



In illo tēpore. Miss⁹
est angelus gabriel
a deo ī ciuitatē galilee cui
nomen nazareth ad virgi
nē despōsatā viro cui no
mē erat ioseph de domo
dauīd: & nomē n virginis
maria. Et ingressus ange
lus ad eam dixit. Ave gra
tia plena dñs tecum: bene
dicta tu ī mulierib⁹. Que
cū audisset turbata est in
sermone eius: & cogitabat

qualis esset ista salutatio. Et ait angelus ei. Ne ti
meas maria inuenisti enim grām apud deū. Ec
ce concipies in vtero & paries filium: & vocabis
nomē eius iesum. Hic erit magnus & filius altis
simi vocabit⁹. Et dabit illi dñs deus sedē dauīd
p̄ris ei⁹: & regnabit in domo iacob in eternum:
& regni ei⁹ nō erit finis. Dixit autē maria ad an
gelū. Quō fiet istud qm̄ virū nō cognosco? Et
r̄ndens angelus dixit ei. Spūsc̄tūs supueniet in
te: & virt⁹ altissimi obūbrabit tibi. Ideoq; & qđ
nasce⁹ ex te sc̄tū vocabit⁹ filius dei. Et ecce eliza
beth cognata tua: & ipsa concepit filium in sene
ctute tua. Et hic mensis est sext⁹ illi que vocat⁹
sterilis: quia non erit impossibile apud deū oē
verbū. Dixit autē maria. Ecce ācilla domini fiat
michi secundum verbum tuum. Deo gratias.

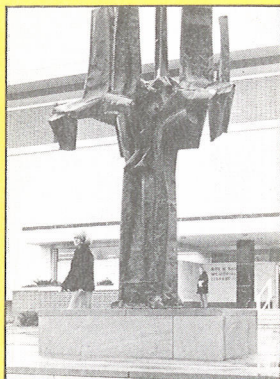
In initium sancti euangelij: secundum
Matheum. Gloria tibi domine.

JANUARY 1968

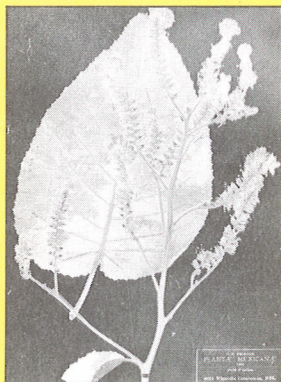
Bulletin of The University of Vermont
THE GRADUATE COLLEGE



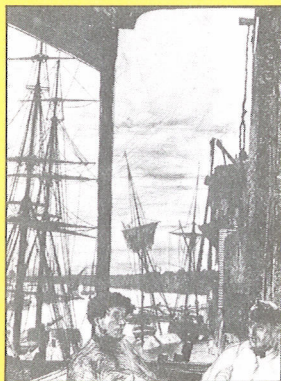
OUR FRONT AND BACK COVERS REPRODUCE PAGES FROM A 16TH CENTURY ILLUMINATED BOOK OF HOURS FROM THE SPECIAL COLLECTIONS OF THE UNIVERSITY'S BAILEY MEMORIAL LIBRARY.



WHEN TRUSTEES OF THE UNIVERSITY WISHED A CONTEMPORARY WORK FOR THE ENTRANCE TO THE LIBRARY, THEY TURNED TO VERMONT SCULPTOR PAUL ASCHENBACH, A MEMBER OF THE ART FACULTY, WHO PRODUCED THE BRONZE SHOWN HERE.



THOUGH OCCUPYING MODEST QUARTERS, THE UNIVERSITY'S PRINGLE HERBARIUM COLLECTION IS KNOWN INTERNATIONALLY. IT IS NAMED TO HONOR A SELF-TAUGHT VERMONTER WHO LEFT THE UNIVERSITY IN THE MID 19TH CENTURY FOR FINANCIAL REASONS, BUT WENT ON TO A CAREER WHICH EARNED HIM THE TITLE OF "PRINCE OF BOTANICAL COLLECTORS."



