly concerned with various aspects of the Arizona economy and it endeavors to promote research projects of direct interest to business and community groups and public administrators in this state. Graduate students choosing fields of research appropriate to the Bureau's program may be permitted to do their research work under the direction of Bureau staff members and their findings may be considered for Bureau publication.

The requirements for the degree of Master of Science with a major in business administration follow the general requirements of the graduate college. The prerequisite for admission for this degree is graduation from an approved college or university with a major in business administration or in business administration and economics.

The Master of Science degree affords an opportunity for specialization to those students who have secured undergraduate training in the general field of business administration. Opportunities are given for specialization in advertising, accounting, finance, marketing, personnel, and real estate. Each candidate for the degree is required to present an acceptable thesis of four units on some phase of his major concentration.

The degree Master of Business Administration is a two-year program intended primarily for students whose undergraduate training has been in other fields. A student with an undergraduate degree from an accredited institution, regardless of the major field, whose grades and letters of reference show promise of ability to handle graduate work may be admitted to candidacy for this degree. For an explanation of requirements see page 19.

208a-208b. PERSONNEL. (3-3) Yr. Gray-Simley

Objectives and organization of a typical personnel program; problems involved in selection and placement, job analysis and evaluation, training, promotion and transfer, merit rating, wage administration, grievances, complaints, discipline, safety and health, employee services, employee relations. P, Psychology 1b, Economics 1b or 2b.

211. GEOGRAPHY OF MEXICO AND CARIBBEAN AMERICA. (3) I. Herrick

The natural regions and economic, political and cultural aspects of the geography of Mexico, Central America, the West Indies, and portions of Venezuela and Colombia. P, 11, Econ. 1b or 2b.

212. GEOGRAPHY OF SOUTH AMERICA. (3) II. Herrick

The physical, economic, political, and cultural geography of the natural regions and countries of South America. P, 11, Econ. 1b or 2b.

213. ECONOMIC GEOGRAPHY OF THE UNITED STATES AND CANADA. (3) I. Wilson
The distribution by geographic regions of the resources of land and minerals. The relation of these to man and his economic activities. Contrasts in regional landscapes.

218. CONSERVATION OF NATURAL RESOURCES. (3) II. 1955-56. Wilson
The conservation movement in the United States. The problem of conservation in farming and grazing, forestry, water supply and water power, minerals, hunting and fishing, and human resources. The place of local, state, and national planning in conservation. Three field trips. Fee, $5.

219. FOREIGN TRADE TECHNIQUES. (3) II. Hayn
Practical aspects of exporting and importing, drawing upon case material derived from the experience of various business organizations. Topics include development of markets abroad, financing, documentation and shipment, and sources of foreign trade services. P, Econ. 217.

220a-220b. BUSINESS LAW. (3-3) Yr. Parnell-Denton
220a: Introduction to sources of commercial law, with emphasis on contracts, property rights, and remedies.
220b: Negotiable instruments, credit instruments, and sales; law of the business unit, agency, partnership, and corporation. P, 31b, Economics 1b or 2b. Not open to students who have completed 6 or more units of law. 220a and 220b are offered both semesters.

233a-233b. COST ACCOUNTING. (3-3) Yr. Merriam
Basic principles involved in accounting for materials, direct labor, and overhead expenses in specific order, process, and standard cost accounting systems. P, 31b.

234a-234b. AUDITING THEORY AND PRACTICE. (3-3) Yr. Bogart
Qualifications, duties, and responsibilities of the professional auditor; principles of auditing; development of auditing technique; preparation of working papers and reports; recent legislation and its effect on auditing procedure. P, 131b.

235. INCOME TAX PROCEDURE. (3) I. Bogart
Interpretation of income tax laws, rules and regulations of the United States and the state of Arizona with particular emphasis on fundamentals of the tax laws and procedures for individual returns. P, 31b.

236a-236b. ADVANCED ACCOUNTING. (3-3) Yr. Myers
Partnerships; joint ventures; special problems of consignments, installment sales, and insurance; branch accounting and consolidated statements; insolvent concerns; estates and trusts. P, 131a-131b or CR therein. 236a is not prerequisite to 236b.

237. GOVERNMENTAL AND INSTITUTIONAL ACCOUNTING. (3) II. Howard
Budgetary accounting and financial control and its applications to various governmental units; cities, counties, and public institutions. P, 31b.

238. CREDITS AND COLLECTIONS. (3) I, II. Staff
Types and purposes of credit; organization, management, principles and practices in the extension of credit and collection of accounts. P, 31b, Economics 1b or 2b.

241. BUSINESS FINANCE. (3) I. Strickler
Financial problems involved in the organization and conduct of a business. P, 31b, Economics 1b or 2b.

242. INVESTMENTS AND THE STOCK MARKET. (3) II. Strickler
Investment market, financial agents and institutions; methods of investment and speculation. P, 241.

243. FINANCIAL STATEMENTS. (3) I. 1956-57. Staff
Form, content analysis, and interpretation of financial statements from the viewpoint of management, creditors, investors, and the general public. P, 31b.

252a-252b. PERSONAL INSURANCE. (3) Yr. 1955-56. Staff
Primary consideration is given to individual life insurance but accident and health, total permanent disability, hospital and medical expense and various employee benefit plans, such as group life and retirement annuities are also treated. P, 31b, Economics 1b or 2b.

253a-253b. PROPERTY INSURANCE. (3-3) Yr. 1956-57. Staff
The nature, services, practices and problems of the various types of property insurance, such as fire, marine, fidelity and surety bonding, workmen's compensation, automobile and casualty insurance. P, 31b and Econ. 1b or 2b.

255. STATISTICAL METHODS IN BUSINESS. (4) I, II. Raaf
A nonmathematical approach to methods of statistical synthesis and analysis; interpretation of results secured by use of such methods. 3R, 3L. P, Mathematics 11, or 20, or 69a. Fee, $1.

261. MARKETING PRINCIPLES AND PRACTICE. (3) I, II. Staff
Marketing methods, institutions, functions and policies; markets, planning marketing activities. P, 31b, Econ. 1b or 2b.

262. PRINCIPLES AND PRACTICE OF WHOLESALING. (3) II. Wood
Systems and structure of wholesaling in the United States. Organization, operation, policies, and management of wholesale establishments for industrial and consumer goods. P, 261.

263. PRINCIPLES AND METHODS OF RETAILING. (3) I. Staff
Organization, management, and operation of retail enterprises. P, 261.

264. RETAIL ADVERTISING AND SALES PROMOTION. (3) I. Wood
Organization and operation of the advertising and sales promotion work in retail stores. A study of media used by retailers. Research as a basis for determining what and how to promote. P, Economics 1b or 2b.

265R. PRINCIPLES OF NATIONAL ADVERTISING. (2) II. Wood
Principles and practices of advertising as applied by producers of trademarked goods. P, 264.

266. ADVANCED ADVERTISING. (3) II. Staff
Study and practice in preparing layouts and copy. P, 264, 265R.

267. SALES MANAGEMENT. (3) II. Wood
The application of scientific methods to the selling and distribution problems of manufacturers and wholesalers of both consumer and industrial goods. P, 261.

268. MARKETING RESEARCH. (3) I. Staff
2R, 3L. P, 255, 261.

269. PROBLEMS IN RETAIL MERCHANDISING. (3) II. Staff
Study of problems current in the field of retailing with training in scientific procedures that lead to satisfactory solutions. Emphasis on actual problems of Arizona merchants. P, 263.

271a-271b. BUSINESS ORGANIZATION AND MANAGEMENT. (3-3) Yr. Gill

Analysis of underlying principles of sound organization and management with applicability to business; merchanisms and methods required for administrative and managerial control. P, 31b, Economics 1b or 2b. 271a and 271b are offered both semesters.

279. URBAN PLANNING AND DEVELOPMENT. (3) II. 1956-57. Wilson

The history of urban planning. Objectives of planning. Similarities and differences in city needs and developments. Problems of planning—regional, political, financial. Economic base studies and master plans. Five field trips. Fee, $2.

281. REAL ESTATE LAW. (3) I. Denton

Law covering title, its acquisition, transfer and limitations. Tenancy and public control stressed. P, 31b, 80 or 81, 220b or CR; Economics 1b or 2b.

282. REAL ESTATE APPRAISALS. (3) I. Denton

The factors, general and specific, affecting the value of real property, including an exposition of the various techniques in appraising and in the preparation of an appraisal report. P, 31b, 80 or 81; Economics 1b or 2b.

283. REAL ESTATE FINANCING. (3) II. Denton

Methods and relative advantages of types of financing; availability of funds, their security, application, and repayment. P, 281, 282.

293. BUSINESS INVESTIGATIONS AND REPORTS. (2) I, II. Staff

Methods of locating, classifying, and evaluating data, and writing a report on the findings. P, Economics 1b or 2b, senior standing.

314a,b,c,d. AREA SURVEYS. (2-2) I, II. Herrick

The physical, economic, political and cultural aspects of the geography of the following regions:

1955-56: a. The Far East
b. The Middle East

1956-57: c. The Pacific Area
d. Other regions in regard to which interest of a sufficient number of students is shown. P, 11.

331. ACCOUNTING THEORY. (2) I. Howard

A study of the development of modern accounting thought; critical analysis of current accounting theory and practice; selected readings on specialized problems; discussion cases and problems. P, 131b.

332a-332b. ADVANCED PROBLEMS IN ACCOUNTING. (2-2) Yr. Myers

Advanced accounting problems selected primarily with the view of preparing candidates for the practice section of the C.P.A. examination. P, 236a-b or CR. 332a is not prerequisite to 332b.

335. ADVANCED INCOME TAX PROCEDURE. (3) II. Bogart

Interpretation of federal income tax laws, rules and regulations with particular emphasis on partnerships, corporations, reorganizations, fiduciaries and gift taxes. P, 131b and 235.

355. RESEARCH METHODS IN BUSINESS. (3) I. ———

Inquiry into objectives and methods of business research; study of contemporary research projects in business; practical participation in a survey research project; consideration of problems of cooperative research and of the organization of industrial research in a business enterprise. P, 255.

356. STATISTICAL INFERENCE AND CONTROLS. (3) II. 1956-57. Raaf
Statistical investigations; inference from limited observations; consideration of procedures in quality control, sales analysis, and other areas of business operation. P, 255.

371. BUSINESS POLICIES. (3) I. Gill
A course using the case method which deals with problems and policies facing top management. P, 271a,b.

372. ADMINISTRATIVE REPORT WRITING. (3) II. Gill
A course to help the student to present analytical thinking in written reports. These will be spaced throughout the semester and will be made on specific business situations giving evidence of the student's ability to organize his thinking and present concise reports for evaluation. A study of the availability, location, and use of source material. P, 371 and 355.

373. MANAGEMENT PROBLEMS. (1) I. Staff
A course dealing with management problems and suggested solutions. P, 271a,b.

399. SEMINAR. (2-4) I, II. Staff
Open to seniors with consent of the instructor. Content confined to some special field such as accounting theory, finance, geography, etc., depending upon student need and availability of staff.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS (4) I, II. Staff

BIOCHEMISTRY AND NUTRITION

Committee on Biochemistry and Nutrition: Professors Arthur R. Kemmerer, Ph.D., Chairman, Ethel M. Thompson, Ph.D., M. W. Pasvogel, Ph.D., A. Picchioni, Ph.D.; Associate Professors Wallace H. Fuller, Ph.D., M. G. Seeley, Ph.D., M. G. Vavich, Ph.D.; Assistant Professors H. L. Micklewright, Ph.D., R. M. Richard, Ph.D., R. Reed, D.V.M., John W. Stull, Ph.D.

Graduate work leading to a Master of Science degree or a Ph.D. degree with a major in biochemistry and nutrition is offered. The minor subject may be in bacteriology, botany, physiology, pharmacology or various branches of chemistry. Representatives from the Departments of Agricultural Biochemistry, Agricultural Chemistry and Soils, Animal Science, Animal Pathology, Chemistry, Dairy Science, Home Economics, Poultry Science, Pharmacy and Zoölogy make up the Committee on Biochemistry and Nutrition. The course of study of the candidate will be selected by the thesis director and approved by the Committee on Biochemistry and Nutrition. The prerequisite is a bachelor's degree in biological science, chemistry, agriculture or home economics, including not less than 6 credits of organic chemistry, 4 credits in biochemistry or nutrition, and 4 credits in bacteriology or physiology. By approval of the Committee on Biochemistry and Nutrition deficiencies may be made up after admission to the Graduate College.

302. CHEMISTRY AND METABOLISM OF CARBOHYDRATES AND LIPIDS. (3) I. 1955-56. Thompson
The chemistry and metabolism of carbohydrates and lipids with emphasis on recent contributions and interpretations . P, Home Economics 202R, 202L; Chemistry 260 and 261, and Zoölogy 144 or equivalent; 6 units of organic chemistry.

304. CHEMISTRY OF ENZYMES. (2) II. 1956-57. Staff
Classification, sources, methods of study, physiochemical properties and mechanism of action of enzymes. P, Bacteriology 107, Zoölogy 144, Animal Science 204 or Chemistry 260.

306. DAIRY CHEMISTRY. (3) II. 1956-57. Stull
The chemical composition and the biological significance of the constituents of milk; some technical problems associated with the physiochemical properties of the milk constituents. P, Chemistry 260 and 261 or equivalent.

308. CHEMISTRY AND METABOLISM OF PROTEINS. (2) II. 1955-56. Kemmerer
The chemistry and structure of proteins and amino acids; the chemistry and physiology of their metabolism and their biological and chemical evaluations. P, 6 units of organic chemistry; Animal Science 204 or Chemistry 261 or Home Economics 202R, 202L; Bacteriology 107 or Zoölogy 144, consent of the instructor.

310. VITAMINS AND MINERALS. (2) I. 1956-57. Vavich
The chemistry and metabolism of vitamins and minerals. P, 6 units in organic chemistry; Animal Science 204 or Chemistry 261 or Home Economics 202R, 202L or equivalent; Bacteriology 107 or Zoölogy 144, consent of the instructor.

312. ADVANCED METHODS IN NUTRITION. (3) I, II. Staff
Chemical, physical, biological techniques used in vitamin, protein, enzyme, and energy research will be studied. 1R, 6L. P, 6 units organic chemistry, Animal Science 204 or Chemistry 261 or Home Economics 202R, 202L; Bacteriology 107 or Zoölogy 144. Fee, $10

399. SEMINAR. (1) I, II. Staff

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

The courses listed below also may be taken for credit in biochemistry and nutrition. For description see as listed under departments elsewhere in catalogue.

Animal Science 204. PRINCIPLES OF ANIMAL NUTRITION. (4) I. Staff
Agricultural Chemistry 321. RADIOACTIVE TRACER TECHNIQUES IN AGRICULTURE. (3) I. 1955-56. Fuller
Bacteriology 225. YEASTS, MOLDS, AND ACTINOMYCETES. (4) I. 1955-56. Evenson
Bacteriology 267. PHYSIOLOGY OF THE BACTERIA. (2) II. Ordanik
Bacteriology 280. IMMUNOLOGY. (4) I. Evenson
Bacteriology 287. AN INTRODUCTION TO THE VIRUSES. (2) II. Staff
Botany 303. ADVANCED PLANT PHYSIOLOGY. (4) I. Staff
Chemistry 250. QUALITATIVE ORGANIC ANALYSIS. (3) I. Rhodes
Chemistry 260. BIOCHEMISTRY. (3) II. Sands
Chemistry 261. BIOCHEMISTRY LABORATORY. (2) II. Sands
Chemistry 284a-284b. PHYSICAL CHEMISTRY. (3-3) Yr. Roberts
Chemistry 285a-285b. PHYSICAL CHEMISTRY LABORATORY. (2-2) Yr. Chapin
Chemistry 288. COLLOID CHEMISTRY. (2) I. Nugent
Chemistry 310. SPECTROCHEMICAL ANALYSIS. (1) II. 1955-56. Seeley

Chemistry 320. ADVANCED ANALYTICAL CHEMISTRY. (3) II.	Rhodes-Wise
Chemistry 341. ADVANCED ORGANIC CHEMISTRY. (3) I.	Kelley
Chemistry 342. THE CARBOHYDRATES. (2) II.	Seeley
Home Economics 202R. NUTRITION. (2) I.	Thompson
Home Economics 202L. NUTRITION LABORATORY. (2) I.	Wood
Home Economics 222. READINGS IN NUTRITION. (2) II.	Thompson
Home Economics 312. LABORATORY METHODS IN HUMAN METABOLISM. (3) I. 1955-56.	Thompson
Pharmacy 207a-207b. ORGANIC PHARMACEUTICAL CHEMISTRY. (3-3) Yr.	Buchdahl
Pharmacy 221a-221b. GENERAL PHARMACOGNOSY. (4-4) Yr.	Brewer
Pharmacy 231a-231b. GENERAL PHARMACOLOGY. (4-4) Yr.	Picchioni
Pharmacy 340R. ADVANCED PHARMACOLOGY. (2) I. 1955-56.	Picchioni
Pharmacy 340L. ADVANCED PHARMACOLOGY LABORATORY. (2) I. 1955-56.	Picchioni
Poultry Science 204. POULTRY NUTRITION. (3) I. 1956-57.	Hinds
Zoölogy 214. HUMAN GENETICS. (2) I.	Marshall
Zoölogy 243. MAMMALIAN PHYSIOLOGY. (4) I.	Caldwell
Zoölogy 244. MAMMALIAN PHYSIOLOGY. (4) II.	Caldwell
Zoölogy 247. VERTEBRATE EMBRYOLOGY. (4) II.	Caldwell
Zoölogy 249. PARASITOLOGY. (4) I.	Mead
Zoölogy 250. TECHNIQUES OF BIOLOGICAL LITERATURE AND NOMENCLATURE. (2) II.	Mead

CHEMISTRY

Professors Lathrop E. Roberts, Ph.D., *Head,* Lila Sands, Ph.D., Robert L. Nugent, Ph.D., Herbert D. Rhodes, Ph.D.; Associate Professor Millard G. Seeley, Ph.D.; Assistant Professors Leslie S. Forster, Ph.D., Edward N. Wise, Ph.D., Alec E. Kelley, M.S.

The Department is adequately equipped for the conduct of research in inorganic, analytical, organic and physical chemistry. The student will select his problem in conference with his major professor. Students beginning work for the M.A. degree must have completed a course equivalent to that required for the degree of B.A. with a major in chemistry. Students beginning work for the M.S. or Ph.D. degrees must have completed a course equivalent to that required for the degree of B.S. with a major in chemistry. Deficiencies in undergraduate work must be made up by taking the necessary courses without graduate credit. All students beginning graduate work in chemistry are given, early in the first semester, placement examinations in the five subjects: (1) general inorganic chemistry, (2) qualitative analysis, (3) quantitative analysis, (4) organic chemistry, (5) physical chemistry. The results of these examinations are used in advising students. Those who show marked deficiencies may be required to complete certain courses without credit.

See page 20 for M.Ed. degree major or minor in this department.

Special requirements for advanced degrees in chemistry are:

THE DEGREE OF MASTER OF ARTS. The work leading to this degree is designed for those who do not plan to enter chemistry as a profession, or to continue work toward the Ph.D. degree. Students who plan to teach chemistry in secondary schools will find this work adapted to their needs. Of the 15 units in the major subject, not more than 5 may, with the consent of the Head of the Department be chosen in a closely related field. At least 6 units of the work in chemistry must be in courses numbered 300 or above, not including the thesis. A thesis is required, but, if

approved by the Head of the Department, need not embody the results of experimental work. In no case will more than 4 units of credit be given for the thesis, while if the major is divided between chemistry and another subject, not more than 2 units will be given for the thesis. If the minor is not in a related scientific field, not more than 10 units of credit will be given in the minor. The examinations for this degree will conform to the policy set forth for the M.S. degree, except that the preliminary examination in organic chemistry will not cover Chemistry 250, and that the examination in physical chemistry will be limited to the material covered in Chemistry 182.

THE DEGREE OF MASTER OF SCIENCE. Before being admitted to candidacy, the student must pass a 2-hour examination in each of the 5 subjects listed above. A student may, by vote of the Department, be excused from this preliminary examination if the grades which he received on the placement examinations warrant such action. This preliminary examination must be passed not less than 2 months nor more than 2 years before the final oral examination. Not more than 2 weeks, nor less than 2 days before the final oral examination, the candidate must pass a comprehensive written examination over all courses in chemistry offered by him for graduate credit.

THE DEGREE OF DOCTOR OF PHILOSOPHY. The requirements for this degree are given on page 23. The final examination will be given in accordance with the procedures there described, and will include both a written and oral examination.

208. INORGANIC PREPARATIONS. (3) I. 1956-57.

A laboratory course designed to acquaint the student with the fundamental preparations and reactions of inorganic chemistry. 1R, 6L. P, 22. Fee, $8.

224. SPECIAL AND INSTRUMENTAL METHODS OF ANALYSIS. (3) II. Wise

1R, 6L. P, 122. Fee, $7.

250. QUALITATIVE ORGANIC ANALYSIS. (3) I. Rhodes

The systematic classification and identification of organic compounds. 1R, 6L. P, 22, 140b, and a reading knowledge of German. Fee, $8.

260. BIOCHEMISTRY. (3) II. Sands

The chemistry of carbohydrates, fats, and proteins; their digestion and metabolism. P, 20, and either 60 or 140b.

261. BIOCHEMISTRY LABORATORY. (2) II. Sands

Qualitative and quantitative study of carbohydrates, fats, and proteins; blood and urine analysis. 6L. P, 20, 260 or CR. Fee, $7.

284a-284b. PHYSICAL CHEMISTRY. (3-3) Yr. Roberts

Fundamental principles and theories; emphasis on problems. P, for 284a, 22, 122 or CR; Mathematics 79a or 95a; Physics 2b or 10b. P, for 284b, Mathematics 79b or 95b.

285a-285b. PHYSICAL CHEMISTRY LABORATORY. (2-2) Yr. Chapin

Experiments illustrating principles in 284a-284b. Credit for 285a is given only when carried concurrently with 284a, and for 285b only when carried concurrently with 284b. 6L. 285a is not prerequisite to 285b. Fee, $7 each semester.

288. COLLOID CHEMISTRY. (2) I. Nugent

Classification, preparation, and properties of colloidal systems. P, 20, and either 10 or 40.

310. SPECTROCHEMICAL ANALYSIS. (1) II. 1955-56. Seeley

The theory and technique of spectography as applied to chemistry. P, 284a. Fee, $4.

320. ADVANCED ANALYTICAL CHEMISTRY. (2) II. 1956-57. Rhodes
A study of some of the non-instrumental concepts, theories and techniques of analytical chemistry. 2R. P, 284b.

341. ADVANCED ORGANIC CHEMISTRY. (3) I. Kelley
The chemistry of the hydrocarbons, aldehydes and ketones. P, 140b.

342. THE CARBOHYDRATES. (2) II. Seeley
The structure and steriochemistry of the carbohydrates and polyuronides. P, 140b.

343. ORGANIC NITROGEN COMPOUNDS. (2) II. 1956-57. Kelley
The chemistry of aliphatic and aromatic amino, nitro and diazonium compounds. P, 140b.

344. HETEROCYCLIC NITROGEN COMPOUNDS. (2) II. 1955-56. Seeley
The chemistry and structure of heterocyclic nitrogen compounds, including the alkaloids. P, 140b.

346. ORGANIC PREPARATIONS. (3) II. Kelley
Methods for the synthesis of organic compounds and the laboratory techniques of organic synthesis. 1R, 6L. P, 140b. Fee, $8.

350. THE CHEMICAL BOND. (3) I. Seeley
An introduction to modern structural chemistry; the nature of the chemical bond and the structure of molecules and crystals presented on the basis of modern theory. P, 122, Mathematics 79b or 95b.

352a-352b. ORGANIC REACTIONS. (3-3) Yr. Kelley
Relationship of structure to chemical reactivity in organic molecules. Mechanisms of organic reactions. 3R. P, 140b.

354. QUANTUM CHEMISTRY. (3) II. Seeley
The interpretation of the properties of organic substances by the use of modern physico-chemical theories. P, 250, 284b or CR 350.

380a-380b. CHEMICAL THERMODYNAMICS. (3-3) Yr. Chapin
P, 284b.

384. CHEMICAL KINETICS. (3) I. 1956-57. Chapin
The study of chemical reaction rates and mechanism. 3R. P, 284b.

392. RADIOCHEMISTRY. (3) II. 1956-57. Wise
Study of properties and applications of radioelements. 2R, 3L. P, 284b.

396. ELECTROCHEMISTRY. (3) II. 1956-57. Chapin
Theory of voltaic and electrolytic cells. The Debye-Hückel-Onsager theory of strong electrolytes. 3R. P, 284b.

399. SEMINAR. (1) I, II. Staff
Reports on current research and assigned topics. Required of students registered for 400 or 410.

400. RESEARCH. (1 to 5) I, II. Staff
Fee, $1 per unit.

410. THESIS. (1 to 2) I, II. Staff

CLASSICS

Professor Garnet D. Percy, Ph.D., *Head;* Assistant Professor Donald M. Ayers, Ph.D.

A graduate major is not offered. In addition to a number of courses open with the consent of the instructor to all graduate students, the department offers one course, Classics 400, restricted to those doing research involving the use of the Greek and Latin languages and admitted to candidacy for an advanced degree in the University.

See page 20 for M.Ed. degree major or minor in this department.

250a-250b. INTRODUCTION TO THE STUDY OF LANGUAGE. (2-2) Yr. Gryting

250a: History of linguistic and science and general survey of the field. P, 16 units of foreign language or equivalent.

250b: Phonetics, phonemics, morphology, syntax; theory of methodology of linguistic analysis. (Identical with Anthropology 250a-250b.)

400. RESEARCH. (2-8) I, II. Staff

Open to students admitted to candidacy for advanced degrees.

DRAMATIC ARTS

Professors Peter R. Marroney, M.A., *Head,* Fairfax P. Walkup, Ph.D.; Assistant Professor Robert C. Burroughs, M.A.; Instructors John E. Lafferty, M.F.A., Jeannette Pratt, M.A.

The Master of Arts degree is offered in all fields of theatre arts and crafts. The University of Arizona is fortunate in possessing the T. E. Hanley collection of dramatic arts material; also, the Thomas Wood Stevens Memorial Theatre Collection. The general University library has a fine collection of books covering the fields and allied branches of theatre. The Dramatic Arts Department has its own separate facilities for play production activities. These include rehearsal laboratory and public performance space; workshops for the design and construction of scenery, costumes, and lighting. The production schedule of the Department susually includes five major productions in the department's own theatre, plus several other specially arranged productions with other departments in the University auditorium. The Department sponsors a "B Series" of presentations in arena style. The weekly laboratory theatre presents scenes from great plays, one-act plays, and original scripts. The Department also cooperates with local and civic groups in the presentation of special programs.

The prerequisites for the advanced degree include 18 to 24 semester hours in technical fields of the theatre, i.e., lighting, stagecraft, scene design and stage costuming; 18 semester hours of acting and directing; 6 semester hours of history of the theatre or of drama survey.

See page 20 for M.Ed. degree major or minor in this department.

210. DRAMA IN THE ELEMENTARY SCHOOL. (3) II. Pratt

The problems and techniques of teaching dramatic arts in the elementary schools; emphasis on the use of creative dramatics. P, Ed. 151.

211. DRAMA IN THE HIGH SCHOOL. (3) II. Burroughs

Technics and materials used in producing the play in the high school, covering all elements and phases of production: Directing, Acting, Lighting, Stagecraft, Make-up, and Budget. P, 100 and Ed. 151.

240a-240b. HISTORY OF THE MODERN THEATRE. (2-2) Yr. Pratt

Study of modern trends in drama through class analysis and reports on leading modern dramatists, from Isben to the present day. P, 40a-40b.

245. ADVANCED ORAL INTERPRETATION. (3) II. Mattingly
(Identical with Speech 245.)

260a-260b. PLAYWRITING. (2-2) Yr. 1956-57. Walkup
The practical application of playwriting principles achieved through a series of creative exercises and writings. In 260a, emphasis is on the one-act play; in 260b, on the full-length play. P, 40a-40b, senior standing.

279a-279b. TECHNICAL PROBLEMS. (3-3) Yr. 1955-56. Burroughs
Production organization; advanced scenic construction; theatre design in regard to academic, professional, and civic buildings; stage planning, including types of shifting devices; advanced scene-painting techniques. P, 20b, 21b, 123a-123b.

280a-280b. PROBLEMS IN STAGE COSTUME. (3-3) Yr. 1955-56. Walkup
Individual projects in designing, execution, organization, and production of stage costumes, including regional and national. P, 40a-40b or 155a-155b, 121a-121b.

300. INTRODUCTION TO GRADUATE STUDY OF DRAMA. (1) I. Walkup
The study of, and methods used, in compiling bibliography, assembling research material, and choosing topics and themes for theses.

320a-320b. PROBLEMS OF
STAGE LIGHTING. (3-3) Yr. 1955-56. Lafferty
Lighting for styles of productions. Special problems; practice and trends in modern lighting, instrument selection, cost, and adaptability. 2R, 1L. P, 20b, 21b, 123b.

327a-327b. PROBLEMS OF THEATRE ORGANIZATION
AND MANAGEMENT. (2-2) Yr. Staff
Study of theatre management, organization, exploitation, financing, and other phases of the university, community, and high-school theatre. P, 12 units of drama, including 6 upper-division.

355a-355b. PROBLEMS OF THE
PRODUCING DIRECTOR. (3-3) Yr. Marroney
The adaptation of directorial philosophies; setting up production policies; analysis of copyright, royalty, and equity laws; producing original and experimental drama. P, 20b, 21b, 40a-40b, 155a-155b.

400. RESEARCH. (2 to 5) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

ECONOMICS

Professors Laurence R. Gray, Ph.D., *Head,* Andrew B. Schmidt, A.M., Glen W. Strickler, M.A., Philip G. Hudson, Ph.D.; Associate Professor John H. D. Spencer, Ph.D.; Assistant Professors William H. Fink, Ph.D., Rolf Hayn, Ph.D.; Instructor Vincent F. Boland, B.A.

Work leading to the degree of Master of Arts with a major in economics is offered for graduates of recognized schools whose undergraduate work includes 24 semester units in economics passed with satisfactory grades. Since there is no sharp dividing line between economics and business administration, consideration will be given to the content of the course rather than its designation.

A graduate program combining two closely related fields may be arranged with the permission of the head of the Department. Supporting courses or a minor should be chosen from related fields such as sociology, philosophy, history, political

science, or anthropology, in which the student has had not less than 12 undergraduate units.

Library facilities are good with particular reference to periodicals and government documents. The Bureau of Business Research can offer many worth-while projects for research in fields of interest to students of economics. Of particular significance is the opportunity to do independent study with the direction and counsel of a member of the staff of the Bureau.

203. ECONOMIC HISTORY OF EUROPE. (3) I. Schmidt
A survey of the economic evolution of Europe. P, 1b or 2b.

204. ECONOMIC HISTORY OF THE UNITED STATES. (3) II. Schmidt
A study of the development of the economic institutions of the United States. P, 1b or 2b.

205. LABOR PROBLEMS AND TRADE UNIONISM. (3) I. Gray
The labor movement; problems and risks of wage-earners in modern economic society; structural and functional types of unions; union policies and practices; unions and the law. P, 1b or 2b.

206. INDUSTRIAL RELATIONS. (3) II. Gray
Problems arising out of employer-employee relations; the law of collective bargaining; wages and hours legislation; regulation of the unions; industrial peace; the collective bargaining agreement. P, 101 and junior standing for students in the College of Engineering and Mines. P, for other students 1b or 2b.

207. COMPARATIVE ECONOMIC SYSTEMS. (3) II. Schmidt
A critical analysis of capitalism, socialism, communism, and fascism. P, 1b or 2b.

217. INTERNATIONAL ECONOMIC RELATIONS. (3) I. Fink
Principles underlying the economic relations between countries; investment and capital movements; population movements; foreign exchange; evaluation of various forms of control; tariff; exchange control; commercial treaties; boycotts. P, 248.

221. TRANSPORTATION. (3) I. Hayn
History of transportation; organization; finance, theory of rates, rate structures; regulation by the states and the federal government; motor transportation. P, 1b or 2b.

222. PUBLIC UTILITIES. (3) II. Fink
The economic basis for and problems of public utility regulations and management. P, 1b or 2b.

245. PUBLIC FINANCE. (3) I. Hudson
Public expenditures; taxation; public debt. P, 1b or 2b.

248. MONEY AND BANKING. (3) I, II. Staff
A comparison of various standards of value; the nature of money and credit, the essential functions of commercial banks and the Federal Reserve system; foreign exchange and the Monetary Fund and International Bank. P, 1b or 2b.

272. GOVERNMENT AND BUSINESS. (3) II. Strickler
Changes in the relations of government to business and the philosophies underlying them. P, 1b or 2b.

284. ECONOMICS OF PRIMITIVE PEOPLE. (3) II. 1955-56. Getty
(Identical with Anthropology 284.)

291. INTERMEDIATE ECONOMIC THEORY. (3) I, II. Staff
Value and distribution. P, 1b or 2b.

292. ECONOMIC INVESTIGATION AND REPORTS. (2) I, II. Staff
Methods of locating, classifying, and evaluating data, and writing a report on the findings. P, 1b or 2b, senior standing.

303. WEALTH AND INCOME. (3) I. Hudson
The progress and limitations of the attempts to measure national income, national wealth, the physical volume of production and other broad economic concepts; empirical testing of certain economic theories. P, 291, BA 255, senior standing.

304. ECONOMIC DYNAMICS. (3) II. Hudson
Business cycle theories. P, 248, 291.

307. HISTORY OF ECONOMIC THOUGHT. (3) I. Schmidt
Development of economic thought from ancient times to the present. P, 291.

308. MANAGERIAL ECONOMICS. (3) II. Hudson
The application of economic theory to problems of business management. Open to seniors. P, 291 and BA 255.

349. ADVANCED PROBLEMS IN MONEY AND BANKING. (3) II. Hudson
P, 248.

399. SEMINAR. (2) I, II. Staff
Open to seniors with consent of the instructor.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (4) I, II. Staff

EDUCATION

Professors Oliver K. Garretson, Ph.D., *Dean,* Victor H. Kelley, Ph.D., Emil L. Larson, Ph.D.; Associate Professors Robert A. Crowell, Ed.D., Curtis B. Merritt, Ph.D., Wesley K. Ruff, Ed.D.; Assistant Professors Paul J. Danielson, Ph.D., Mary Frances Flournoy, Ph.D.

Graduate work in education has a primary function: the preparation of instructors and administrative officers for elementary schools, secondary schools, and departments of education in colleges and universities. For such preparation a thorough and complete knowledge of the subject matter to be taught is basic. In addition, it is essential that teachers not only have a complete understanding of the philosophy of education and methods of instruction but also that they attain skill in the collection and interpretation of data necessary for the adaptation of acquired knowledges and skills to specific community situations and to individual differences among pupils.

Research is carried on in the fields of elementary and secondary education, counseling and guidance, special education, the curriculum, administration and supervision, and measurement.

Programs leading to the following degrees are offered: Master of Arts, Master of Education, Doctor of Philosophy, and Doctor of Education. The requirements for each of these degrees are discussed elsewhere in this catalogue. Students electing a major in education must demonstrate on the written examination for the master's degree proficiency in the general field and also in two of the following areas: administration, secondary education, elementary education, guidance, special education, statistics, tests and measurements, history and philosophy of education, and educational psychology.

Fields of study which are acceptable for either a major or minor in fulfillment of the requirements of the M.Ed. degree are: agriculture, home economics, art, biology, chemistry, dramatic arts, English, French, history, political science, Latin, mathematics, music, physical education—men, physical education—women, physics, Spanish, and speech. Other fields may be used as major or minor areas upon the recommendation of the Dean of the College of Education and with the approval of the Dean of the Graduate College.

209. PRINCIPLES OF VOCATIONAL EDUCATION. (2) II. Cline
The social and economic values of vocational education; federal laws, state policies and administration; theories and principles with special reference to programs in the secondary school. Required of those preparing to teach agriculture and home economics.

211. HISTORY OF EDUCATION. (3) II. Kelley
A general survey of the educational system of the leading foreign nations and an evaluation of modern tendencies.

212. HISTORY OF EDUCATION IN THE UNITED STATES. (3) I. Kelley
The development of our educational system from colonial foundations to the present.

217. VISUAL AND AUDITORY AIDS IN TEACHING. (3) II. Larson
Use and management of motion pictures, stereoscopes, slides, charts, radio programs, blackboard techniques; actual instruction in the use of equipment. P, 151, 224, 225, 226, 227 or 234 recommended.

224. THE TEACHING OF READING. (3) I, II. Kelley-Staff
A basic course in elementary curriculum and methods involving the functions, organization of materials, and methods of teaching reading and literature. P, 151 or CR.

225. THE TEACHING OF LANGUAGE ARTS. (3) I, II. Kelley-Flournoy-Staff
A basic course in elementary curriculum and methods involving the functions, organization of materials, and methods of teaching the language arts of spelling, handwriting, speaking, and written communication. P, 151 or CR.

226. THE TEACHING OF ARITHMETIC. (3) I, II. Flournoy
A basic course in elementary curriculum and methods involving the functions, organization of materials, and methods of teaching arithmetic. P, 151 or CR.

227. THE TEACHING OF SOCIAL STUDIES AND SCIENCE. (3) I, II. Staff
A basic course in elementary curriculum and methods involving the functions, organization of materials, and methods of teaching the social studies and the elementary sciences. P, 151 or CR.

231. THE HIGH SCHOOL AS AN INSTITUTION. (3) I, II. Larson
Historical development of the high school; aims, functions, and outcomes; the curriculum; relation to other divisions of the school system. P, 3 units in education.

234. GENERAL HIGH SCHOOL METHODS. (3) I, II. Crowell-Johnston
Teaching techniques based on principles of educational psychology. P, 151, 231 or CR.

240. PRINCIPLES AND TECHNIQUES OF GUIDANCE. (3) I. Shafer
Introductory course for those who expect to specialize in student guidance or for the teacher to whom some functions of guidance are assigned. P, 231, Psychology 1a.

241. COUNSELING TECHNIQUES. (3) I. Danielson
The functions and techniques of educational and vocational counseling. P, 240.

242. OCCUPATIONAL INFORMATION. (2) II. Danielson
Occupational information and its interpretation and use for purpose of counseling. P, 241 or CR.

243. TESTING INSTRUMENTS FOR SCHOOL COUNSELORS. (3) I. Danielson
Study, analysis and evaluation of standardized tests used in counseling; quantitative aspects of the guidance program; use of results of specific tests. P, 257. Psychology 250 recommended. Fee, $2.

244. ELEMENTARY-SCHOOL GUIDANCE. (3) I. 1955-56. Danielson
Principles and practices of guidance as they apply to the elementary school. P, 9 units in Educ., including 151.

250. MENTAL HYGIENE. (3) I, II. Merritt
The principles of mental hygiene and their application to personal and social needs. P, 151.

252. PSYCHOLOGY OF ELEMENTARY EDUCATION. (2) I. 1955-56. Merritt
Application of the principles of psychology and of the laws of learning to the several subjects of the curriculum. P, 151, Psychology 1a.

253. PSYCHOLOGY OF SECONDARY EDUCATION. (2) I. 1956-57. Merritt
Application of the principles of mental hygiene and of the laws of learning to the government and curricular activities of the secondary school. P, 151, 231.

254. STATISTICAL METHODS IN EDUCATION. (3) I, II. Merritt-Johnston
Elementary methods of dealing quantitatively with school data and data resulting from experimental investigations. P, 9 units in education or psychology.

257. EDUCATIONAL TESTS AND MEASUREMENTS. (3) I, II. Merritt-Shafer
The principles underlying the making and using of informal objective examinations; practice in making and scoring such examinations; surveys of standard tests in the respective fields. P, 151. Fee, $1.50.

301. CURRENT PROBLEMS IN EDUCATION. (2) I. Larson
A systematic study of the problems found in current educational literature, research studies, school reports, and similar material. For seniors and graduate students. Prerequisite for seniors, 6 units in education. Required of all graduate students having education as a major or minor.

306. COMPARATIVE EDUCATION. (3) II. Kelley
A study of national systems of education and the development of underlying philosophies and practices. Contemporary movements in the educational systems of western European countries with special reference to similar movements in the United States and certain Latin American countries.

310. PHILOSOPHY OF EDUCATION. (3) II. Kelley
A critical study of the data which recent scientific research has furnished with reference to the nature of the learning process; determination of the leading objectives in teaching. Open to seniors. P, for seniors, 6 units in education.

314. ARIZONA STATE SCHOOL SYSTEM AND SCHOOL LAW. (3) II. 1956-57. Larson
Public education in Arizona; the code relating to schools and a comparison of this code with other state codes and ideal codes. Open to seniors. P, for seniors, 6 units in education.