THE UNIVERSITY'S FLEMING MUSEUM PROVIDES THE RESOURCES OF A FINE, SMALL ART MUSEUM FOR TEACHING, RESEARCH AND SERVICE PROGRAMS. IT OFFERS A WIDE RANGE OF EXHIBITS FROM ITS OWN AND VISITING COLLECTIONS. SHOWN HERE IS AN ETCHING, "ROTHERHITE," BY THE AMERICAN-ENGLISH ARTIST, JAMES MCNEIL WHISTLER.

GRADUATE COLLEGE

THE UNIVERSITY OF VERMONT

CATALOGUE 1967-1968

ANNOUNCEMENTS 1968-1969

BULLETIN OF THE UNIVERSITY OF VERMONT

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Correspondence:

All correspondence concerning applications and admission to the Graduate College should be addressed to the Office of the Graduate College.

Requests for transcripts of work done at The University of Vermont should be addressed to the Registrar.

Requests for the Summer Session Bulletin and other information regarding Summer Session offerings should be addressed to the Director of the Summer Session.

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Academic Calendar

- SPRING SEMESTER 1968

January 16	Registration
January 17	Classes begin
February 16-17	Kake Walk Recess
March 1	Deadline for applications for Graduate Fellowships and Traineeships for 1968-69
March 18-22	Enrollment
March 25-31	Spring recess
April 1	Classes resume
April 1-5	Enrollment
April 8	Deadline for submission of doctoral theses
April 29	Deadline for submission of masters' theses
May 6-14	Course examinations
May 13	Deadline for oral defenses of theses
May 19	Commencement; academic year terminates

- SUMMER SESSION 1968

June 24-August 16	Eight-Week Session
July 8-August 16	Six-Week Session

- FALL SEMESTER 1968

September 3	Registration
September 4	Classes begin
October 28-	
November 8	Enrollment
November 28-30	Thanksgiving Recess
December 11-19	Course examinations

- SPRING SEMESTER 1969

January 14	Registration
January 15	Classes begin
February 14-15	Kake Walk Recess
March 1	Deadline for applications for Graduate Fellowships and Traineeships 1969-70
March 17-21	Enrollment
March 24-31	Spring recess
March 31	Classes resume
April 7	Deadline for submission of doctoral theses
March 31-April 4	Enrollment
April 29	Deadline for submission of masters' theses
May 5-13	Course examinations
May 12	Deadline for oral defenses of theses
May 18	Commencement; academic year terminates

The University of Vermont

• ABOUT THE GRADUATE COLLEGE

The Graduate College of the University of Vermont administers all advanced degree programs except the program leading to the degree of Doctor of Medicine. As such, it serves the need of college graduates who desire a broader and more thorough knowledge of the scholarship and research in a particular field.

Many academic departments of the University have a long history of providing formal graduate study. The first master's degree was awarded in 1875. For many years graduate degree programs were under the direction of a University Committee on Graduate Study. The Graduate College was formally established with a full-time dean in 1952. Since that time it has served to provide graduate study opportunities in academic fields in which the University resources have made sound programs possible.

The Graduate College is the fastest growing college in the University of Vermont. In 1953, following its formal establishment by the trustees, 46 master's degrees were awarded. In 1967, 85 master's degrees and 8 Doctor of Philosophy degrees were awarded. The Graduate College currently enrolls over 500 students pursuing advanced degrees with about 150 pursuing the Doctorate. Scholarships, fellowships, assistantships, and special loan programs are available in increasing numbers and value for students who have achieved a good academic record in their undergraduate and graduate programs. With the rapidly expanding facilities, library holdings and laboratories, combined with its reasonable size, the Graduate College of the University of Vermont offers unique programs of high quality graduate study.

• ABOUT THE UNIVERSITY OF VERMONT

The University was founded in 1791, taking its place among the handful of colleges founded in this country in the eighteenth century for the higher education of young colonials and Americans of the first post-revolutionary generation. The University was the fifth New England college chartered, the second established by a state to grant the bachelor's degree, and the twentieth in the nation to do so.

Though it has enjoyed a long tradition which has seen it receive substantial private support, University development has been closely identified with that of the State since 1791, when Vermont's founding General Assembly granted a charter to the University and set aside about 29,000 acres throughout the State with the intent that rents from this land would support the new educational institution.

That same Vermont General Assembly established that the by-laws of the University should give no preference to any religious sect or denomination or discriminate against any, making the University of Vermont the first in this country and possibly the first in history to go on public record as supporting freedom of religion upon its campus.