323. THE ELEMENTARY-SCHOOL CURRICULUM. (3) I. Kelley
The elementary-school curriculum and its relationships; basic theories and techniques of curriculum construction discussed, evaluated, and applied.

329. INVESTIGATIONS IN ELEMENTARY EDUCATION. (2) II. 1955-56. Staff
A critical study and evaluation of the investigations and experimental evidence basic to the aims and instructional practices of the elementary school. P, 9 units in education.

333. EXTRA-CLASSROOM ACTIVITIES. (3) I. 1956-57. Larson
The purposes of extra-classroom activities; technique of administration. Open to seniors. P, for seniors, 231, 234.

334. THE TEACHING OF ENGLISH COMPOSITION. (3) I. Muir
(Identical with English 334.)

336. HIGH-SCHOOL ADMINISTRATION. (3) II. 1955-56. Johnston
The problem of organization and administration of the modern high school. Open to seniors. P, for seniors, 231.

337. SECONDARY-SCHOOL SUPERVISION. (3) II. 1955-56. Crowell
A comprehensive treatment of the organization used, the relationships involved, and the techniques developed for the effective supervision of modrn high-school instruction. Open to seniors. P, for seniors, 231 and 234.

338. CURRICULUM CONSTRUCTION. (3) I. 1955-56. Staff
The curriculum and its relationships; basic theories and techniques of curriculum construction discussed, evaluated, and applied. P, 231.

339. INVESTIGATIONS IN SECONDARY EDUCATION. (2) II. 1956-57. Crowell
A critical study and evaluation of the investigations and experimental evidence underlying the aims and instructional practices of the various subject-matter fields of the secondary schol. P, 9 units in education.

341. DIRECTED APPLICATION IN GUIDANCE. (3) II. Danielson
Actual practice under supervision in applying the principles, techniques, and tools studied in the guidance program. P, 240, 241, 243.

343. ORGANIZATION AND ADMINISTRATION OF GUIDANCE PROGRAMS. (2) II. Danielson
An analysis and evaluation of the administrative organization for guidance and of the techniques for counseling of pupils. Open to seniors. P, for seniors, 6 units in education.

344. PROBLEMS IN GUIDANCE. (2) II. Danielson
Review of current literature in guidance. Individual or group investigations related to guidance practices. P, 240, 241, 254.

351. ADVANCED EDUCATIONAL PSYCHOLOGY: LEARNING AND INSTITUTION. (2) II. 1956-57. Merritt
An intensive study of the learning process, including such topics as principles of learning, transfer of training, individual differences in learning ability and the application of these to instructional situations. P, Psychology 1a, Education 151 and a total of 10 hours in education.

354. ADVANCED STATISTICAL METHODS IN EDUCATION. (3) II. 1955-56. Merritt
Further methods of dealing quantitatively with educational data. Required of all doctoral students in education. P, 254 or equivalent.

360. GENERAL SCHOOL ADMINISTRATION. (3) I. 1956-57. Larson
The organization, administration, and supervision of city and town school systems. Open to seniors. P, for seniors, 6 units in education.

370. PERSONNEL PROBLEMS IN SCHOOL ADMINISTRATION. (2) I. 1955-56. Staff
Open to seniors. P, for seniors, 6 units in education.

371. SCHOOL FINANCE. (3) II. 1955-56. Larson
Sources and distribution of school funds; accounting and reports. Open to seniors. P, for seniors, 6 units in education.

373. PLANNING AND MAINTENANCE OF SCHOOL BUILDINGS. (3) II. Staff
A comprehensive treatment of the problems involved in the planning, construction and maintenance of school buildings. An opportunity will be afforded to visit and evaluate some of the newer and more adequate school buildings. P, 12 hours in education.

376. SUPERVISION: ITS ORGANIZATION AND ADMINISTRATION. (3) II. 1956-57. Larson
Qualifications and preparation of supervisors; essential activities in supervision; organization and administration. Open to seniors. P, for seniors, 6 units in education.

390. TECHNIQUES IN EDUCATIONAL RESEARCH. (2) I. Merritt
Required as part of the graduate major or minor in education. Open to seniors. P, for seniors, 6 units in education.

399. SEMINAR. (2) II. Staff

400. RESEARCH. (2) I, II. Staff

410. THESIS. (4) I, II. Staff

SCHOOL LIBRARY SCIENCE

Instructor Mary E. Foster, M.A.

The following courses emphasize school library work but also are designed to include a general, basic library program. Students planning to enter school library work should also complete all requirements for a teaching certificate.

These credits may be useful to apply toward admission requirements to graduate library schools; although the position of a student in such a school is often determined by examination.

The North Central Association of Colleges and Secondary Schools, in which the larger high schools in Arizona hold membership, requires in secondary schools of more than 500 a librarian with 24 semester hours in library science; in schools enrolling between 200 and 499, a librarian with 16 hours credit; and in schools with less than 200 students, a librarian with a minimum of 6 hours credit in library science.

201a-201b. LITERATURE FOR CHILDREN. (2-2) Yr. Foster
The history and development of children's literature with emphasis throughout on standards of evaluation and reading interest. Reading and analysis of books, particularly modern publications, for student interest, ability, and need, up to the junior high school level. P, 151, and 6 units in English or American literature.

280a-280b. LIBRARY MATERIALS. (2-2) Yr. Foster
Selection, evaluation, and acquisition of library books and materials, and generally-used methods of acquisition in school and public libraries. Evaluation of general reference works, indexes, bibliographies, and selected titles in subject fields. P, 151.

281. LIBRARY ADMINISTRATION AND ORGANIZATION. (2) I. Foster
The functions, activities, organization, and management of the library, particularly the school library, budgeting, equipment, and personnel; the contributions of non-library officials, school administrators, teachers, etc., to the successful operation of the library. P, 151.

282. ORGANIZATION OF LIBRARY MATERIAL. (2) II. 1955-56. Foster
Purpose and principles of cataloguing and classification. The card catalogue, shelf list, filing, vertical files. Organization of materials for use, particularly in school libraries; weeding, maintenance, etc. P, 151.

283. LIBRARY SERVICES AND
SPECIAL PROBLEMS. (2) II. 1956-57. Foster
Workshop centered on the use of the school library in the instructional program; individual guidance, readers' advisory service, and other special aspects of school and public library work. Discussion of problems encountered by working librarians. P, 151.

Related course:

EDUCATION 217, VISUAL AND
AUDITORY AIDS IN TEACHING. (3) II. Larson
This course may be counted as credit in the field of library science.

ENGINEERING

Work leading to the master's degree is offered with majors in civil, electrical, mechanical, metallurgical, and mining engineering. Adequate facilities for research are available. For civil, electrical, and mechanical engineering, a minimum of 15 units, exclusive of thesis, must be selected from courses listed below in these three fields, except that courses numbered 100 to 299 may not be used if they, or their equivalents, were used in fulfilling requirements for the bachelor's degree. The remaining courses, exclusive of thesis, may be selected from appropriate fields. Not less than 30 units will be required for this degree.

Advanced work in metallurgical engineering is directed towards research and the work in mining engineering to the professional development of the student by providing suitable specialization in mining and allied fields. The Department is especially well equipped to offer graduate work in mineral dressing, hydrometallurgy, pyrometallurgy, and in ventilation or mining methods as applied to either underground or open pit operations. Suitable fields of minor study for these degrees comprise chemistry, physics, and geology.

CIVIL ENGINEERING

Professors Erasmus S. Borgquist, C.E., *Head,* John C. Park, M.S., David J. Hall, M.S.; Associate Professors Quentin M. Mees, M.S., Richmond C. Neff, Ph.D., Philip B. Newlin, M.S., Andrew W. Ross, M.S.; Assistant Professor Rudolph A. Jimenez, M.S.

Jimenez, M.S.

200. ADVANCED SURVEYING - SUMMER CAMP. (5) Newlin
A field course in route, topographic and triangulation surveys. P, 53, 48L for 5 weeks. Fee, $17.

203. ADVANCED SURVEYING. (3) II.
1955-56 (but not thereafter). Newlin
Base lines; day and night triangulation; adjustment and computations; plane table; general Polaris observations; introduction to photogrammetry. 1R, 6L. P, 52. Fee, $6.

226. STRUCTURES II. (3) II. Ross
Theory of structures; continuation of stress analysis, including influence lines; design of plate girders and timber trusses. 1R, 6L. P, 115R, 123. Fee, $2.

251. WATER SUPPLY. (3) I. Mees
Development of water supply; study of present and future needs; design of purification plants and distribution systems. Standard tests. 2R, 3L. P, 111R. Fee, $3.

252. SEWERAGE. (3) II. Mees
Sewage collection; design of sewers and storm drains; treatment processes in sewage disposal. 2R, 3L. P, 111R. Fee, $2.

260. PAVEMENTS. (2) I. Hall-Park
Design and methods of construction of flexible and rigid pavements, including a study of asphalts and subgrade characteristics. 2R. P, 122; 271R, 271L, or CR.

263. SOIL ENGINEERING. (3) I. Jimenez-Hall
A study of soil as an engineering material, including standard tests. 2R, 3L. P, CR in 260. Fee, $4.

265. CONSTRUCTION METHODS. (3) II. Ross
Fundamentals of estimating, methods of construction, and field control engineering. 2R, 1L. P, CR in senior design.

271R. REINFORCED CONCRETE CONSTRUCTION. (3) I. Borgquist
Beams, girders, slabs, columns, footings, retaining walls, and buildings. 1R, 6L. P, 226. Fee, $2.

271L. REINFORCED CONCRETE LABORATORY. (1) I. Borgquist-Staff
Testing of sand, rock, cement, and plain and reinforced concrete. 3L. Fee, $4.

273. STATICALLY INDETERMINATE STRUCTURES. (4) II. Borgquist
Study of moment area method of deflections of beams and trusses; single span frames and arches, slope deflection methods, and Hardy Cross method of moment distribution. 2R, 6L. P, 271R, 281, CR in 282. Fee, $2. Field-trip fee not to exceed $25 will be collected when trip is arranged.

281. STEEL MILL BUILDINGS. (3) I. Borgquist
Roof trusses, steel bracing, transverse bents, and structural steel detailing. 1R, 6L. P, 226. Fee, $2.

282. BRIDGE DESIGN. (3) II. Borgquist
Highway and R.R. bridges. 1R, 6L. P, 281. Fee, $2.

284. FOUNDATIONS OF BRIDGES AND BUILDINGS. (1) II. Hall
Underground exploration; bearing power of soils; footings; caissons; cofferdams; piles. P, 263, 271R.

290. CONTRACTS, SPECIFICATIONS, AND ENGINEERING RELATIONS. (2) II. Hall
P, CR in senior design.

294. MODERN ENGINEERING PROJECTS. (1) II. Borgquist
Preparation, presentation, and discussion of engineering reports on assigned subjects. P, CR in senior design.

301. ADVANCED MECHANICS OF MATERIALS. (3) I. Neff
Use of the fundamental tools of stress analysis; statics, geometry, and properties of the material; common limiting assumptions and the results of their violation. P, 114 or 115R.

303. ADVANCED HIGHWAY ENGINEERING. (3) I. Hall
Economics of highway improvement, vehicle time lost studies, economics of road surfaces, access highways, and parkways, geometric highway design. P, 260. 2R, 3L. Fee, $2.

304. HIGHWAY TRAFFIC AND SAFETY. (3) II. Hall
The study of traffic for purpose of traffic control and highway improvement; traffic counts, relief of congestion, signal control, and channelization of motor vehicle flow. P, 260. 2R, 3L. Fee, $2.

307. ADVANCED GEODETIC SURVEYING. (3) II. Newlin
Refinements in the branch of surveying by which latitudes, longitudes, and elevations of points on the earth's surface and the form and dimensions of the earth are determined; adjustment of triangulation systems and level nets by the method of least squares; methods of surveying and computing as practiced by the U. S. Coast and Geodetic Survey and the U. S. Geological Survey. 1R, 6L. P, 200, Mathematics 79b or 95b. Fee, $6.

308. ADVANCED PHOTOGRAMMETRY. (2) I. Newlin
Study of aerial cameras, accessory equipment, and flight procedure. Reading and interpretation, and geometric characteristics of aerial photographs. Stereoscopic principles and their application in the production of planimetric and topographic maps. Plotting with radial line methods and types of plotting instruments. Aerial mosaics and compilation methods. Map projections, grids, and forms. 1R, 3L. P, 200 or 203. Fee, $6.

310. RIGID FRAMES—BRIDGES. (3) I. Neff
A study of modern rigid framed bridges, particularly the arch, culminating in the complete design of a bridge of this type in reinforced concrete. Analytical tools in arch design; analysis of symmetrical arches; analysis of non-symmetrical arches; analysis of series of arches; factors influencing design; basis for selection of design features; complete bridge design. 1R, 6L. P, 273, 284. Fee, $2.

311. RIGID FRAMES—STRUCTURES. (3) II. Neff
A study of modern rigid framed buildings, culminating in the complete design of a reinforced concrete building. Analytical tools and their application; effect of various loading and foundation conditions on analysis and design; the source and application of various design concepts; derivation, limitations, and use of various design tables and handbooks; complete design of a building. 1R, 6L. P, 273, 284. Fee, $2.

400. RESEARCH. (2 to 5) I, II. Staff

410. THESIS. (2 to 5) I, II. Staff

ELECTRICAL ENGINEERING

Professors Thomas L. Martin, Jr., Ph.D., *Head,* James C. Clark, M.E.E., E.E., Harry E. Stewart, M.S., Paul E. Russell, Ph.D., Leander W. Matsch, M.S., E.E., Robert A. Hessemer, Ph.D.; Associate Professor Charles R. Hausenbauer, M.S.; Assistant Professors James L. Knickerbocker, B.S., Merle H. Wittmeyer, M.S., Orville E. Dunn, M.S., E.E., Leroy J. Smith, M.S., Robert Manhart, M.S.

205. INDUSTRIAL ELECTRONICS AND CONTROLS. (3) II. Dunn
A study of elementary electronic circuits and their application to controls and other industrial equipment (for non-electrical engineering students). 3R. P, 126a-126b.

217. ELECTRICAL EQUIPMENT FOR INDUSTRY. (2) I. Dunn
The selection of motors, motor control, power distribution design, illumination design. For non-electrical engineering students. P, 126bR and 126bL.

222. STEADY STATE ANALYSIS. (3) II. Hausenbauer
Continuation of E.E.120. Fourier analysis, filter networks and transmission line theory. P, 120.

223. CIRCUITS LABORATORY. (3) II. Hausenbauer-Dunn
P, 222 or CR. Fee, $5.

228. ADVANCED CIRCUIT THEORY. (3) I. Hausenbauer-Dunn
Advanced subjects in circuit analysis and synthesis with reference to current developments appearing in periodical literature. P, 122, Math. 201a.

229. ADVANCED CIRCUITS LABORATORY. (1) I. Hausenbauer-Dunn
P, 228 or CR.

244. ENVIRONMENTAL ENGINEERING. (2) I Staff
Effects of natural and physical phenomena on the electrical and mechanical properties of electronic devices; instrumentation.

245. AUTOMATIC TEST METHODS. (2) II. Staff
Comparison between automatic and normally operated philosophy; computor techniques, programming, quality decisions, digital data systems, feedback techniques and controls; particular emphasis on missile test applications.

254. ADVANCED ELECTRONICS. (3) I. Manhart-Smith
Advanced topics in electronics with reference to current developments in the periodical literature. P, 152.

255. ADVANCED ELECTRONICS LABORATORY. (1) I. Manhart-Smith
Experiment aspect of E.E.254. P, 254 or CR. Fee, $5.

266. DESIGN OF ELECTRICAL MACHINES. (4) II. Clark
Analytical and graphical treatment of the problems arising in the process of the complete design of three machines including one direct current generator, one alternating current generator, and one alternating current motor. P, 162. Fee, $4.

270. THEORY OF AUTOMATIC CONTROL. (3) I. Wittmeyer-Russell
Theory and analysis of closed loop systems and control applications. P, 120.

271. AUTOMATIC CONTROL LABORATORY. (1) I. Wittmeyer
Experimental work illustrating E.E.170. P, 270 or CR.

280. ELECTOMAGNETIC ENGINEERING. (3) II. Hessemer, Stewart
High frequency transmission lines, waveguides, waveguide components, antennas, horns, and parabolas. P, Phys. 211a.

281. ELECTOMAGNETIC ENGINEERING LABORATORY. (1) II. Hessemer-Stewart
P, 280 or CR. Fee, $5.

310. TRANSIENTS IN LINEAR SYSTEMS. (3) I. Hausenbauer-Wittmeyer
Use of the Laplace transform in the solution of linear integrodifferential and the difference equations arising in the formulation of electrical, mechanical and electro-mechanical systems.

315. SERVOMECHANISMS. (3) II. Wittmeyer-Russell
Analysis and synthesis of closed loop control systems. P, 270.

319. SYMMETRICAL COMPONENTS. (3) I. Knickerbocker
Analysis of unbalanced polyphase power systems; sequence impedances and networks; fault calculations. Application to problems of grounding, relaying and unbalanced operation of apparatus.

321. PROTECTIVE RELAYING. (3) II. Knickerbocker-Clark
System protection by relays against abnormal conditions; steady state and transient conditions; single and multiple faults. P, 319.

326. ADVANCED ALTERNATING CURRENT MACHINERY. (3) II. Matsch
Harmonic analysis of the magnetic density in the air gap, and the effect of harmonies on emf, torque, and vibration; transient conditions following sudden load changes; stability criteria; unbalanced operation.

327. POWER SYSTEM STABILITY. (3) II. Matsch
Steady state and transient stability of power systems; power limits; high speed relaying; rapid operation of circuit breakers; action and effects of governors, excitation systems, and damper windings. P, 319.

330. ADVANCED ELECTRONIC CIRCUITS I. (3) I. Martin-Hausenbauer
Design of wide band and fast amplifiers using vacuum tubes and transistors; stagger tuning, distributed amplifiers and related problems.

331. ADVANCED ELECTRONIC CIRCUITS II. (3) Martin-Hausenbauer
A continuation of E.E.330 to include feedback and transistor amplifiers, wave shaping, computing, and trigger circuits and non-sinusoidal oscillators. P, 330.

332. ADVANCES IN ELECTRONICS. (3) I, II. Martin-Dunn
New developments in electronic components and circuitry; principles of transistors, magnetic, and dielectric amplifiers; some types of transducers.

333. SYSTEMS ENGINEERING. (3) II. Martin, Russell
Definition and development of systems; block diagram representations, equations of physical systems, transfer functions and analogs; considerations of cost, maintenance, reliability, accuracy, and stability; system measurements.

350. MICROWAVE CIRCUITS. (3) I. Hessemer, Stewart
Application of electromagnetic field equations to the analysis of wave propagation and reflection, waveguides, resonators, and waveguide discontinuities. Measurement of power, wavelength, standing wave ratio, impedance, and attenuation in microwave systems. P, 280.

351. MICROWAVE ELECTRONICS. (3) II. Hessemer, Stewart
Introductory study of fundamental electronic concepts and their application to the analysis of UHF triodes; klystrons, magnetrons, travelling-wave tubes, and related devices. P, 350.

360. METHODS OF ANALYSIS OF NONLINEAR SYSTEMS. (3) I, II. Russell
Study of methods of solution of nonlinear electrical and other systems; nonlinear resonance; criteria for stability of nonlinear oscillations.

370. ANALOG COMPUTATION. (3) I, II. Russell
Solution of physical systems by means of analog machines.

371. MACHINE LOGIC. (3) I, II. Russell
Extension of E.E.270. Methods and means for solution of systems of equations using high speed computors. P, 370.

400. RESEARCH. (2 to 5) I, II. Staff

410. THESIS. (3 to 8) I, II. Staff

MECHANICAL ENGINEERING

Professors Martin L. Thornburg, M.E., *Head,* Heliodore A. Marcoux, M.S.; Associate Professors William C. Currie, M.S., Arland G. Foster, M.S.; Assistant Professors John S. Phelps, M.S., Anthony R. Yappel, M.S., Claud L. Brattin, B.M.E.

228R. INTERNAL COMBUSTION ENGINES. (3) I, II. ———
P, 118a.

228L. MECHANICAL LABORATORY. (1) I, II. ———
3L. P, 228R or CR. Fee, $5.

235a-235b. POWER EQUIPMENT DESIGN. (3-3) Yr. Thornburg
Design and selection of equipment for power production. 2R, 3L. P, 118a, 125. Fee, $1 each semester. Field-trip fee for 235b, not to exceed $12, will be collected when trip is arranged. 235a is not a prerequisite to 235b.

238R. POWER PLANTS. (3) I, II. Marcoux
P, 118a.

238L. POWER PLANT LABORATORY. (1) I, II. Marcoux
3L. P, 238R or CR. Fee, $5.

240. PRODUCTION ENGINEERING. (2) I. Foster
Tool and jig design. 1R, 3L. P, 102, 125.

242. INDUSTRIAL ENGINEERING. (2) I. Marcoux
Industrial organization and management.

246. ENGINEERING DEVELOPMENTS. (2) II. Thornburg
Reports and conferences.

247. PETROLEUM. (2) I. ———
Production, refining, and use of petroleum. 1R, 3L. P, 228R, 228L. Fee, $3.

248. AIR CONDITIONING. (3) II. Marcoux
P, 118b.

250. AVIATION. (2) I. Thornburg
Simple aerodynamics and the airplane. P, 1 year of physics.

258. REFRIGERATION. (3) I. Marcoux
P, 118b.

301. VIBRATIONS. (2) I. Yappel
P, C.E.114 and Math. 201a.

302. HEAT TRANSFER. (3) II. Staff
P, Math. 201a and M.E.118a.

318. ADVANCED THERMODYNAMICS. (3) I. Andrix
P, 118b and Math. 201a.

321. ADVANCED FLUID MECHANICS. (3) II. Yappel
P, 121R or C.E.111R.

400. RESEARCH. (2 to 5) I, II. Staff

410. THESIS. (3 to 8) I, II. Staff

METALLURGICAL ENGINEERING

Professors John B. Cunningham, M.S., *Head,* Thomas G. Chapman, Sc.D.; Associate Professor Sigmund L. Smith, M.S.; Assistant Professor John K. Anthony, M.S.

205. ORE MICROSCOPY. (1) I. Smith
The theory and practice involved in the use of various types of microscopes to identify common minerals; the determination of size of grains in concentrator products; and the quantitative determination of minerals in ores and concentrator products. 3L. P, 111, Geol. 10.

207R*. MINERAL DRESSING. (3) I. Chapman
The crushing, grinding, and concentration of ores by mechanical methods. P, Physics 10b, junior standing in mining, metallurgy, geological engineering, geology, or chemistry.

207L*. MINERAL DRESSING LABORATORY. (1 to 2) I. Smith
Experimental work in the preparation and concentration of ores by mechanical methods. 3 or 6L. P, 106, 207R. Fee, $4 per unit; deposit, $3.

212*. NONFERROUS METALLURGY. (2) II. Cunningham
The study of the various smelting and refining processes used for the treatment of copper, lead, and zinc ores. P, 111. One field trip to a smelting plant is required. Fee, $3.

218. FERROUS METALLURGY. (2) I. Cunningham
Survey of the iron and steel industry. Study of ores; melting of iron ores; steel making and refining; wrought iron; alloy steel making in the electric furnace. P, 212.

220R*. HYDROMETALLURGY. (1 or 2) II. Chapman-Smith
A study of the principles and hydrometallurgical processes employed for the recovery of gold, silver, copper, and zinc from ores. P, 207R, junior standing in mining, metallurgical, or geological engineering, or chemistry.

220L†. HYDROMETALLURGY LABORATORY. (2) II. Cunningham
Experimental work in the principles and practice of treating gold, silver, and copper ores by hydrometallurgical methods. 6L. P, 106, 220R, 207R, Chem. 22. Fee, $10; deposit, $3.

221. METALLURGICAL CALCULATIONS. (2) I. Cunningham
Problems involving calculations encountered in the practice of metallurgical engineering. P, 212.

225. PYROMETALLURGY AND PYROMETRY. (2) I. Cunningham
Theory of high temperature measurements; calibration of various instruments used in pyrometry; furnace testing, including gas analyses; roasting; and a study of the heat balance. 1R, 3L. P, 112 and 121 or CR.

226. METALLURGY OF THE LESS COMMON METALS. (1) II. Cunningham
A study of the principles and metallurgical processes employed for the extraction of nickel, tin, mercury, antimony, bismuth, platinum, tungsten, molybdenum, and other metals from their ores. P, senior standing in mining engineering, metallurgy, chemistry, or geological engineering.

**Not for graduate credit for degrees in mining or metallurgical engineering.*
†Not for graduate credit for the degree in metallurgical engineering.

228. DESIGN OF AN ORE TREATMENT PLANT. (2) II. ———
The design of a small capacity concentrating plant including the selection of a site, the design of a flow plan, the selection of equipment, excavation, the installation of building and equipment and estimation of capital cost and operating cost. 1R, 3L. P, 207R, and M.E.21.

303. ADVANCED METALLURGICAL CALCULATIONS. (2) II. Cunningham
P, 212, 221.

305. ADVANCED MINERAL DRESSING AND HYDROMETALLURGY. (2 to 8) I, II. Smith
Advanced classroom or laboratory work, or both, in mineral dressing or hydrometallurgy. P, 107R, 107L, and senior standing in mining, metallurgy, geological engineering, or chemistry. Fee, $1 per unit.

306. ADVANCED PYROMETALLURGY. (2 to 4) I, II. Cunningham
A seminar in current practices of smelting ores and refining metals; discussion of recent advances in pyrometallurgy and electrometallurgy. P, 212, 218, 221.

310. SPECTROCHEMICAL ANALYSIS. (1) I, II. Smith
The theory and techniques of spectrography as applied to metallurgy. P, Chemistry 284a. Fee, $4.

313. ADVANCED METALLOGRAPHY AND HEAT-TREATMENT. (1 to 5) I, II. Smith-Anthony
Subject matter fitted to the student's needs; may include ternary phase diagrams, advanced heat-treatment, metals testing, microscopic identification.

400. RESEARCH. (1 to 4) I, II. Staff

410. THESIS. (1 to 6) I, II. Staff

MINING ENGINEERING

Professors John B. Cunningham, M.S., *Head,* Harry E. Krumlauf, M.S.

209. MINE SURVEYING. (3) II. (May) Staff
Surveying and mapping of a portion of an underground mine. The course is added to the second semester schedule but is given immediately following the close of the second semester. The equivalent of two weeks work is required at some mine in Arizona and 50 hours of laboratory work on the campus. P, 102, Civil Engineering 52. Fee, $15, which does not include room and board.

215. MINE INSPECTION. (1) II. Staff
Inspection trips to mines with written reports thereon. P, senior standing in mining engineering. Field trips. Fee, $10.

217. MINE EXAMINATION AND VALUATION. (2) I. Krumlauf
Procedure of the examination, collection of data, and calculation of the valuation of mining property. P, completion of junior work in mining or geological engineering.

219. INTRODUCTION TO GEOPHYSICAL PROSPECTING. (3) I. Kassander
(Identical with Physics 219.)

220. MINE PLANT. (2) I. Krumlauf
A study of problems and plant design involving hoisting, compressed air distribution, drainage and mine structures. 6L. P, senior standing in mining engineering.

222. OPEN PIT METHODS. (2) II. ———

Ore control systems, drilling and blasting, prospect drilling, excavation, transportation as applied to open-pit mining methods. Laboratory work in open-pit development calculations. 1R, 3L. P, 217. Fee, $2.

230. MINE MANAGEMENT. (2) II. Krumlauf

Development plans, reports, ore reserves, incentive labor contracts, use of office equipment. 1R, 3L. P, senior standing in mining engineering.

312. FIELD WORK IN MINING ENGINEERING. (2) I. Staff

Field study of special problems of mining properties. P, senior standing in mining or geological engineering. Fee, $5.

316. EXPLOSIVES USED IN MINING OPERATIONS. (2) I. ———

Theory, properties, and uses of commercial explosives. Application of explosives to the mineral industry will be stressed. P, senior standing in mining, civil, or geological engineering.

399. SEMINAR. (2) II. Staff

Study of and reports on mining literature. P, senior standing in mining or geological engineering.

400. RESEARCH. (1 to 4) I, II. Staff

410. THESIS. (1 to 6) I, II. Staff

ENGLISH

Professors Desmond S. Powell, Ph.D., *Head,* William J. Tucker, Ph.D., Inez Thrift, Ph.D., Marie P. Hamilton, Ph.D., Laurence A. Muir, Ph.D., Frances Gillmor, M.A.; Associate Professor Albert F. Gegenheimer, Ph.D.; Assistant Professors Dorothy Fuller, M.A., Florence H. Morgan, A.M., Alsie F. Schulman, M.A., Jack W. Huggins, M.A., William Irmscher, Ph.D., Robert W. Ramsey, M.A.; Instructor H. Christian Kiefer, M.A.

Students wishing to work for the degree of Master of Arts in English must have completed the undergraduate major in English or an acceptable equivalent. Such students are usually expected to have studied a foreign language for at least two years. The degree is conferred on those who have completed 26 or 27 hours of course work with an average grade of 2, passed a comprehensive examination, completed a thesis, and passed an oral examination on the thesis. The courses may be entirely in English or partly in an allied field. They must include Old English, Chaucer, History of the English Language, and Bibliography, provided such courses have not previously been taken for credit. The thesis may be in the field of the English language, in English literature, in American literature, or in comparative literature.

See page 20 for M.Ed. degree major or minor in this department.

210. ADVANCED WRITING. (1-4) I. 1956-57. ———

P, 7 and 102 or 104, or professional experience.

226a-226b. SURVEY OF ENGLISH LITERATURE. (3-3) Yr. Tucker

Required of all majors and teaching minors. 226a is not a prerequisite to 226b.

227a-227b. THE ROMANTIC MOVEMENT IN ENGLISH LITERATURE. (3-3) Yr. ———

227a: The rise of revolutionary ideas and techniques; Wordsworth, Coleridge, Byron.

227b: Shelley, Keats, Scott, and the minor poets. 227a is not prerequisite to 227b.

228. VICTORIAN POETS. (3) I. Powell
Tennyson, Browning, and their contemporaries.

229. VICTORIAN ESSAYISTS. (3) II. Powell
Literary and social aspects of the essay in the Victorian Age: Carlyle, Newman, Arnold, Ruskin, and others.

230a-230b. THE ENGLISH NOVEL. (3-3) Yr. 1955-56. Tucker
230a: The novel from its beginning to the death of Scott, 1832.
230b: Thackeray and Dickens to the present. 230a is not prerequisite to 230b.

231a-231b. SHAKESPEARE. (3-3) Yr. Tucker
231a: Introductory course. The life and times of Shakespeare; rapid reading of several representative plays.
231b: A careful study of three plays.

232a-232b. THE DEVELOPMENT OF ENGLISH DRAMA. (3-3) Yr. ———
232a: English drama from its beginning to the end of the Stuart period.
232b: Shakespeare's later contemporaries, the Restoration, the eighteenth century, the poetic drama of the nineteenth century. 232a is not prerequisite to 232b.

234. MODERN DRAMA. (3) II. Tucker
The chief dramatic writers of the last half century.

237a-237b. CHAUCER AND HIS AGE. (3-3) Yr. Hamilton
237a: *Troilus and Cressida, The Legend of Good Women,* and selections from the Gawain poet, read in Middle English.
237b: *The Canterbury Tales* and selections from *Piers Plowman.* 237a is not prerequisite to 237b. One semester is required of all graduate majors who do not have undergraduate credit in Chaucer.

239. MILTON. (3) II. 1955-56. Thrift

240. THE AGE OF POPE. (3) I. 1956-57. Tucker
Literary and social ideas in the poetry of the neoclassic period.

241. SWIFT AND JOHNSON. (3) II. 1956-57. Tucker
Essays, letters, journals, and biographies of the period from 1660 to 1800.

242. CONTEMPORARY POETRY. (3) II. Fuller
The lyric of England and America in the last three decades.

244. AMERICAN DRAMA. (3) II. Gegenheimer
The development of drama in the United States from the Colonial period to the present time. P, 6 units in American literature or in English and European drama.

250a-250b. THE LITERATURE OF THE BIBLE. (2-2) Yr. Thrift
The most notable portions of the Bible, with historical and social background.

260. HISTORY OF THE ENGLISH LANGUAGE. (3) II. Hamilton
Required of all graduate English majors.

285. TYPES OF FOLKLORE. (3) I. Gillmor
A study of types, including tales, legends, riddles, proverbs, folk songs, children's games and rhymes. Training in methods of collection and analysis. P, 6 units of literature and 6 units of related social science.

315a-315b. LITERARY CRITICISM. (3-3) Yr. Muir
The theory of criticism; important critical documents; preparation of papers applying the principles of criticism.

324. STUDIES IN AMERICAN LITERATURE. (3) I. Gegenheimer
P, 1 year of American literature.

331. STUDIES IN SHAKESPEARE. (3) II. Kiefer
P, 231a and 231b or 232a.

334. THE TEACHING OF ENGLISH COMPOSITION. (3) I. Muir
An introduction to the problems and procedures in composition courses, with emphasis on Freshman English and attention to secondary school courses and to the relationship between high school and college English. Use of college freshman classes for observation and practical work. (Identical with Education 334.)

338. OLD ENGLISH. (3) I. Hamilton
The language, with reading of representative prose and poetry. Required of all graduate English majors.

340. STUDIES IN THE SEVENTEENTH CENTURY. (3) I. Morgan
A general view of the period, exclusive of Milton, with selected studies in the central figures: Donne, Jonson, Herrick, Herbert, and the religious lyrists; the Cavalier poets; the prose of Bacon, Walton, Sir Thomas Browne, and Dryden.

350. BIBLIOGRAPHY. (2) I. Gegenheimer
Aims, methods, and history of literary scholarship; bibliographical tools for the study of literature; thesis style and form. Required of all graduate English majors.

400. RESEARCH. (2 to 3) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

FRENCH

(See Romance Languages)

GEOCHRONOLOGY - DENDROCHRONOLOGY

Committee (Graduate): Professors Andrew E. Douglass, D.Sc., *Chairman,* Edwin F. Carpenter, Ph.D., Frederic W. Galbraith, Ph.D., Emil W. Haury, Ph.D., Walter S. Phillips, Ph.D.; Associate Professors John F. Lance, Ph.D., James E. McDonald, Ph.D., Edmund Schulman, Ph.D.; Assistant Professors John W. Anthony, M.S., Donald L. Bryant, M.S., Edwin B. Kurtz, Ph.D., Edward N. Wise, Ph.D.; Terah L. Smiley, M.A., Geochronologist.

Geochronology encompasses all scientific methods which can be applied to the dating of terrestrial events: dendrochronology is specially concerned with the precise dating of events in years by means of tree-rings.

Studies in geochronology-dendrochronology may constitute a doctoral minor for students with majors in anthropology, botany, chemistry, or geology. A minor for the master's degree is offered to qualified students in one of the related fields. Credit in Mathematics 91 (Introduction to Statistics) or the equivalent is required.

The Laboratory of Tree-Ring Research houses one of the most extensive collections of its kind. It contains, besides specimens from many parts of the world, approximately 60,000 archaeological tree-ring specimens from the Southwest. Dated specimens within this collection give an exact and continuous chronology from the present back to 59 B.C. This chronology is gradually being expanded in area and in time as archaeological excavations uncover additional material. Supervised research within this laboratory is open to qualified students.

The Carbon^{14} Age Determination Laboratory also offers opportunity for research. Material covering the full range of the carbon^{14} dating potential is plentiful in the immediate and adjacent areas. Qualified students will be able to study at first hand the techniques of this dating.

Opportunities to study various other methods of geochronology are offered in the individual departments. These methods include archaeological stratigraphy, paleontology, pollen analysis, and analytical methods in chemistry.

275. INTRODUCTION TO METHODS IN GEOCHRONOLOGY. (2) I. Smiley and others
A survey of the various methods used in geochronology with special emphasis on those methods applicable to the Southwest.

276. LABORATORY METHODS IN GEOCHRONOLOGY. (2) II. Smiley and others
A series of controlled laboratory demonstrations in tree-ring analysis, Carbon^{14} analysis, pollen analysis, geologic laminations, and field observations. 1R, 3L. P, 275. Fee, $4.

285. INTRODUCTION TO THE TREE-RING DATING FOR ARCHAEOLOGISTS. (3) I. Smiley
The theoretical approach to the development and application of tree-ring dating in Southwestern archaeology.

301. METHODS IN TREE-RING DATING FOR ARCHAEOLOGISTS. (3) II. Smiley
The mechanics of tree-ring dating, field and laboratory techniques, and interpretation of tree-ring dates as applicable in Southwestern archaeology. 2R, 3L. P, 285. Fee, $4.

311. DENDROCLIMATOLOGY. (2) II. Schulman
Study of the development and the interpretation of tree-ring indices in terms of biologic, climatic, and other variations. 2R. 1 field trip. Open to seniors in the related fields. Fee, $5.

312. DENDROCLIMATOLOGY LABORATORY. (2) II. Schulman
Quantitative analysis of tree-ring series. 6L. P, 311 or CR.

Geology 202. STRATIGRAPHIC GEOLOGY. (3) I. Bryant
Systematic study of American and international stratigraphic geology. 2R, 3L, which includes 3 field trips. P, 1a, 1b, and junior standing. Fee, $4.

Geology 314. SEDIMENTATION. (3) I. Kiersch
Sources of material, agents of transportation and methods of deposition of sediments. 2R, 3L. P, 121. Fee, $3.

400. RESEARCH. (1 to 4) I, II. Staff
Supervised research may be carried on within the related departments, the Laboratory of Tree-Ring Research, or the Carbon^{14} Dating Laboratory.

GEOLOGY

Professors Frederic W. Galbraith, Ph.D., *Head,* Bert S. Butler, D.Sc., Evans B. Mayo, Ph.D.; Associate Professor John F. Lance, Ph.D.; Assistant Professors George A. Kiersch, Ph.D., Donald L. Bryant, M.S., John W. Anthony, M.S., Robert L. DuBois, Ph.D.

Each student entering graduate work in geology must have credits in undergraduate courses equivalent to those required for either a Bachelor of Science in geology or a geological engineering degree at the University of Arizona. The Graduate Record Examination is required before full graduate standing is granted. Course requirements include a minimum of 32 units in geology, 21 of which must be upper division courses. Certain specified courses include: general chemistry (8 hours); other chemistry (7 hours); engineering drawing (3 hours); surveying (6 hours); college algebra (3 hours); plane trigonometry (2 hours); descriptive geometry (3 hours); analytic geometry (4 hours); general physics (8 hours). For those stressing the paleontological aspect of geology, 12 hours of zoölogy may be substituted for 8 hours of physics and 4 hours of chemistry. Deficiencies must be made up before an advanced degree is awarded.

After entering graduate work in geology, each student must take a written placement examination to evaluate his general background in geology. This is used to assist in advising him concerning his program.

A preliminary examination covering all phases of geology is required of every candidate for an advanced degree. The Ph.D. candidates must take the examination (both written and oral) not later than February 15 of the last year of graduate work and after having satisfied all language requirements. The M.S. candidates must take an oral examination not later than March 1 of the year they plan to complete work on the degree. Advancement to candidacy for these degrees is conditional upon passing these examinations.

202. STRATIGRAPHIC GEOLOGY. (3) I. Bryant
Systematic study of American and international stratigraphic geology. 2R, 3L, which includes 3 field trips. P, 121 or CR. Fee, $4.

203. ORE DEPOSITS. (3) I. Staff
Study of metalliferous deposits; their geologic relations and origins. P, 121. Two field trips. Fee, $7.

204. NONMETALLIFERIOUS DEPOSITS. (3) II. Kiersch
Study of the industrial minerals covering the occurrence, exploitation, and beneficiation of: coal; ceramic, industrial, manufactured, and metallurgical materials; construction materials; chemical and fertilizer minerals; abrasives; ground-water. P, 203. Two field trips. Fee, $2.

207. GEOLOGICAL INTERPRETATION OF AERIAL PHOTOGRAPHS. (2) II. Lance
6L. P, 1b, 121. Fee, $2.

208. GEOLOGY OF NORTH AMERICA. (2) I. 1955-56. DuBois
General physiographic, stratigraphic, structural, igneous and metamorphic geology of North America. P, 52, 121.

209. INTRODUCTORY VERTEBRATE PALEONTOLOGY. (3) I. Lance
Osteology, affinities, and history of the vertebrates, with special reference to Tertiary mammalian faunas of North America. 2R, 3L, which includes 2 field trips. P, 1b or Zoölogy 4a, and junior standing. Fee, $5.