The University consists of the College of Arts and Sciences, the College of Agriculture and Home Economics, the College of Technology, the College of Education and Nursing, the College of Medicine, the Graduate College, and the two-year School of Dental Hygiene.

The present physical plant is valued at more than \$45,000,000, a major share made possible through the interest and support of alumni and private philanthropy.

The University Libraries The combined holdings of the University's Guy W. Bailey and Medical College Library amount to over 426,000 volumes, including subscriptions to more than 4,000 journals.

Bailey Library, in addition to its general collections, is a depository for United States Documents, a partial depository for Canadian Government publications, a subscriber to U.N. Documents, and to many UNESCO publications. It also subscribes, currently, to some 3,000 journals and a variety of domestic and foreign newspapers. In its Reference Collection are the major encyclopedias, indexing and abstracting services, foreign language dictionaries, and an expanding variety of special and general bibliographies, biographical dictionaries, handbooks, and other reference resources. In its Special Collections Department, the Wilbur Collection is strong in manuscripts, early imprints, and books dealing with Vermont culture and history. Wilbur materials include letters and papers of Dorothy Canfield Fisher, John Spargo, and Warren Austin. The private library of George P. Marsh, about 12,000 volumes, enriches Bailey Library for students in the Humanities as does the Howard-Hawkins Civil War material, and the Whittingham-Stevens collection of Chiswick imprints.

The University's Medical College Library has a collection of over

30,000 volumes and subscribes to 1,000 medical journals. It is a convenient on-campus supplement to Bailey Library's scientific materials, and in 1968 will occupy new, enlarged facilities.

The Robert Hull Fleming Museum The Museum, an integral part of the University's teaching program, provides an educational service to the University and the people of Vermont. The permanent collection is arranged to augment the University's teaching in varied fields. Particular galleries are devoted to ancient, medieval, and renaissance art; baroque and modern painting and sculpture; American art; primitive art; and the Orient. Two galleries are devoted to changing exhibitions. Museum activities also include lectures, gallery talks and a film series.

The Computation Center The Computation Center of the University of Vermont was organized in 1960 to provide computing facilities for the campus community. The Center services the computation needs of the varied research projects on campus; its facilities are also used as an integral part of several graduate and undergraduate courses.

Present equipment includes three separate IBM computer systems; a 1620 computer, a 1401 computer, and a 1130 computer. An IBM System 360-30 computer will be installed in December 1967. This new computer will greatly increase the Center's ability to perform service function.

The staff of the Computation Center is available at all times to anyone who requires assistance with the use of the machines, or the programming of them. A large up-to-date program library is maintained by the Center for use by University personnel.

The George Bishop Lane Artists Series The George Bishop Lane Artists Series is one of the largest collegiate artists series in the country. It was inaugurated in 1955 by a gift of over \$300,000 from the late Mrs. Lane, in honor of her husband, George Bishop Lane of the Class of 1883.

The Lane Series makes it possible for the University to bring annually to the campus and the community a continuing program of some 30 outstanding musical, theatrical, dance and other artistic productions for a moderate admission fee. The Series is planned and produced by a student-faculty committee, with townspeople serving with student and faculty members on an advisory committee.

In past years the Lane Series has brought to the campus such attractions as the Royal Philharmonic Orchestra of London, Van Cliburn, Joan

THE UNIVERSITY OF VERMONT

Baez, The Royal Ballet, Artur Rubenstein, Harry Belafonte, Moscow Philharmonic Orchestra with David Oistrakh, Philadelphia Orchestra and Rudolph Serkin. The 1967-68 Series includes the Czech Philharmonic Orchestra, Ravi Shankar, Ella Fitzgerald, Marcel Marceau, Hal Holbrook in "Mark Twain Tonight," Danny Kaye, Cesare Siepi, Maurice Chevalier, Gina Bachauer, and the National Ballet.

The Placement Service To assist graduates in exploring and selecting among various employment possibilities, the University and the College operates an extensive Placement Program. Under the aegis of the University Placement Service, a large number of representatives of business organizations, governmental agencies, and school systems come to the campus each year to interview for full time positions. Related services include individual career counseling, the preparation of confidential credentials, and teacher placement.