210. MINING GEOLOGY. (3) II. Staff
The application of geology to exploration, valuation and development of mineral deposits, including underground geologic mapping and the preparation of maps, structure sections and reports. 1R, plus 10 days field work at some mine in Arizona. P, 212s and 213s. Fee, $15, which does not include room and board.

212s. FIELD GEOLOGY (SUMMER CAMP).* (3) † Staff
Field methods of geologic mapping and the preparation of geologic reports. Laboratory comprises daily field work. Required of geological engineers, and geology majors. 45L, 3 briefing sessions. P, 121, Civil Engineering 52. Fee, $30 for 212, or $60 for 212 and 213 together, not including meals. Students required to report to camp or to nearest rail and bus station.

213s. GEOLOGIC MAPPING (SUMMER CAMP). (3) † Staff
Field methods of geological mapping and the preparation of geological reports. Laboratory comprises daily field work. Required of geological engineers and geology majors. 45L, 3 briefing sessions. P, 212s. Fee, $30 for 213 and $60 for 212 and 213 together, not including meals. Students required to report to camp or to nearest rail and bus station.

215. OPTICAL MINERALOGY. (3) I. DuBois
Microscopic study of the rock-forming minerals. 2R, 3L. P, 114, Chemistry 22, Physics 2b or 10b. Fee, $2.50.

216. PETROGRAPHY. (3) II. DuBois
Preparation and study of thin sections of rocks. 2R, 3L. P, 215. Fee, $3.50.

219. INTRODUCTION TO GEOPHYSICAL PROSPECTING. (3) I. Kassander
(Identical with Mining Engineering 219 and Physics 219.)

222. PETROLEUM GEOLOGY. (3) I. Lance
Principles and methods of pretroleum geology and practical exercises. 2R, 3L. P, 121.

225. INTRODUCTION TO PALEONTOLOGY, (3) I. Bryant
Morphology, classification, and geologic significance of fossil invertebrates. 2R, 3L. P, 1b or Zoölogy 4a. Fee, $5.

226. SYSTEMATIC PALEONTOLOGY. (3) II. Bryant
Advanced studies of fossil invertebrates. 2R, 3L. P, 225. Fee, $5.

227. PRINCIPLES OF METAMORPHISM. (3) II. DuBois
A study of metamorphism from the viewpoint of iso-chemical and metasomatic processes. 2R, 3L. P, 215.

301. ORE DEPOSITS OF THE ROCKY MOUNTAINS. (3) II. Butler
P, 203, 204.

302. ADVANCED DETERMINATIVE MINERALOGY. (2) I. Anthony
Application of the various methods used to identify minerals. 6L. P, 103, 114, Chemistry 10. Fee, $2.

303. ADVANCED MINERAL DEPOSITS. (3) I. Staff
P, 121, 203.

304. GEOLOGY OF ARIZONA. (2) II. Lance
P, 202.

305. ENGINEERING GEOLOGY. (3) I. Kiersch
Geologic factors influencing the site reconnaissance, planning, construction and maintenance of engineering projects such as mines, tunnels, dams, reservoirs, bridges and highways; construction materials, exploration methods. 2R, 3L, which includes 1 field trip. P, 215 or CR. Fee, $2.

The Department recommends that Geology 212s be substituted for Geology 105.
†Graduate credit permitted if student has completed 6 units of field geology.

308. ADVANCED STRUCTURAL GEOLOGY. (3) II. Kiersch
Causes and effects of tectonic features with particular reference to mountain building. Laboratory experiments, three dimensional representation of tectonic features, and fault problems. 2R, 3L. P, 121. Fee, $2.

309. THE MICROSCOPIC STUDY OF OPAQUE MINERALS. (2) I. Anthony
Identification and paragenesis of ore minerals by means of the reflecting microscope. 6L. P, 203. Fee, $2.50.

310. ADVANCED IGNEOUS PETROLOGY. (3) I. 1956-57. DuBois
Origin and formation of igneous rocks including selected petrographic studies. 2R, 3L. P, 216.

311. ADVANCED OPAQUE MICROSCOPY. (2) II. Anthony
Identification of ore minerals and microscopic study of suites of ore specimens from representative mining districts. 6L. P, 309. Fee, $5.

312. SEDIMENTARY PETROLOGY. (3) II. Kiersch
Preparation of sedimentary particles for study and microscopic examination of such materials. 2R, 3L. P, 215. Fee, $2.

313. GRANITE TECTONICS. (2) I. Mayo
Application of principles of structural geology to problems of genesis in igneous rocks. 2R. P, 121.

314. SEDIMENTATION. (3) I. Kiersch
Sources of material, agents of transportation, and methods of deposition of sediments. 2R, 3L. P, 121. Fee, $3.

316. GEOLOGY OF GROUNDWATER. (3) II. Lance
Geologic and hydro logic factors controlling occurrence and development of groundwater. 2R, 3L, which includes 2 field trips. P, 121. Fee, $2.

320a-320b. MICROPALEONTOLOGY. (2-2) Yr. Bryant
Preparation, identification and classification of microfossils with emphasis on Foraminifera, Ostracoda and conodonts. 6L. P, 225. 320a is not prerequisite to 320b. Fee, $2.

322. ADVANCED PETROLEUM GEOLOGY. (3) II. Bryant
Application of the principles of petroleum geology to the search for new petroleum provinces and for new fields within existing provinces. 2R, 3L. P, 222. Fee, $2.

323. GEOTECTONICS. (3) II. Mayo
District, regional and continental patterns in the earth's structural network. 2R, 3L. P, 308.

324. PREPARATION OF GEOLOGIC REPORTS. (2) I. Lance
Planning and writing geologic reports; preparation of illustrations. 2R. P, 105 or 212s.

399. SEMINAR. (1) I, II. Staff

400. RESEARCH. (1 to 4) I, II. Staff
Includes fields of invertebrate and vertebrate paleontology, sedimentation, stratigraphy, metallic and non-metallic mineral deposits, mineralogy, petrology and petrography, structural geology, engineering geology, and areal geology.

410. THESIS. (2 to 4) I, II. Staff

Related courses which may be taken for credit in geology:

GEO-DENDROCHRONOLOGY 275. (2) I. Smiley-Staff
GEO-DENDROCHRONOLOGY 276. (2) II. Smiley-Staff

GERMAN

Professor Frederick J. Schmitz, Ph.D., *Head;* Assistant Professor Jean R. Beck, Ph.D.; Instructor Thomas Smitham, M.A.

In agreement with general practice, a graduate desiring to work for the degree of Master of Arts in German should have completed, at this institution, an undergraduate major in German consisting of the required 24 units (16 of them in upper division) in addition to elementary German 1a-1b, or have completed equivalent work at another institution. Included in the 30 units of graduate work for the Master's Degree (15 of them in German and chosen from courses offered for graduate credit) is a thesis covering 2-4 units.

201. NINETEENTH-CENTURY AUTHORS. (2) I. 1956-57. Smitham
Intensive study of one author each semester. P, 16 units in German.

203a-203b. SURVEY OF CLASSICAL GERMAN LITERATURE. (3-3) Yr. 1955-56. Smitham
P, 3b. 203a is not prerequisite to 203b.

205a-205b. GERMAN LITERATURE OF THE NINETEENTH CENTURY. (3-3) Yr. 1956-57. Beck
P, 3b. 205a is not prerequisite to 205b.

207a-207b. GOETHE'S *Faust*, PARTS I AND II. (2-2) Yr. 1956-57. Schmitz
P, 3 years, or in exceptional cases, 2 years of college German. 207a is not prerequisite to 207b.

209. MODERN GERMAN LITERATURE. (2) II. 1956-57. Smitham
Class and collateral reading; lectures and reports in German. P, 16 units in German.

300a-300b. HISTORY OF GERMAN LITERATURE. (2-2) Yr. 1955-56. Beck
Historical survey of German literary development from the beginning to the present. Lectures in German alternating with conferences in English. P, 20 units in German.

400. RESEARCH. (1 to 3) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

HISTORY AND POLITICAL SCIENCE

Professors Oswald H. Wedel, Ph.D., *Head,* Howard A. Hubbard, Ph.D., Neal D. Houghton, Ph.D., Russell C. Ewing, Ph.D.; Associate Professor Paul Kelso, Ph.D.; Assistant Professors Rosendo A. Gomez, Ph.D., Herman E. Bateman, Ph.D., James A. Beatson, Ph.D.; Instructor Bernard Hennessy, Ph.D.

Students wishing to work for the degree of Master of Arts in history or political science should have completed the undergraduate major in history or political science or an acceptable equivalent. Students may be required to pursue such fundamental courses in history or political science as the department deems necessary to provide a suitable background. The degree is conferred on those who have completed 20 hours or more of graduate work in history or political science with an average grade of 2, passed a comprehensive examination, completed a thesis, and passed an oral examination on the thesis. The courses may be entirely in

history or political science or, with the permission of the department, some courses in addition to the 20 hours mentioned above may be taken in other fields.
See page 20 for M.Ed. degree major or minor in this department.

203a-203b. MEDIEVAL HISTORY. (3-3) Yr. 1956-57. Beatson
Origin and development of European states, and of social and political institutions, from the fall of the Roman Empire in the West to the Reformation. 203a is not prerequisite to 203b.

205a-205b. NINETEENTH-CENTURY EUROPE. (3-3) Yr. Wedel
The liberal reform movement of Europe; the evolution of constitutional government; various movements toward national unity. 205a is not prerequisite to 205b.

209. GREEK HISTORY. (3) I. 1955-56. Hubbard
Greece to the death of Alexander; the political, social, and economic life of the Greek people.

210. ROMAN HISTORY. (3) II. 1955-56. Hubbard
The organization of the Republic and the Empire; the social and economic development of the people; the relation of Rome to the Mediterranean world; to the fall of the Empire.

212a-212b. HISTORY OF THE BRITISH EMPIRE. (3-3) Yr. Beatson
First semester: The first empire; British North America in the 18th Century; the East India Company; Oceania, Australia and the British at the Cape of Good Hope.
Second semester: Age of Free Trade; New Nations Overseas; the Boer War; Dominion Status; the empire between the two World Wars; World War II and its aftermath. 212a is not prerequisite to 212b.

213a-213b. MODERN EUROPE. (3-3) Yr. 1955-56. Beatson
From the beginning of the Reformation to the Napoleonic period, including an intensive study of the French Revolution. 213a is not prerequisite to 213b.

215a-215b. THE TWENTIETH CENTURY, (2-2) Yr. Wedel
International relations before 1914; the causes and results of World War I; the Russian Revolution; the new Europe; emergence of dictatorships. 215a is not prerequisite to 215b.

217a-217b. CONSTITUTIONAL HISTORY OF THE UNITED STATES. (3-3) Yr. 1956-57. Bateman
Origin and development of the Constitution. P, 2a-2b. 217a is not prerequisite to 217b.

219a-219b. HISTORY OF THE UNITED STATES SINCE THE CIVIL WAR. (3-3) Yr. 1955-56. Bateman
P, 2a-2b. 219a is not prerequisite to 219b.

221. THE LATIN-AMERICAN COLONIES. (2) I. Ewing
Survey of Spanish institutions and culture in discovery, exploitation, and settlement of Latin America; social organization, economic conditions, and the struggle for independence.

222. THE LATIN-AMERICAN REPUBLICS. (2) II. 1956-57. Ewing
Progress toward stability, prosperity, and international recognition; geography and resources; social, political, and financial situation.

223a-223b. LATIN AMERICA AND THE UNITED STATES. (2-2) Yr. 1955-56. Ewing
A survey of inter-American relations from about 1800 to present time. P, 2a-2b or 221 and 222.

224a-224b. CIVIL WAR AND RECONSTRUCTION. (2-2) Yr. 1956-57. Ewing
The causes, military operation, and results of the Civil War. P, 2a-2b.

229. MEXICO AND THE CARIBBEAN AFTER 1819. (2) II. 1955-56. Ewing
A study of internal politics, international relations, and foreign investments.

230a-230b. THE HISTORY OF THE WEST. (3-3) Yr. Ewing
The settlement and development of the West, and its influences upon national and international affairs at each stage; emphasis on the Trans-Mississippi West. 230a is not prerequisite to 230b.

232a-232b. AMERICAN HISTORY, COLONIAL AND REVOLUTIONARY. (3-3) Yr. 1955-56. Beatson
First semester: The early Spanish, French and English Settlements. Growth of the English colonies to the end of the French and Indian War. English Colonial policy.
Second semester: Rise of the movement for independence. Economic and social radicalism under the Articles of Confederation. The movement for a stronger government and the Constitutional Convention. 232a is not prerequisite to 232b.

234a-234b. HISTORY OF THE UNITED STATES, 1789-1850. (3-3) Yr. 1956-57. Beatson
First semester: The Federalist Period; the Virginia Dynasty; Era of Jacksonian Democracy; Clay's American System.
Second semester: The rise of sectionalism; Calhoun, Clay, and Webster; the Mexican War; the Compromise of 1850. 234a is not prerequisite to 234b.

237a-237b. STUDIES IN THE FAR EAST. (2-2) Yr. 1956-57. Hubbard
The early history of India, China, and Japan; the entrance of European powers and the United States into the Far East; the rivalry, diplomatic relations, and the resulting wars incident to western occupation of the Orient. 237a is not prerequisite to 237b.

238a-238b. CENTRAL EUROPE. (2-2) Yr. 1955-56. Wedel
The rise of central European states, the attempt to create a unified state, the conflict among them, the gradual victory of the North, and the results of this victory. 238a is not prerequisite to 238b.

239a-239b. HISTORY OF RUSSIA. (3-3) Yr. Bateman
A survey of Russian history from early times to the present day.

301. STUDIES IN UNITED STATES HISTORY. (2) II. 1956-57. Ewing
Intensive study of some phase of American history. Open to seniors.

302. STUDIES IN LATIN-AMERICAN HISTORY. (2) II. 1955-56. Ewing
Intensive study of some phase of Latin-American history. Alternates with 301.

303. STUDIES IN EUROPEAN HISTORY. (2) I. Staff
Intensive study of some phase of European history. Open to seniors.

311. METHODS OF RESEARCH IN HISTORY AND POLITICAL SCIENCE. (1) I. Staff
The technique and methods of research work. Supplements the seminar. Required of all graduate majors.

312. HISTORIOGRAPHY. (1) II. Wedel
A survey of historical writing; great historians of the past and present. Open to seniors. Required of all graduate majors.

399. SEMINAR. (2-4) I, II. Staff

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

POLITICAL SCIENCE

225a-225b. CURRENT PUBLIC PROBLEMS AND TRENDS, (3-3) Yr. Houghton
A survey of the problems involved in domestic welfare and foreign relations, and their political implications; current and pending efforts to find solutions. P, 6 units from the fields of history, political science, economics, sociology. 225a is not prerequisite to 225b.

235. PUBLIC OPINION. (3) II. Hennessy
The nature of public opinion and its role in the political process; myths and symbols in opinion formation; propaganda, newspapers, radio, motion pictures, and other media of communication. P, 51a.

252. PROBLEMS OF MUNICIPAL MANAGEMENT. (3) I. 1955-56. Kelso
A study of the significance, organization, and processes of management on the municipal level. P, 51a-51b and upper-division standing.

253. GOVERNMENT OF AMERICAN CITIES. (3) I. 1956-57. Kelso
P, 51a-51b.

254. POLITICS IN THE UNITED STATES. (3) I. Hennessy
A study of the nature of politics and of pressure groups and parties, nominations and elections, and the electorate.

255. AMERICAN FOREIGN POLICY. (3) I. Houghton
Analytical history of American policies and practices; recent and current developments and trends.

256. INTERNATIONAL LAW. (3) II. Houghton
Origin and development of international law; recent and current influences and trends. P, 255 or 264.

258. POLITICAL ASPECTS OF LAW ENFORCEMENT AND CRIME CONTROL. (3) II. Houghton
The political science of the problems of law enforcement which challenge our democracy. P, 6 units from the fields of political science, history, sociology, psychology or economics.

264. INTERNATIONAL RELATIONS. (3) I. Houghton
Development of modern international cooperation and international organization; the League of Nations; the United Nations; current challenges and prospects; position of the United States. P, 51a-51b, or Modern European History.

265. PRINCIPLES OF CONSTITUTIONAL LAW. (3) II. 1955-56. Gomez
Judicial interpretation of the national constitution; nature and scope of the powers of Congress and the state legislature; recent and current trends. P, 51a-51b.

271. INTRODUCTION TO PUBLIC ADMINISTRATION. (3) I. Kelso
Development, organization, and functions of the national administrative agencies; merit system of appointment.

275. GOVERNMENTS OF LATIN AMERICA. (3) I. Gomez
The organization, powers, and functions of the major Latin-American governments.

282. PRINCIPLES AND PROBLEMS OF PUBLIC ADMINISTRATION. (3) II. Kelso
Development, organization, and functions of state and county administrative agencies; movement for reorganization; special application to Arizona. P, 51a-51b.

290a-290b. ADVANCED POLITICAL THEORY. (2-2) Yr. 1956-57. Wedel
Evolution of European and American political doctrines, with emphasis upon the forces producing the doctrines. P, 6 units in upper-division history or political science.

292. AMERICAN POLITICAL THOUGHT. (3) II. 1955-56. Gomez
American political ideas from Colonial times to the present. Prerequisite 51a-51b.

304. STUDIES IN STATE AND LOCAL GOVERNMENT. (2) II. Kelso
Intensive study of selected problems of structure, organization, and powers of state and local government; intergovernmental relationships; administrative and personnel management; special application to Arizona. Open to seniors.

306. STUDIES IN AMERICAN NATIONAL GOVERNMENT. (2) I. Houghton
Intensive study of selected aspects of the problems and functions of our national government. Open to seniors and graduate students.

308. STUDIES IN INTERNATIONAL POLITICS. (2) II. Houghton
Intensive study of selected topics in the field of international relations and American foreign policy. Open to seniors and graduate students.

399. SEMINAR. (2-4) I, II. Staff

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

HOME ECONOMICS

Professors Bertha Akin Gregory, M.S., *Head,* Ethel M. Thompson, Ph.D., Mildred R. Jensen, M.S.; Associate Professor Mary A. Wood, M.S.; Assistant Professor Alice Books, M.A.

Graduate work leading to the Master of Science degree with a major in home economics is available in two fields of study: food and nutrition, and family economics. Courses in textiles, clothing and related art, and in family life, which are listed below, also carry graduate credit and may be of interest in the supporting fields.

See page 20 for M.Ed. degree major or minor in this department.

202R. NUTRITION. (2) I. Thompson
Fundamental principles of human nutrition; nutrient requirements and dietary planning. 2R. P, Chem. 60 or 140b.

202L. NUTRITION LABORATORY. (2) I. Wood
Calculation of nutrients in food and preparation of dietaries to meet human requirements. Animal feeding experiments. 6L. P, 1, 202R or CR. Fee, $8.

222. READINGS IN NUTRITION. (2) II. Thompson
Preparation of abstracts and bibliographies of publications in scientific literature. Oral reports. P, 202R.

232. DIET THERAPY. (3) II. Thompson
Adaptation of diet to disease. P, 202R and senior standing.

242. COMMUNITY NUTRITION. (2) I. 1956-57. Thompson
Experience in social agencies leading to improvement of nutritional status in families and institutions. 1R, 3L. P, 202R. Fee, $3.

302. CHEMISTRY AND METABOLISM OF CARBOHYDRATES AND LIPIDS. (3) I. 1955-56. Thompson
The chemistry and metabolism of carbohydrates and lipids with emphasis on recent contributions and interpretations. P, 202R or Chemistry 260 and 261, and Zoölogy 144 or equivalent; 6 units of organic chemistry.

Biochem. 312. ADVANCED METHODS IN NUTRITION. (3) I, II. Nutrition Staff
For course description, see page 206a.

322. LABORATORY METHODS IN NUTRITION. (3) I. 1955-56. Thompson
Dietary surveys; studies in mineral and energy metabolism. 1R, 6L. P, 202R, Chemistry 20 and 60, or 260. Fee, $8; deposit, $2.

TEXTILES, CLOTHING, AND RELATED ART

204. BUYING TEXTILES AND CLOTHING. (3) II. ———
A comparative study of type and quality of ready-to-wear clothing and household textiles. P, 94 and junior standing.

225. HISTORY OF COSTUME. (3) I. ———
Period costumes as an expression of the artistic, social, and historic life of the time. P, History 17a or Introduction to Humanities.

254. RECENT DEVELOPMENTS IN THE TEXTILE FIELD. (3) II. Jensen
Readings, reports, and discussions based on current literature and research in the textile and clothing field, including the social, economic, and psychological phases. P, 204.

255. HISTORY OF FURNITURE. (3) I. 1955-56. Jensen
A study of period furniture from Egyptian through contemporary styles. P, History 17a or Introduction to Humanities.

265. HISTORY OF DECORATIVE TEXTILES, CHINA, GLASS, AND SILVER. (3) I. 1956-57. Jensen
A study of period styles. P, History 17a, Introduction to Humanities, or Art 7a-7b.

294. TEXTILE ANALYSIS. (2) I. 1956-57. Jensen
Physical testing of fabrics for comparison of qualities. For majors in textiles and clothing. 1R, 3L. P, 94. Fee, $3.

FAMILY ECONOMICS AND HOME MANAGEMENT

246. THE CONSUMER AND THE MARKET. (3) I. Gregory
Consideration of the market agencies from the standpoint of advantages and disadvantages to the consumer; consumer buying problems under existing market conditions. Open to men and women. P, Economics 1a.

FAMILY LIFE

237. FAMILY RELATIONSHIPS. (3) II. Gregory
An analysis of the problems of the modern family. Open to upper-division men and women.

327. PROBLEMS IN CHILD DEVELOPMENT. (3) II. 1955-56. Books
Study of child behavior at the pre-school level; review of recent research in the field. Open to men and women. P, 127, Psychology 213.

399. SEMINAR. (1) II. Staff

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

MATHEMATICS

Professors Roy F. Graesser, Ph.D., *Head,* Edwin J. Purcell, Ph.D.; Associate Professor Donald L. Webb, Ph.D.; Assistant Professors Louise C. Lim, Ph.D., Burnett C. Meyer, Ph.D., Deonisie Trifan, Ph.D., Kenneth A. Fowler, Ph.D., Joseph F. Foster, Jr., Ph.D., H D Sprinkle, Ph.D.

Students beginning graduate study with a major in mathematics must have completed a one-year course in calculus and 12 units of more advanced work. Credit for Mathematics 197a and a reading knowledge of French or German are required for the M.S. degree. A thesis is not required.

201a-201b. DIFFERENTIAL EQUATIONS. (3-3) Yr. Staff
201a is offered each semester. P, 79b or 95b.

202a-202b. ADVANCED CALCULUS. (3-3) Yr. 1955-56. Trifan
Vector analysis, partial differentiation, multiple integration, line and surface integrals, infinite series. Designed to be of interest to majors in mathematics, engineering, and physics. P, 79b or 95b.

204a-204b. PROJECTIVE GEOMETRY. (3-3) Yr. 1956-57. Purcell
P, 79b or 95b.

210. THEORY OF NUMBERS. (3) II. 1955-56. Meyer
Divisibility properties of the integers, prime numbers, continued fractions, theory of congruences. P, 79b or 95b.

211. ADVANCED EUCLILEAN GEOMETRY. (3) II. 1956-57. Foster
Recommended for prospective high school teachers. P, 79a or 95a.

225. THEORY OF EQUATIONS. (3) II. 1956-57. Webb
P, 79b or 95b.

240. HISTORY OF MATHEMATICS. (3) II. 1955-56. Graesser
P, 79b or 95b.

280. INTRODUCTION TO ANALYSIS. (3) I. Meyer-Sprinkle
Dedekind cut, limits of sequences and functions, the Riemann integral, infinite series. P, 79b or 95b.

291a-291b. THEORY OF STATISTICS. (3-3) Yr. 1956-57. Graesser
Frequency distributions of one variable and of several variables; theoretical distribution functions; correlation; sampling. P, 79b or 95b.

295a-295b. MATHEMATICAL LOGIC. (3-3) Yr. 1955-56. Sprinkle
In 295a attention is restricted to a particular system to acquaint the student with a formal development of parts of mathematics. Metamathematical notions and some of the work of prominent logicians are discussed in 295b. Designed to be of interest to majors in both mathematics and philosophy. P, 79b or 95b or Phil. 12a.

297a-297b. FOUNDATION AND NATURE OF PURE MATHEMATICS. (3-3) Yr. Fowler-Purcell
P, 79b or 95b, 297b will be offered only in 1955-56 and alternate years.

306. POINT SET TOPOLOGY. (3) II. 1956-57. Fowler
Topological spaces; connectedness; local connectedness; compactness; separation axioms; metric spaces; product spaces; perfectly separable spaces. P, 79b or 95b.

308. TENSOR ANALYSIS. (3) I. 1956-57. Trifan
The algebra and calculus of tensors with applications to algebraic and differential geometry, analytical mechanics, and the mechanics of continuous media. P, 79b or 95b.

321a-321b. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE. (3-3) Yr. 1955-56. Webb
Calculus of complex numbers; elementary functions; conformal mapping; linear fractional transformations; infinite series. P, 202a or equivalent.

322a-322b. THEORY OF FUNCTIONS OF A REAL VARIABLE. (3-3) Yr. 1956-57. Meyer
Point set theory, Lebesgue measure, the Riemann and Lebesgue integrals, the inversion of derivatives. P, 280 or equivalent.

325a-325b. INTRODUCTION TO HIGHER ALGEBRA. (3-3) Yr. 1955-56. Lim
Properties of polynomials; matrices; invariants; topics from abstract algebra. P, 79b or 95b.

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (3 to 6) I, II. Staff

MUSIC

Professors Arthur O. Andersen, D.Mus., *Dean Emeritus,* John B. Crowder, M.A., *Director,* School of Music, Julia M. Rebeil, M.M., Mme. Elenore Altman, Samuel S. Fain, M.A., John H. Bloom, M.A., Andrew W. Buchhauser, M.M., Rollin Pease, A.B.; Associate Professors Anna Mae Sharp, M.M., Henry P. Johnson, Jr., M.M., Jack K. Lee, M.A.; Assistant Professors James R. Anthony, M.A., Edna E. Church, Eugene T. Conley, M.A., Anita Sammarco, M.A., George W. Lotzenhiser, M.M., Marguerite Ough, M.A., Wilbur Peterson, Ed.D.

Graduate work is offered leading to the Master of Music degree with majors in cello, clarinet, composition, organ, piano, theory, trombone, viola, violin, voice, the Master of Music Education degree, and the Master of Arts degree with a major in music.

Master of Music degree requirements with a major in applied music include 12 units of Music 317, with supporting work to include 6 units in music theory and/or music literature and/or music education.

Master of Music degree requirements with a major in composition include Music 410, Original Composition in Large Form, with a maximum credit of 8 units; Music 399; Music 351; 6 units in orchestration, arranging and composition; and 12 units of supporting work satisfactory to the major professor.

Master of Music degree requirements with a major in theory are Music 410, Thesis, maximum of 4 units; Music 400, directed individual study and research, 4 units; Music 399; 8 units of theory electives; and 12 units of supporting work satisfactory to the major professor.

Master of Music Education degree requirements include Music 399 with a professional paper or optional thesis; 6 units selected from Music 375, 376, 377, and 400; and 10 units selected from Music 272, 273ab, 274abc, and 278. Supporting courses include 4 units in applied music; Music 351; 4 units in theory and/or literature; and 4 units in education or academic subjects.

A music major within the Master of Arts degree includes not less than 15 units of music selected from courses in music literature, music theory and composition, applied music, and thesis.

A preliminary comprehensive examination is required before official approval of candidacy for the above degrees.

See page 20 for M.Ed. degree major or minor in this department.

APPLIED MUSIC
(Individual Instruction)

PIANO

217-P. PIANO. (1 to 4) I, II. Rebeil-Staff
Advanced technic; Clementi, Chopin, Liszt etudes; Bach, *Well-Tempered Clavier* or larger works; sonatas or concertos; romantic and modern repertory. P, 8 units of 16-P.

218-P. PIANO. (1 to 4) I, II. Rebeil-Staff
Advanced technic, larger works of Bach; Chopin, Liszt etudes; sonatas, concertos; romantic and modern compositions. Public recital required. P, 8 units of 217-P.

317-P. PIANO. (3 to 6) I, II. Rebeil-Staff
Materials for public performance; master's recital. P, 8 units of 218-P.

ORGAN

217-O. ORGAN. (1 to 4) I, II. Buchhauser
The more difficult of the larger preludes and fugues of Bach; *Chorale Preludes* (Bach); modern compositions; essentials of service playing. P, 8 units of 16-O.

218-O. ORGAN. (1 to 4) I, II. Buchhauser
Trio Sonatas, Passacaglia (Bach); the advanced works of Widor, Franck, Vierne, and Dupre; representative works by contemporary composers. Public recital required. P, 8 units of 117-O.

317-O. ORGAN. (3 to 6) I, II. Buchhauser
Materials for public performance; master's recital. P, 8 units of 118-O.

VOICE

217-V. VOICE. (1 to 4) I, II. Bloom-Staff
French art songs and opera; Hugo Wolf and Richard Strauss; contemporary English and American songs. Junior recital required; 2 foreign language groups; opera or oratorio arias; songs in English. P, 8 units 16-V.

218-V. VOICE. (1 to 4) I, II. Bloom-Staff
Modern German, French, English, and American songs. Spanish and Latin-American songs. Programming and program notes. Public recital required, three foreign language groups, operatic arias, contemporary English and American songs. P, 8 units of 217-V.

317-V. VOICE. (3 to 6) I, II. Bloom-Staff
Materials for public performance; master's recital. P, 8 units of 118-V.

VIOLIN

217-Vn. VIOLIN. (1 to 4) I, II. Sharp
Carl Flesch Scale System. Rode Caprices. Bach Sonatas. Mendelssohn or Bruch Concertos or equivalent. P, 8 units in 16-Vn.

218-Vn. VIOLIN. (1 to 4) I, II. Sharp
Dout Etudes or equivalent. Beethoven Sonatas. Bach unaccompanied sonatas. Concertos by Lalo, Wieniawski, Saint-Saens, or equivalent. Public recital required. P, 8 units of 217-Vn.

317-Vn. VIOLIN. (3 to 6) I, II. Sharp
Materials for public performance; master's recital. P, 8 units in 218-Vn.

VIOLA

(Course descriptions similar to violin)

217-Va. VIOLA. (1 to 4) I, II. Sharp

218-Va. VIOLA. (1 to 4) I, II. Sharp

317-Va. VIOLA. (3 to 6) I, II. Sharp

CELLO

217-C. CELLO. (1 to 4) I, II. Sammarco
Scales and arpeggios through 3 octaves. Technical studies of Cossmann. Scales in thirds. Suites by Bach. Concertos by Goltermann, Saint-Saens, Lalo. Selected repertory. P, 8 units in 16-C.

218-C. CELLO. (1 to 4) I, II. Sammarco
Sonatas by Bach, Sammartini, Brahms. Suites by Bach. Concertos by Boccherini, Dvorak. Advanced solos. Public recital required. P, 8 units in 217-C.

317-C. CELLO. (3 to 6) I, II. Sammarco
Materials for public performance; master's recital. P, 8 units in 218-C.

CLARINET

217-Cl. CLARINET. (1 to 4) I, II. Fain
Solo and symphonic literature. Concertos: Mozart, Weber; Langenus, *Clarinet Cadenzas;* Bonade, *Orchestra Studies.* P, 8 units in 16-Cl.

218-Cl. CLARINET. (1 to 4) I, II. Fain
Advanced solo and symphonic literature. Concertos: Mozart, Sophr; Bonade, *Orchestral Studies;* Cavallini, *Caprices.* Public recital required. P, 8 units in 217-Cl.

317-Cl. CLARINET. (3 to 6) I, II. Fain
Materials for public performance; master's recital. P, 8 units in 218-Cl.

FLUTE

(Course description similar to clarinet)

217-F. FLUTE. (1 to 4) I, II. Fain-Lee

218-F. FLUTE. (1 to 4) I, II. Fain-Lee

OBOE
(Course description similar to clarinet)

217-Ob. OBOE. (1 to 4) I, II. Fain

218-Ob. OBOE. (1 to 4) I, II. Fain

BASSOON
(Course description similar to clarinet)

217-B. BASSOON. (1 to 4) I, II. Fain

218-B. BASSOON. (1 to4) I, II. Fain

SAXOPHONE
(Course description similar to clarinet)

217-S. SAXOPHONE. (1 to 4) I, II. Fain-Lee

218-S. SAXOPHONE. (1 to 4) I, II. Fain-Lee

TRUMPET OR CORNET

217-T. TRUMPET. (1 to 4) I, II. Lotzenhiser

Scale and arpeggio studies. W. Smith, *Top Tones;* Sachse, *Transposition Etudes.* Solos such as Williams, *Sonata for Cornet.* P, 8 units in 16-T.

218-T. TRUMPET. (1 to 4) I, II. Lotzenhiser

Scales and arpeggio studies for velocity. *Band and Orchestral Parts,* Vol. II; Glantz, *48 Studies for Trumpet.* Solos such as Haydn, *Concerto for Trumpet;* Boeck, *Allegro.* Public recital required. P, 8 units in 217-T.

TROMBONE
(Course description similar to trumpet)

217-Tr. TROMBONE. (1 to 4) I, II. Lotzenhiser

218-Tr. TROMBONE. (1 to 4) I, II. Lotzenhiser

317-Tr. TROMBONE. (3 to 6) I, II. Lotzenhiser

FRENCH HORN
(Course description similar to trumpet)

217-Fh. FRENCH HORN. (1 to 4) I, II. Lotzenhiser

218-Fh. FRENCH HORN. (1 to 4) I, II. Lotzenhiser

COURSES IN MUSIC

202. MUSIC OF THE BAROQUE PERIOD. (2) I. 1955-56. Staff

A study of Basso Continuo 1580-1750, opera and oratorio, instrumental forms, keyboard music and performance practices. P, 12 units in music including 1a-1b or 6a-6b.

203. MUSIC OF THE CLASSICAL PERIOD. (2) II. 1955-56. Staff

Music of Haydn, Mozart, and Beethoven with emphasis on its stylistic and structural characteristics. P, 12 units in music including 1a-1b or 6a-6b.

204. MUSIC OF THE ROMANTIC PERIOD. (2) I. 1956-57. Staff

The rise of Romanticism from the late Beethoven Quartets and Sonatas through the symphonies of Bruckner. P, 12 units of music including 1a-1b or 6a-6b.

205. MUSIC OF THE TWENTIETH CENTURY. (2) II. 1956-57. Staff

Styles and trends in contemporary music with emphasis on American composers. P, 12 units in music including 1a-1b or 6a-6b.

231a-231b. FORM AND ANALYSIS. (2-2) Yr. Buchhauser
A course in the technic of harmonic and contrapuntal analysis; a study of formal design and method of structural treatment in representative scores of music from the 17th to the 20th centuries. P, 33b.

232a-232b. COUNTERPOINT I. (2-2) Yr. Buchhauser-Staff
A practical study of the sixteenth-century style of the motet and mass. P, 33b.

233a-233b. ORCHESTRATION I. (2-2) Yr. Buchhauser-Staff
A study of the instruments of the orchestra together with the practical study of the art of symphonic scoring. Original work and transcriptions. P, 33b.

234. MODERN HARMONY. (2) II. 1956-57. Buchhauser
Advanced study of the technic of the modern composer. P, 33b.

237. BAND ARRANGING. (2) II. 1955-56. Lotzenhiser
Detailed study of band instrumentation; major works transcribed for concert band. P, 233a.

238a-238b. COMPOSITION I. (2-2) Yr. Buchhauser-Johnson
Original work in composition, including all the primary forms; theme and variations, sonatina-allegro, simple rondo and suite. P, 231a-231b or CR.

242a-242b. COUNTERPOINT II. (2-2) Yr. Buchhauser-Johnson
A study of the eighteenth-century style of harmonic counterpoint; various types of the chorale-prelude, fugues in two, three, and four voices, passacaglia and chaconne. P, 232a-232b.

243a-243b. ORCHESTRATION II. (2-2) Yr. Buchhauser
Application of orchestration in original work in the larger forms; overture, concerto, symphonic poem, chamber music, symphony, or vocal forms with orchestral accompaniment. P, 233a-233b.

248a-248b. COMPOSITION II. (2-2) Yr. Buchhauser
Intensive work in the larger forms; variation, rondo, and sonata-allegro forms; symphonic forms. 238a-238b.

255a-255b. OPERA WORKSHOP. (1-1) Yr. Bloom-Conley
Training in production and performance of opera.

272. ELEMENTARY SCHOOL MUSIC. (3) I, II. ———
The problems, technics and the observation of teaching music in the elementary grades. P, 31 and Educ. 151.

273a-273b. MUSIC FOR CHILDREN. (2-2) I, II. Peterson-Sammarco
A study of the folk and historic background of materials which deal with the singing, listening and rhythmic activities of the music lesson. 273b will include music material for grades 5-8. 237a not prerequisite to 273b. P, 171 or 272.

274abc. MATERIALS AND PROBLEMS IN THE SCHOOL MUSIC PROGRAM. (2)
P, 171.
274a: Instrumental. II. 1956-57. Lee-Johnson
274b: Choral. II. 1955-56. Bloom
274c: Piano Pedagogy. I. 1956-57. Anthony

278. MARCHING BAND TECHNICS. (2) I. 1955-56. Lee
Technics of drilling a marching band; analysis of materials for field and street maneuvers and actual preparation of shows. P, 33b, 171.

351. ADVANCED CONDUCTING. (2) II. Staff
A study of the style of choral, band and orchestral literature as they pertain to the problems of the conductor. References to the styles of all periods with a special emphasis on the contemporary and modern.

375. COMPARATIVE MUSIC EDUCATION. (2) II. 1956-57. ————
A comparative study of various music courses of study and textbook series for teaching music, the construction of units. P, 171 or 272.

376. MODERN TENDENCIES IN MUSIC EDUCATION. (2) I. ————
Critique on trend in objectives and articulation of current publications and practice in the field. P, 171 or 272, Education 197m.

377. PROBLEMS IN MUSIC SUPERVISION. (2) II. ————
Improvement of instruction through the analysis of supervisory objectives, procedures and evaluation of the music education program. P, 171 or 272, Education 197m.

399. SEMINAR. (2 to 4) I, II. Staff

315. PROBLEMS IN APPLIED MUSIC AND ENSEMBLES. (1) I, II. Staff
For students with graduate standing in music. Participation in ensembles and/or applied music. Special problems dealing with technics and literature. Presentation of a critique paper required of students participating in music ensembles. May be repeated for credit. For fees for individual instruction in applied music.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

PHARMACY

Professors Willis R. Brewer, *Dean,* Albert L. Picchioni, Ph.D.; Joseph A. Zapotocky, Ph.D.; Associate Professor Eugene L. Parrott, Ph.D.; Assistant Professor Kemper W. Merriam, M.B.S.

Special facilities of the Pharmacy College available for graduate study include animal, plant and chemical science laboratories; a manufacturing laboratory; a greenhouse and medicinal plant garden; an animal colony; a distillation and extraction unit; a reading room and numerous mechanical, optical, and electronic instruments for research purposes.

The single major field of study and the only degree granted is the Master of Science given in the field of pharmacy. However, courses are to be selected to provide emphasis in one or more of the following areas of specialization: general pharmacy, pharmaceutical chemistry, pharmacology, and pharmacognosy.

Acceptable minor fields of study may be found in one of two categories: combinations of courses in the areas of pharmacy specialization not undertaken in the major; courses in the related areas of business administration, chemistry, bacteriology, zoölogy, botany, or others.

Graduation with the degree of Bachelor of Science in pharmacy, or its equivalent, with high standing, from a school or college of pharmacy accredited by the American Council on Pharmaceutical Education, is prerequisite to graduate study in the Pharmacy College. Further, the candidate may be required to pass a comprehensive qualifying examination administered by the graduate teaching members of the pharmacy faculty.

207a-207b. ORGANIC PHARMACEUTICAL CHEMISTRY. (3-3) Yr. Zapotocky
A study of relationship between the chemical structure and physiological activity, sources, production methods, properties, reactions, tests, incompatibilities and stability of the organic chemicals used in pharmacy. 3R. P, 100, Chemistry 140b.

221a-221b. GENERAL PHARMACOGNOSY. (4-4) Yr. Brewer-Staff
A study of crude drugs of biological origin and of their active constituents. 3R, 3L. P, 52, Botany 1, Chemistry 140b. Fee, $10 each semester.

231a-231b. GENERAL PHARMACOLOGY. (4-4) Yr. Picchioni
A study of pharmacodynamic actions, therepeutic applications, and toxicology of drugs and poisons. 3R, 3L. P, 207b, 221b, Chemistry 260, Zoölogy 24. Fee, $10 each semester.