The Physical Education Facilities The University's extensive physical education plant is available for recreation by faculty, staff and students during hours not devoted to specific instruction. Swimming, handball, skating, tennis, squash and many other individual and group activities are available for interested participants.

• ABOUT BURLINGTON

The University and the people of the Burlington area have long enjoyed cordial relations dating from 1800 when Burlington citizens voluntarily subscribed the necessary funds to provide Vermont's first institution of higher learning with its first building.

With a population of about 40,000, Burlington is Vermont's largest city. The greater Burlington area of approximately 80,000 inhabitants is divided between pleasant suburbs and picturesque farm and woodland. Burlington enjoys magnificent views of Lake Champlain and the Adirondack Mountains to the west and Vermont's Green Mountains to the east. Easily available outdoor activities include swimming, boating, hiking, climbing and skiing.

Some 200 miles northwest of Boston, 300 miles north of New York City and about 100 miles south of Montreal, Burlington is served by Mohawk and Northeast Airlines and Vermont Transit and Greyhound Bus Lines. The expanding Vermont interstate highway system increasingly shortens automotive travel time.

Degree Programs Offered

The Graduate College offers sixty different programs leading to the Master's degree and ten programs leading to the degree of Doctor of Philosophy.

• **MASTER OF ARTS**

Programs are offered in the following fields:

Economics	Latin
English	Mathematics
French	Music
German	Philosophy
Greek	Political Science
History	Psychology
	Spanish

• **MASTER OF SCIENCE**

Programs are offered in the following fields:

Agricultural Biochemistry	Home Economics
Agricultural Economics	Mechanical Engineering
Anatomy	Medical Microbiology
Animal and Dairy Science	Medical Technology
Animal Pathology	Microbiology
Biochemistry	Pathology
Biomedical Engineering	Pharmacology
Botany	Physics
Chemistry	Physiology and Biophysics
Civil Engineering	Plant and Soil Science
Electrical Biophysics	Poultry Science
Electrical Engineering	Speech Pathology
Forestry	Zoology
Geology	

DEGREE PROGRAMS OFFERED

• *MASTER OF ARTS IN TEACHING*

This degree is appropriate for teachers who are interested primarily in increasing their knowledge of their subject matter fields and thereby the effectiveness of their classroom instruction. Programs are offered in the following fields:

Agriculture
Botany
Chemistry
English
French
Geology
German
Greek

History
Home Economics
Latin
Mathematics
Music
Physics
Spanish
Zoology

• *MASTER OF EDUCATION*

Programs are designed to prepare qualified candidates for school positions in guidance, supervision, administration, and reading, or to give classroom teachers a more complete understanding of professional education as applied to teaching and to membership in the profession. Programs are planned on an individual basis and may include courses in areas outside professional education.

• *MASTER OF BUSINESS ADMINISTRATION*

Study leading to the degree of Master of Business Administration is designed to provide opportunity for the individual to develop knowledge and understanding in a wide range of business activities that will provide foundation for growth and success in a business career. Programs are planned on an individual basis.

• *MASTER OF EXTENSION EDUCATION*

This degree is designed to meet the needs of county agricultural agents, home demonstration agents, 4-H Club agents, extension specialists, professional cooperative and agricultural business leaders.

• *DOCTOR OF PHILOSOPHY*

Programs are offered in the following fields:

Biochemistry	Pharmacology
Botany	Physics
Chemistry	Physiology and Biophysics
Electrical Engineering	Psychology
Microbiology	Zoology

Fifth Year Certificate in Education

A special fifth year program culminating in a certificate of advanced study is offered by the Department of Education for students who wish to work beyond the bachelor's degree. It is especially designed to meet the needs of teachers who are developing new teaching fields, for advanced students who are meeting requirements for state certification, and for experienced teachers who desire flexibility in choice of courses at both graduate and undergraduate levels. Information about the certificate program may be obtained by contacting the Dean of the College of Education and Nursing.

Regulations of the Graduate College

• ADMISSION

To be eligible for admission a student should hold a baccalaureate degree, prior to the date of first enrollment, or have completed work equivalent to that required for a baccalaureate. His undergraduate records should indicate a capacity for successful study at the graduate level. Graduates of unaccredited institutions must support their applications with satisfactory aptitude and advanced scores on the Graduate Record Examinations. Foreign students, see special instructions on p. 13.