315. PHARMACEUTICAL FORMULATIONS. (3) I. 1955-56. Parrott
A study of existing formulas from the physico-chemical viewpoint and the formulation of new pharmaceutical and cosmetic products. Each student develops at least one dosage formula. 2R, 3L. P, 110a or CR. Fee, $10.

318. PHARMACEUTICAL MANUFACTURING. (3) I. 1956-57. Parrott
A study and practice of procedures used in pharmaceutical manufacturing, employing pilot scale equipment and unit operations such as granulation, compression, coating, sterilization, levigation and filtration. Each student is required to develop and manufacture one selected dosage form. 1R, 6L. P, 110a or CR. Fee, $10.

322R. DRUG PLANT PRINCIPLES. (2) II. 1956-57. Brewer
A study of drug plant principles. 2R. P, Chemistry 140b.

322L. DRUG PLANT PRINCIPLES LABORATORY. (2) II. 1956-57. Brewer
6L. P, 322R or CR, Chemistry 140b. Fee, $10.

332. BIOLOGICAL ASSAYS. (4) I. 1956-57. Picchioni
A study of the quantitative standardization of drugs by biological procedures. 2R, 6L. P, 231b or CR. Fee, $10.

340R. ADVANCED PHARMACOLOGY. (2) I. 1955-56. Picchioni
A study of the pharmacological action of drugs on cells, organs, and organisms. 2R. P, 231b.

340L. ADVANCED PHARMACOLOGY LABORATORY. (2) I. 1955-56. Picchioni
Laboratory exercises for 240R. 6L. P, 231b, 340R or CR. Fee, $10.

350. ADVANCED TOXICOLOGY. (4) II. 1955-56. Staff
A study of the action, methods of detoxication, and detection of some of the more potent medicinal agents with special reference to those found in the United States Pharmacopeia, National Formulary, and New and Nonofficial Remedies. 2R, 6L. P, 207b, 221b or CR. Fee, $10.

370R. ADVANCED PHARMACEUTICAL CHEMISTRY—ANTIBACTERIAL AND NEUROTROPIC DRUGS. (2) II. 1955-56. Zapotocky
A study of the isolation, purification, assay, and the chemical structure—physiological activity relationship of compounds affecting specialized tissues. 2R. P, 207b, 231b, or CR.

370L. ADVANCED PHARMACEUTICAL CHEMISTRY LABORATORY. (2) II. 1955-56. Zapotocky
Laboratory exercise for 270R. 6L. P, 207b, 231b, or CR, or 370R, or CR. Fee, $10.

372R. ADVANCED PHARMACEUTICAL CHEMISTRY—STEROIDS, VITAMINS, ANTIBIOTICS. (2) II. 1956-57. Zapotocky
A study of the isolation, purification, assay, and the chemical structure—physiological activity relationship of compounds affecting specialized tissues. 2R. P, 207b, 231b, or CR.

372L. ADVANCED PHARMACEUTICAL CHEMISTRY LABORATORY. (2) II. 1956-57. Zapotocky
Laboratory exercise for 372R. 6L. P, 207b, 231b, or CR; 372R, or CR. Fee, $10.

399. SEMINAR. (1) I, II. Staff
Reviews of current pharmaceutical literature and fields of special interest and research. 1955-56, first semester—pharmacognosy; second semester—general pharmacy. 1956-57, first semester—pharmaceutical chemistry; second semester—pharmacology. Required of all graduate students. Attendance open to anyone interested in the health science by contacting the dean of the Pharmacy College.

400. RESEARCH. (1 to 5) I, II. Staff
Fee, $10.

410. THESIS. (1 to 8) I, II. Staff

PHILOSOPHY AND PSYCHOLOGY

Professors Matthew M. R. Schneck, Ph.D., *Head,* Emil R. Riesen, M.A., Ole A. Simley, Ph.D., Charles F. Wallraff, Ph.D.; Associate Professor Dorothy I. Marquart, Ph.D.; Assistant Professors Robert W. Bretall, Ph.D., Charles A. Barnes, Ph.D.

The Department offers graduate work leading to the degree of Master of Arts.

PHILOSOPHY

Persons seeking admission to graduate work in philosophy must have completed 24 semester hours in addition to Introduction to Philosophy. Graduate work in philosophy revolves around a central core of basic study, including logic, history of philosophy, ethics, esthetics, metaphysics, and epistemology. A minor subject should be selected from the following fields: history, literature, mathematics, physical and biological sciences, psychology, and social sciences.

201a-201b. HISTORY OF PHILOSOPHY. (3-3) Yr. Schneck
The principal European systems of thought; solutions of philosophical problems, their beginnings and development from the Greeks to modern times. P, 6 units of philosophy.

220. PHILOSOPHY OF CONDUCT. (3) I. Bretall
The meaning of moral values and responsibility; a critical study of historical philosophies of life. P, 3 units in philosophy other than 12a-12b.

228. PRINCIPLES OF ESTHETICS. (3) I. Bretall
The nature and value of the arts; principles and media of expression. P, 6 units in philosophy other than 12a-12b, or 6 upper-division units in the history of art. (Identical with Art 228.)

230. AMERICAN PHILOSOPHY. (3) II. 1955-56. Wallraff
The main currents of contemporary American philosophical thought, their developmental history, and relation to social and cultural processes. P, 6 units of upper-division philosophy.

231. METAPHYSICS. (3) I. 1955-56. Wallraff
The nature and function of metaphysical speculation; survey and criticism of recurrent metaphysical systems. P, 6 upper-division units in philosophy.

232. EPISTEMOLOGY. (3) I. 1956-57. Wallraff
Critical examination of the major problems involved in theory of knowledge; study of classical and contemporary viewpoints; relation of theory of knowledge to the other principal divisions of philosophy. P, 6 upper-division units in philosophy.

233. PHILOSOPHIES OF RELIGION. (3) I. 1956-57. Bretall
Critical consideration of prevailing points of view in Occidental religious philosophy. P, 6 upper-division units in philosophy.

234. SOCIAL PHILOSOPHIES. (3) II. 1956-57. Wallraff
Contemporary, social, and political movements in the light of human values involved. P, 6 units in philosophy other than 12a-12b and 228, and 6 units in anthropology, economics, history, political science, or sociology.

235. RELIGION AND CULTURES. (3) II. Bretall
Cultural forms as expressions of religious concern; religion as expression and critique of culture, especially in the Judaeo-Christian tradition. P, Phil. 20 or equivalent, and 1 additional course in philosophy. Open to anthropology majors without prerequisites in philosophy.

335. CONTEMPORARY PHILOSOPHY. (3) II. Bretall
Principal philosophical tendencies in Europe and America since 1866; the relation between philosophical writings and world events. Open to seniors. P, 201a-201b.

399. SEMINAR. (2) I, II. Staff
Subject matter to be determined in consultation with the members of the class. Open to seniors. P, 201a-201b and 3 additional units in philosophy.

400. RESEARCH. (1 to 2) I, II. Staff

410. THESIS. (1 to 4) I, II. Staff

PSYCHOLOGY

Persons seeking admission to graduate work in psychology must have completed 24 semester hours in addition to elementary psychology. Graduate work in psychology revolves around a central core of basic study, including experimental psychology, tests and measurements, statistics, abnormal psychology, and social psychology. The Department does not offer professional work in psychological specialties such as clinical psychology or industrial psychology but does provide graduate study in clinical psychology. A minor subject should be selected from the following fields: sociology, anthropology, personnel, zoölogy, physics, mathematics.

203. PHYSIOLOGICAL PSYCHOLOGY. (3) I. Marquart
Psychological processes and their relation to bodily structures and functions. P, Zoölogy 4a and 4 additional units in biological laboratory science.

210. THE INDIVIDUAL IN THE GROUP. (3) I, II. Schneck-Wallraff
Theory and fact in social psychology. The psychological effects of membership and nonmembership in group situations. (Credit will not be available to any student for both this course and any other course in social psychology.)

211. COMPARATIVE PSYCHOLOGY. (3) I. Simley
Historical and systematic study of animal behavior; animal psychological functions compared with corresponding functions in human beings. 2R, 3L. Fee, $2.

213. DEVELOPMENT OF HUMAN BEHAVIOR—
CHILDHOOD. (3) I. Marquart
The principal changes in human beings from birth to adolescence.

214. DEVELOPMENT OF HUMAN BEHAVIOR—
ADOLESCENCE. (3) II. Marquart
The principal changes in human behavior from the beginnings of adolescence to maturity. Problems of social, vocational and family adjustment.

216. PERSONALITY. (3) II. Barnes
Theories of personality; methods and results of personality study.

217. MOTIVATION. (3) II. 1955-56. Barnes
The functioning of native and acquired drives in behavior.

218. ABNORMAL PSYCHOLOGY. (3) I, II. Simley
Forms of mental deficiency and other deviations. Fee, $3.

225a-225b. CRITICAL REVIEW OF
MAJOR PROBLEMS. (3-3) Yr. Marquart
Theoretical significance and experimental treatment of selected problems. 2R, 3L. Fee, $5 each semester.

250. MENTAL TESTS AND MEASUREMENTS. (3) I, II. Simley-Barnes
Theory, uses, and construction of tests. 2R, 3L. P, Business Administration 255, Education 254, or Mathematics 91 or 291a-291b, or CR in any one of these. Fee, $5.

252. TECHNIQUE AND PRACTICE IN
PSYCHOLOGICAL TESTING. (3) II. 1956-57. Marquart
Training and practice in the clinical administration and interpretation of psychological measurements. 2R, 3L. P, Psychology 250. Fee, $5.

253. GROUP DYNAMICS. (3) II. 1955-56. Mulligan
(Identical with Sociology 253.)

275. HISTORY OF PSYCHOLOGY. (3) II. Wallraff
P, 225a and either 225b or CR.

301. CLINICAL PSYCHOLOGY. (3) I. Barnes
Theory and methods of personality appraisal and clinical diagnosis. P, 218, 250.

302. DIAGNOSTIC TECHNIQUES
IN PSYCHOLOGY. (3) II. 1955-56. Barnes
A study of clinical procedures in the diagnosis and treatment of behavior problems and personality disorders. P, Psychology 301 or CR.

400. RESEARCH. (1 to 2) I, II. Staff

410. THESIS. (1 to 4) I, II. Staff

PHYSICAL EDUCATION FOR MEN

Professors James F. McKale, M.A., *Head,* Fred A. Enke, B.S., Joseph L. Picard, M.S., Warren B. Woodson, B.P.E.; Associate Professors Carl W. Cooper, M.S., Frank T. Gibbings, B.S., Frank Sancet, B.S.; Assistant Professors Charles H. Ott, M.A., Wesley K. Ruff, Ed.D., Robert S. Svob, M.A., Henry R. Stanton, B.A.

Physical education is an acceptable minor subject for the degrees of Master of Education and Master of Arts with a major in education. Courses listed in either department are open to both men and women.

See page 20 for M.Ed. degree major or minor in this department.

282. SUPERVISION AND ADMINISTRATION OF INTRAMURAL SPORTS. (2) II. Svob

The nature of intramural; their organization for units of competition, program content, scoring systems, awards, officiating, physical facilities, purposes, and special administrative problems (open to both men and women).

283. PRINCIPLES AND ADMINISTRATION OF RECREATION PRORGAMS. (3) II. Ruff

Theory and principles of recreation. Organization and administration of tax supported recreation to include: financing, personnel, programming, facilities, public relations and leadership development. P, 6 units of education.

285. MEASUREMENT AND EVALUATION IN HEALTH AND P.E. (2) I. Ruff

Survey of literature and standardized tests. Criteria for determining student progress, techniques and devices for measuring facilities and programs in terms of objectives sought. P, 6 units of physical education and 6 units of education to include Ed. 257.

289. ELEMENTARY SCHOOL PHYSICAL EDUCATION. (2) I. Cooper

Methods of planning, organizing, and directing a modern physical education program in the elementary school. P, 6 units of education and 6 units of physical education.

293. REMEDIAL AND CORRECTIVE PHYSICAL EDUCATION. (3) II. Picard

Theory and practice in the treatment of physical defects and organic disabilities by exercise and other physiotherapeutic modalities. Open to men and women. P, Zoölogy 4a, 8, 57.

297. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION. (3) I. Enke

A study of the administrative problems involving athletic plant facilities and equipment; conduct of interscholastic athletics and tournament competition; maintenance of public relations; the office management and financing of physical education and athletics. Open to men and women. P, 12 units in physical education, 9 units in education, and for graduate credit, teaching experience.

PHYSICAL EDUCATION FOR WOMEN

Professor Marguerite Chesney, M.A., *Head;* Associate Professor Mary Pilgrim, M.S.; Assistant Professors Anne G. Natonek, Elizabeth R. Gatewood, M.A.; Instructors Evelyn L. Jensen, M.S., Marilyn R. Markel, M.S., Ramona Farish, M.A., Mavis K. Wright, M.A., Rita Custeau, M.S.

252. HEALTH PROGRAMS, PROBLEMS, AND APPLIED PHYSIOLOGY. (3) II. Jensen
Social, economic, and educational influences on health; principles and procedures in conducting a health program. The application of human physiology to problems of physical education. Open to men and women. P, Zoölogy 4a, 8.

258. HISTORY AND PRINCIPLES OF PHYSICAL EDUCATION. (3) II. 1956-57. Markel
A study of the progress of physical education from the ancient civilizations to the present time; philosophy, principles and objectives of physical education. Open to men and women.

400. RESEARCH. (2 to 6) I, II. Staff

PHYSICS

Professors Earle H. Warner, Ph.D., *Head,* Leon Blitzer, Ph.D.; Assistant Professors Jay E. Treat, Ph.D., Stewart Becker, Ph.D., John Robson, Ph.D.

The program leading to the master's degree is planned with each student after a consideration of his needs and interests. Prerequisites for admission to full graduate standing are 24 semester hours of undergraduate work in physics completed with acceptable scholarship and providing adequately for advanced study in this field.

Research opportunities are available in spectroscopy, nuclear magnetic resonance, paramagnetic resonance, cosmic rays, electronics, the collection of solar energy, and atmospheric physics. For work in spectroscopy a large Bausch and Lomb Litrow-type spectrograph is available. A microwave spectrograph is now under construction which offers opportunities for research.

See page 20 for M.Ed. degree major or minor in this department.

205L. THERMODYNAMICS AND THEORY OF HEAT LAB. (1) II. 1955-56. Warner
P, completion of or CR in 205R.

205R. THERMODYNAMICS AND THEORY OF HEAT. (3) II. 1955-56. Warner
Laws of thermodynamics; radiation; kinetic theory of gases; heat measurements. P, 2b or 10b, Mathematics 95b, Chemistry 1b or 2b or 5. Fee, $4.

206L. GEOMETRICAL AND PHYSICAL OPTICS. (1) I. 1955-56. Becker-Robson
P, completion of or CR in 206R.

206R. GEOMETRICAL AND PHYSICAL OPTICS. (3) I. 1955-56. Becker-Robson
Fermat's principle; cardinal points; aberrations of optical systems; wave motion, interference, diffraction; polarization; double refraction. P, 2b or 10b, Mathematics 95b. Fee, $4.

210a-210b. ELECTRICAL MEASUREMENTS AND ELECTRONICS. (3-3) Yr. 1956-57. Becker

Galvanometer theory, calibration of electrical instruments, bridges, cathode ray oscilloscope, electron ballistics, multi-element vacuum tubes, rectifiers, amplifiers, wave shaping circuits, counters, thyratrons, transistors. 2R, 3L. P, 2b or 10b and Math. 95b. Fee, $5 per semester. 210a is not prerequisite to 210b. (Credit not allowed in both 210a and 260.)

211a-211b. ELECTRICITY AND MAGNETISM. (3-3) Yr. Becker-Treat

An introduction to the theory of electricity, magnetism, and electromagnetic phenomena. Maxwell's equations developed in first semester. P, 10b, Mathematics 95b.

213a-213b. THEORETICAL MECHANICS. (3-3) Yr. 1956-57. Robson

A study of the laws of motion; statics and dynamics of particles and rigid bodies; theory of oscillation; Hamilton's principle. P, 10b, Mathematics 95b.

218a-218b. MODERN PHYSICS. (3-3) Yr. Becker-Robson

Introductory course in modern physics; emphasis on current developments in atomic physics. P, 2b or 10b, Mathematics 95b, Chemistry 1b or 2b or 5. 218a is not prerequisite to 218b.

219. INTRODUCTION TO GEOPHYSICAL PROSPECTING. (3) I. Kassander

A survey of the application of the methods of physics to the location of petroleum or mineral deposits: seismograph, gravimeter, magnetometer, electrical and radioactivity measuring devices. P, Physics 2b or 10b. (Identical with Geology 219 and Mining 219.)

220. ATOMIC, MOLECULAR, AND X-RAY SPECTRA. (2) I. Blitzer

The theory of spectra; applications to physics, chemistry, astronomy, and metallurgy. P, 2b or 10b, Mathematics 95b.

250. ADVANCED LABORATORY. (1) I, II. Becker-Treat

Advanced experiments in various fields of physics including atomic, nuclear, cosmic rays, electronics, spectra, and in experiments and shop techniques. May be repeated for credit. 3L. P, 10b, Mathematics 95b; open only to seniors majoring in physics and graduate students.

260. THEORY OF MEASUREMENTS. (2) II. Becker

Theory of measurements, galvanometer theory, types of electrical instruments, standards, calibration of electrical instruments, bridges, industrial instrumentation. 2R or 1R, 3L. P, E.E. 222, 153, Math. 201a. Fee, $4. (Credit not allowed in both Phys. 260 and 210a. Will not be given 1955-56 but will be given yearly thereafter.)

270. SOLID STATE PHYSICS. (3) II. 1956-57. Robson

A description of the microscopic properties of matter in the solid state in terms of molecular, atomic and electronic theory. Emphasis on current research in the field of semi-conductor physics. P, 211a or 213b.

300. INTRODUCTION TO THE THEORY OF RELATIVITY. (2) II. 1955-56. Blitzer

The special theory of the relativity of motion in free space; applications to mechanical and electro-magnetic problems; introductory to tensor calculus. P, 218b and either 211b or 213b.

301. NUCLEAR PHYSICS. (3) I. 1955-56. Robson

Experimental evidence supporting current theories of the nucleus. Applications to engineering and industry. P, 218b and either 211b or 213b.

305. QUANTUM MECHANICS. (3) II. 1956-57. Blitzer
Introduction to the principles of quantum mechanics; Schrodinger's equation and the idea of quantum states; principle of indeterminacy; applications to spectroscopy and atomic structure. P, 218b and either 211b or 213b.

306a-306b. ELECTROMAGNETIC THEORY. (3-3) 1955-56. Treat
Theory of electromagnetic waves, their production, their properties in vacuum and their interaction with matter; emphasis on microwaves. P, 211b, Mathematics 95b.

307a-307b. INTRODUCTION TO THEORETICAL PHYSICS. (4-4) Yr. Blitzer
The laws of motion as developed by Newton, Hamilton, Lagrange, and d'Alembert: hydrodynamics of perfect fluids; statistical mechanics. P, 211b or 213b.

308. THEORY OF ELECTRON TUBES. (3) I. Becker
Electron emission, electron ballistics, electron optics, multi-element tubes, cathode ray tubes, klystrons, magnetrons, photoelectricity. 3R. P, 210b or 211a, Math. 201a.

400. RESEARCH. (1 to 4) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

ROMANCE LANGUAGES

Professors John Brooks, Ph.D., *Head,* Sidney B. Brown, Ph.D.; Associate Professor Mario B. Rodriguez, Ph.D.; Assistant Professors Frances Eberling, M.A., Loyal Gryting, Ph.D., Robert M. Hammond, Ph.D., John P. Wonder, Ph.D.; Instructor Arthur H. Beattie, Ph.D.

FRENCH

For admission to graduate work the student must satisfy the Department as to his ability to do work at the graduate level. For students studying for the degree of Master of Arts there are opportunities in French literature and French civilization. Supporting work may be taken in a closely related field or in education. The candidate must have completed a minimum of 24 semester hours of French at the undergraduate level exclusive of the elementary course.

Students will be encouraged to register for independent study at the graduate level with members of the faculty in whose special field they are interested. To qualify for the degree of Master of Arts, the candidate must submit a thesis and pass both a written and an oral examination covering all graduate work.

See page 20 for M.Ed. degree major or minor in this department.

201a-201b. SURVEY OF FRENCH LITERATURE. (3-3) Yr. ———
A comprehensive view of French literature from the earliest times to the end of the eighteenth century. Stress on seventeenth century. P, 3b. 201a is not prerequisite to 201b.

202a-202b. FRENCH CIVILIZATION. (2-2) Yr. 1956-57. Beattie
Historical, social, economic, literary, and artistic elements in the development of the French nation. Conducted in French. 202a is not prerequisite to 202b. P, 3b.

203a-203b. FRENCH LITERARY CRITICISM. (2-2) Yr. 1956-57. ———
An historical study of the ideas, methods of literary critics, and their influence on literature and thought from the Renaissance to modern times. Conducted in French. 203a is not a prerequisite to 203b.

205a-205b. NINETEENTH-CENTURY AND CONTEMPORARY FRENCH NOVEL. (2-2) Yr. Brown
The novel of the Romantic, Realist, and Naturalists schools. Reaction against Naturalism; modern trends. Conducted in French. P, 201a-201b or CR. 205a is not prerequisite to 205b.

207. NINETEENTH-CENTURY AND CONTEMPORARY FRENCH POETRY. (2) I. 1956-57. Brown
Poetry of the Romantic, Parnassians, and Symbolists; later poets. Conducted in French. P, 201a-201b or CR.

208. NINETEENTH-CENTURY AND CONTEMPORARY FRENCH DRAMA. (2) II. Brown
Romantic, Realistic, Naturalistic, Social and Poetic drama; modern trends. Conducted in French. P, 201a-201b or CR.

209. VOLTAIRE. (2) I. 1955-56. _____
The life and times of Voltaire. Readings in French from representative works. P, 3b.

210. ROUSSEAU. (2) II. 1955-56. _____
The life and times of Rousseau. Readings in French from representative works. P, 3b.

399. SEMINAR. (3) I, II. Staff
The topics for the seminar will be chosen from the following:
17th Century ..... Gryting
18th Century ..... Hammond
19th or 20th Century ..... Brown

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

SPANISH

The Department offers courses which will lead to the Master of Arts degree in Spanish. The prerequisite for admission is a minimum of 16 acceptable units in upper-division Spanish or the equivalent. Candidates will consult with the head of the Department about the courses which are to be taken. A minimum of 30 units is required for the degree, including 6 units for a thesis. It is possible to minor in some other subject with the permission of the head of the Department. A written examination covering the field will be given, in addition to the oral examination.

See page 20 for M.Ed. degree major or minor in this department.

211a-211b. SPANISH LITERATURE OF THE NINETEENTH CENTURY. (3-3) Yr. Eberling
Conducted in Spanish. 211a is not prerequisite to 211b.

213a-213b. SPANISH LITERATURE OF THE TWENTIETH CENTURY. (3-3) Yr. Wonder
Conducted in Spanish. 213a is not prerequisite to 213b.

215a-215b. LITERATURE OF THE GOLDEN AGE. (3-3) Yr. 1956-57. Brooks
Conducted in Spanish. 215a is not prerequisite to 215b.

216a-216b. SPANISH AMERICAN LITERATURE. (3-3) Yr. 1955-56. Rodriguez
Conducted in Spanish. 216a is not prerequisite to 216b.

217a-217b. HISPANIC AMERICAN CIVILIZATION. (3-3) Yr. Rodriguez
217a is not prerequisite to 217b.

295. ADVANCED GRAMMAR. (2) II. 1956-57. Wonder

399. SEMINAR. (2) I, II. Staff

400. RESEARCH. (1 to 3) I, II. Staff

410. THESIS. (6) I, II. Staff

SECRETARIAL STUDIES

Assistant Professors Herbert J. Langen, M.A., *Head,* Florence W. Toland, M.S.

272. OFFICE MANAGEMENT AND CONTROL. (3) II. Langen
Office management from the supervisory point of view. Analysis of functions of various office departments, their organization and management. Development and use of office manuals; selection, training, pay and promotion of office employees; controlling office expenses and measuring office efficiency; quality and quantity production standards. P, 9 hours of secretarial studies or business administration courses.

280. ADVANCED SECRETARIAL TRAINING. (3) I. Toland
Emphasis on actual secretarial duties in routine office procedure. Required of all majors in secretarial training. P, 174b or ability to take dictation at 100 words per minute for five minutes. Fee, $5.

SOCIOLOGY

Professors Frederick A. Conrad, Ph.D., *Head,* Edward H. Spicer, Ph.D.; Associate Professors Donald S. Klaiss, Ph.D., Raymond A. Mulligan, Ph.D.; Instructor Joseph R. Hambenne, M.A.

The Department of Sociology offers graduate work leading to the Master of Arts degree. The prerequisite for admission is graduation from an approved college or university with a major in sociology or a concentration in sociology and closely related subjects. A minimum of 20 units in sociology and 10 units in psychology or anthropology may be offered in lieu of an undergraduate major in sociology.

Course requirements for a graduate major in sociology follow the usual plan for the degree. Certain courses in advanced theory and a course in statistics may be required if the student's background is deficient in these subjects or if they are deemed essential to the program of study.

A limited number of pre-professional courses in social work may be included in the major, but the Department does not offer graduate work leading to a professional degree in social work.

210. THE INDIVIDUAL IN THE GROUP. (3) I, II. Schneck-Wallraff
(Identical with Psychology 110.)

220. MINORITY PEOPLES OF THE UNITED STATES. (3) I. Spicer
(Identical with Anthropology 220.)

240. CHILD WELFARE PROBLEMS. (2) I. Mulligan
Extent, causes, and treatment of child welfare problems in the field of social work; child welfare agencies and services. P, 81 and either 138 or 6 additional units of sociology or psychology.

241. JUVENILE DELINQUENCY. (2) II. Mulligan
Extent, causes, and control of juvenile delinquency. P, 81 and either 287 or Psychology 15.

252. SOCIAL STRATIFICATION. (3) II. 1956-57. Mulligan
Theories and character of status systems. Theories of, and research in, social structure, social differentiation, relations between social stratification and social institutions. Some emphasis on sociometric methods. P, 6 units of sociology.

253. GROUP DYNAMICS. (3) II. 1955-56. Mulligan
Analysis of factors and processes of social groups. Deals with such problems as group leadership, group effectiveness, group goals, communication within groups and their individual members. P, 6 units of Sociology or Soc. 81 and Psych. 1b. (Identical with Psych. 253.)

281. PRINCIPLES OF SOCIOLOGY. (3) I. Conrad
Analysis of the nature and structure of society; types of groups and associations; their functions, organization, and control; examination of theories of human nature and the social order. P, 81 and either 84 or 282.

282. SOCIAL ORGANIZATION. (3) II. Hambenne
Theories and problems of social organization and social control. Analysis of social change and disorganizations as they relate to individuals, groups, and communities. P, 81, 84, Psychology 15.

283a-283b. SOCIAL EVOLUTION AND PROGRESS. (2-2) Yr. Conrad
Analysis of factors and processes of social change; theories of social evolution and progress. P, 81 and senior standing.

285. SOCIOLOGY OF THE FAMILY. (3) II. 1956-57. Klaiss
Analysis of the modern family and its institutions in their social and historic setting. P, 81 and either 281 or Psychology 15.

287. CRIMINOLOGY. (3) I. Hambenne
Nature and causes of crime; theories of punishment and correction; administration of penal and reformatory institutions. P, 81 and either 84 or Psychology 1b.

289. POPULATION PROBLEMS. (3) II. 1955-56. Klaiss
Analysis of population; its composition, distribution, growth, migration; emphasis on population of the United States. P, 81 and 84 or Economics 1b or 2b.

293. RURAL AND URBAN COMMUNITIES. (3) II. 1955-56. Conrad
Trends in rural-urban populations; comparisons of rural and urban modes and standards of living; analysis of typical institutions and their problems growing out of changes in rural-urban relations and community organization. P, 6 units of sociology or Soc. 81 and Econ. 1b.

294. SOCIAL INVESTIGATION. (2) I, II. Conrad
Methods of locating, classifying, and evaluating data, and writing a report on the findings. P, major and senior standing.

295. SOCIAL ECOLOGY. (3) II. 1956-57. Conrad
Factors influencing the spatial distribution of populations and institutions; processes such as concentration, dispersal, succession, and dominance as they affect the ecological organization of cities, metropolitan areas and regions. P, 6 units of sociology.

303. CULTURAL CONTACT AND CHANGE. (3) II. 1955-56. Spicer
(Identical with Anthropology 303.)

315. HISTORY OF SOCIAL THOUGHT. (3) I. 1956-57. Conrad
Analysis of social theories from the Greeks to the close of the 19th century with emphasis on the relation of social thought to the social forces of the time. Special emphasis on the development of concepts and views which paved the way for contemporary sociology. Open to seniors.

316. CONTEMPORARY SOCIOLOGICAL THEORIES. (3) II. 1956-57. Hambenne
A review of the development of sociological theories and of the sociological movement since 1900. Open to seniors.

400. RESEARCH. (2 to 4) I, II. Staff

410. THESIS. (4) I, II. Staff

SPANISH
(See ROMANCE LANGUAGES)

SPEECH

Professors Klonda Lynn, Ph.D., *Head,* W. Arthur Cable, Ph.D.; Alethea S. Mattingly, Ph.D.; Assistant Professor George F. Sparks, Ph.D.; Instructor James D. Lambert, Ph.D.

The graduate major in speech at the University of Arizona is limited to the area of speech correction and is designed to qualify students for positions as speech clinicians, or as laboratory technicians in audiometry and voice science. Ample opportunities are available for research and for clinical training. The speech laboratory is equipped with standard apparatus for recording and analyzing speech and hearing. The speech clinic is equipped with consultation and practice rooms. A large number of adults are regularly under corrective treatment, and there is an opportunity to gain additional experience in the Crippled Childrens Clinic and the Cerebral Palsy Foundation of Tucson. Candidates for the master's degree will have completed 200 clock hours of supervised clinical experience prior to the granting of the degree.

Persons seeking admission to graduate work in speech correction must present the bachelor's degree with a major in speech or an area of concentration in speech and psychology or education representing a minimum of 24 units, 15 of which must be in speech.

The department also provides a suitable minor for various majors for the master's degree; for example, education, English, or psychology.

211. DRAMA IN THE HIGH SCHOOL. (3) II. Burroughs
(Identical with Drama 211.)

245. ADVANCED ORAL INTERPRETATION. (3) II. Mattingly
History and trends of platform reading; aesthetic criteria, analytical study of literary forms, emphasizing their differentiation for oral presentation; preparation and presentation for public recital. P, 5 or 267, 36 and 137a or 137b or CR.

260. VOICE SCIENCE. (3) I. Lambert
Vocal Anatomy; the physical characteristics of speech sounds; and the psycho-physical processes involved in hearing.

267. ENGLISH PHONETICS. (3) I. Lynn
A scientific study of the structure of English speech, laws and principles determining the facts of pronunciation.

269. SPEECH CORRECTION. (3) II. Lynn
A survey of the field of speech correction and of the common defects of speech; methods of detection and general principal of retaining. Open to teachers.

270. SPEECH PATHOLOGY. (3) I. Lambert
A study of the types, causes, and symptoms of speech disorders. P, 269.

272. APPLIED PHONETICS. (3) II. 1955-56. Lynn
Analysis and methods of correcting dialectal forms used by children of foreign-language background. Emphasis on Spanish-American usage. Designed to aid elementary and high-school teachers in working with bilingual children. P, 267.

277a-277b. CLINICAL TECHNIQUES IN SPEECH AND HEARING DISORDERS. (1 to 2) Yr. Lynn-Cable-Lambert
P, 269. 277a is not a prerequisite to 277b.

278. AUDIOLOGY. (3) I. Lambert
Description of normal audition; structure and functioning of the hearing mechanism; causes and types of hearing loss and their effects on the individual and his speech. P, 269.

279. AUDIOMETRY. (3) II. Lambert
The principles and techniques of auditory testing, and the interpretation of hearing tests. P, 269, 278. 2R, 3L.

300. INSTRUCTION TO GRADUATE STUDY IN SPEECH. (2) I. Staff
A survey and study of problems relating to graduate research, including bibliographies, methods of research, and experimental design. Required of all graduate majors in Speech.

369. ADVANCED STUDY OF SPEECH AND HEARING DISORDERS. (3) II. Lambert
Critical study of experimental research dealing with the etiology and diagnosis of speech and hearing disorders and related remedial procedures. P, 269.

371. PSYCHOLOGICAL DISORDERS OF SPEECH. (3) I. Cable
Psychogenic speech disorders, including stuttering and aphasia; symptoms, etiology, diagnosis, and therapy. P, Psychology 1a-1b, 218, Speech 269, 270.

372. ORGANIC DISORDERS OF SPEECH. (3) II. Lambert
Etiology, diagnosis, therapy, and prognosis of those speech disorders arising from organic pathologies such as cerebral palsy, cleft palate, and laryngeal anomalies. P, 269, 270, or equivalent.

400. RESEARCH. (1 to 3) I, II. Staff

410. THESIS. (2 to 4) I, II. Staff

ZOOLOGY

Professors George T. Caldwell, Ph.D., *Head,* William H. Brown, Ph.D., Albert R. Mead, Ph.D.; Associate Professor Lyle K. Sowls, Ph.D., *Leader,* Arizona Co-operative Wildlife Research Unit; Assistant Professors Joe T. Marshall, Ph.D., E. Lendell Cockrum, Ph.D., Charles H. Lowe, Ph.D., Helen Micklewright, Ph.D.; Instructor Charles R. Hungerford, M.S.

The campus of the University is situated in southern Arizona in the heart of the Sonoran Desert at an elevation of 2,400 feet. For field problems in zoölogy, there is no other area in the country which offers a greater array than in Arizona where there are many isolated mountain ranges with desert to alpine habitats containing essentially unexplored, unique faunas. The proximity of northwestern Mexico and the Gulf of California makes almost unlimited the research opportunities in both

vertebrate and invertebrate zoölogy. Thus, within a short range, marine, fresh water, and terrestrial environments are available for study.

The zoölogical acquisitions in the University Library are the most extensive in the state and reflect years of careful procurement. In addition to the American journals many current foreign journals are received. The Library is a depository for United States Government documents and the publications of the Carnegie Institution. The Bibliographical Center for Research, Rocky Mountain Region, of which the Library is a member, provides inter-library loans and other indispensable services to research in this area.

The vertebrate collections of the Department contain many thousands of specimens which are available to advanced students for study and research in ichthyology, herpetology, ornithology, and mammalogy. These collections are continually expanding through research activities emphasizing the distinctive fauna of the Southwest. Research in the Department includes studies in physiology, morphology, ecology, and taxonomy of the invertebrates and vertebrates. Special emphasis is placed upon problems relating to the Southwest.

See page 20 for M.Ed. degree major or minor in this department.

THE CO-OPERATIVE WILDLIFE RESEARCH UNIT. Through the co-operation of the University of Arizona, the Arizona Game and Fish Commission, the U. S. Fish and Wildlife Service, and the Wildlife Management Institute, there has been established within the Department of Zoölogy a Co-operative Wildlife Research Unit. The unit offers fellowships in Wildlife Management and financial assistance to students majoring in related fields and doing wildlife research.

Graduate Record Examination scores are required of applicants for admission. There are no foreign language requirements for the Master of Science degree in zoölogy and wildlife management.

Before a student can be admitted to graduate standing with a major in zoölogy, he must have completed at least the equivalent to the undergraduate major in zoölogy, viz., 32 units of zoölogy, including a year of general zoölogy (or its equivalent), comparative anatomy and histology; 16 of these units must be upper-division.

For the degree of Master of Science with a major in wildlife management, an applicant must have completed basic required courses in botany, chemistry, mathematics, and zoölogy. For more specific information inquiry should be directed to the Leader of the Co-operative Wildlife Research Unit.

212. HEREDITY. (2) I. Brown
The principles of inheritance and their relation to biological problems. P, 4a, 4 additional units in biological science, and junior standing.

214. HUMAN GENETICS. (2) I. Marshall
Mendel's laws and population genetics applied to man. P, 8 units in biology, psychology or sociology and junior standing.

215. EVOLUTION. (2) II. Brown
History, theories, and mechanics of evolution. P, 212 or 214 and junior standing in zoölogy, anthropology, botany, geology, or sociology.

225. HISTORY OF BIOLOGY. (2) II. Marshall
The great writings in botany, medicine and zoölogy. P, junior standing in a biological science or in psychology.

233. ICHTHYOLOGY AND HERPETOLOGY. (4) II. Lowe
Classification and distribution, ecology, behavior, and evolution of the fishes, amphibians, and reptiles. 2R, 6L or field work. P, 4b. Fee, $8.

234. ORNITHOLOGY. (4) II. Marshall
The natural history of birds and its bearing upon the problems of animal behavior, distribution, and evolution. 2R, 2L, 4-hour field trip. P, 4b. Fee, $8.

235. MAMMALOGY. (4) I. Cockrum
Classification, distribution, life history, ecology, and evolution of mammals with emphasis on Southwestern species. 2R, 6L or field work. P, 4b or 4a and junior standing in range management. Fee, $8.

238. GENERAL ECOLOGY. (4) I. Lowe
Interrelations of organisms and their environment, ecological concepts and principles, physical and biotic factors affecting the evolution, behavior, and patterns of distribution of organisms; analysis of plants, invertebrates, and veretebrates. 2R, 6L or field work. P, 4b or 4a and junior standing in botany, entomology, or range management. Fee, $8.

241. ZOOGEOGRAPHY. (2) II. Cockrum
Principles and concepts concerning the great regional patterns of distribution of the animals of the world, both past and present. 2R. P, 4a and junior standing.

243. MAMMALIAN PHYSIOLOGY. (4) I. Caldwell
Physiology of the supporting and motor tissues, the nervous system, and the special senses. 3R, 3L. P, 8 or 45, Chemistry 1b or 2b or 5, and junior standing. Fee, $6.

244. MAMMALIAN PHYSIOLOGY. (4) II. Caldwell
Physiology of circulation, respiration, digestion, absorption, and excretion. 3R, 3L. P, Chem. 40 or 140a. May not be taken for graduate credit by zoölogy majors.

246. ANIMAL HISTOLOGY. (4) II. Brown
Microscopic anatomy of animal tissues and the technique involved in their preparation. May not be taken for graduate credit by zoölogy majors. 2R, 6L. P, 8 or 45. Fee, $8.

247. VERTEBRATE EMBRYOLOGY. (4) II. Caldwell
Development of the veretebrate embryo, with emphasis on organogenesis. 2R, 6L. P, 45. Fee, $7.

249. PARASITOLOGY. (4) I. Mead
The biology, distribution, symptomatology, pathology, epidemology, diagnosis, treatment, and control of parasites of man and domestic animals, with emphasis on the evolution of parasitism and host-parasite relationships. 2R, 6L. P, 16 units in zoölogy or bacteriology. Fee, $7.

250. TECHNIQUES OF BIOLOGICAL LITERATURE AND NOMENCLATURE. (2) II. Mead
A critical study of the biologically important works of reference; development of techniques for finding and assembling complete information relative to any biological subject; selecting the scientific problem; preparation and illustration of the scientific report for publication, advanced degrees, or oral presentation; examination of publication procedure; taxonomy and biological nomenclature. P, junior standing in a biological science.

260. WILDLIFE MANAGEMENT. (4) I. Hungerford
The behavior and structure of wildlife populations; habitats and wildlife communities; the effects of climate and land-use on plant and animal communities. 3R, 3L, or field trip. P, 10 and one field course in zoölogy, botany, or range management. Fee, $7.

265. WILDLIFE MANAGEMENT TECHNIQUES. (4) II. Hungerford
Presentation of the techniques used in present day wildlife management and research by professional workers. 3R, 3L or field trip. P, 260. Fee, $7.

302. CELLULAR PHYSIOLOGY. (3) II.

Physiology at the cellular level. Includes consideration of the general functions of the cell membrane, nucleus and cytoplasm, and other activities peculiar to the functional economy of the single cell. 2R, 3L. P, 24 or 243 or Botany 103. Chemistry 140a-b. Fee, $6.

305. SPECIATION. (2) II. Lowe

The mechanisms of evolution in the formation of races and species of animals and plants; mutation, selection, effective population size, genetic drift, gene exchange, reproductive association, isolating mechanism, ploidy, and apomixis; the concepts of karyotype, ecotype, race, species, environment and genetic system. 2R. P, 212, or 214, or 215.

399. SEMINAR. (1) I, II.

Review of current literature with assigned topics, reports and discussions. Open to qualified seniors.

(a) Seminar in Zoölogy. Staff
(b) Seminar in Wildlife Management. Sowls

400. RESEARCH. (2 to 8) I, II. Staff

410. THESIS. (2 to 8) I, II. Staff

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