Admission is limited to students who intend to become candidates for advanced degrees, other than Doctor of Medicine, and students whose enrollment will consist of courses to be taken for graduate credit. Students who hold bachelors' degrees but whose entire enrollment will be in undergraduate courses should seek admission as non-matriculated students in the appropriate undergraduate college.

Only applicants who desire to work along lines in which the University offers graduate programs will be admitted to the Graduate College. Students in the Graduate College therefore fall into three categories: (1) duly admitted students accepted to candidacy, (2) degree candidates at other institutions who study at The University of Vermont for transfer of credit, (3) duly admitted students not yet accepted to candidacy.

Students seeking admission to the Graduate College to pursue an advanced degree must make application on an official form which can be obtained from the Office of the Graduate College. All applications must be supported by official transcripts from each college or university attended and by three letters of recommendation from persons qualified to assess the applicant's capacity for graduate work. For submission of necessary test scores, see Aptitude and Achievement Tests, p. 13. *All applications for admission must be accompanied by a \$10.00 application fee.*

The deadline for applications for admission in the fall semester is May 15. It is not always possible to admit additional students at mid-year in all departments. Such applications should be initiated well in advance of the date study is to begin. Students who wish to be con-

sidered for fellowships as well as admission should complete the appropriate section on the application form. Such applications, with supporting materials, must be filed by March 1, of the academic year preceding that for which the application is made.

Admission to the Graduate College does not mean that a student is automatically accepted as a candidate for an advanced degree.

Foreign Students Applications from students who are citizens of the United Kingdom, Australia, New Zealand and Canada will be accepted directly. Foreign students currently studying in the United States may apply directly but must submit evidence of proficiency in English.

Foreign students should apply through the following international agencies:

Africa	The African-American Institute 866 United Nations Plaza New York, New York 10017
Middle East	American Friends of the Middle East, Inc. Middle East House 1607 New Hampshire Avenue, N.W. Washington, D. C. 20009
Korea	The American-Korean Foundation, Inc. 345 East 46 Street New York, New York 10017
Europe, South America, and South East Asia	Institute of International Education 809 United Nations Plaza New York, New York 10017

Foreign applicants must be highly qualified, and present evidence of independent financial support for their first year (approximately \$3,500 U.S.). Applicants should submit Graduate Record Examination scores. In the case of non-English speaking countries, applicants should submit scores of the Graduate Record Examination or Test of English as a Foreign Language. Information on these examinations may be obtained from the Educational Testing Service, Box 592, Princeton, New Jersey 08540.

Aptitude and Achievement Tests Applicants for admission to graduate programs in some departments must submit scores on the Graduate Record Examination and the Miller Analogies Test (see under department).

Information on the Miller Analogies Test may be obtained from the Testing Office, University of Vermont, or from any college testing office.

REGULATIONS OF THE GRADUATE COLLEGE

Information on the Graduate Record Examination may be obtained from the Testing Office or directly from the Educational Testing Service, Box 592, Princeton, New Jersey, 08540.

Arrangements for taking the Writing Proficiency Test, required of applicants for the Master of Education degree program, should be made with the Dean's Office, College of Education and Nursing.

All applicants requesting fellowship support must submit scores on the Graduate Record Examination.

Deposit A deposit of \$35 is required of each applicant upon notification of admission into the Graduate College. The deposit will cover the advanced degree fee of \$35 (cf. p. 26, Fees). Any residue from this deposit will be returned to the student upon withdrawal from his graduate degree program.

Health Record A satisfactory health record must be submitted by students after being accepted for a degree program by the Graduate College and prior to enrollment.

Credentials submitted by the student, such as transcripts and letters of recommendation, become the property of the Graduate College and may not be returned.

• ENROLLMENT

Every student is required to enroll and register at the time and in the manner designated by the Registrar. All charges for the ensuing semester must be paid, or otherwise provided for, before registration is completed.

Changes in Enrollment Any changes in enrollment must be approved by the student's advisor and authorized by the Dean of the Graduate College. A student may add a course only during the first week of classes; he may drop a course without academic penalty only during the first three weeks of classes.

Completion of Thesis A student who has completed all credits required in his degree program, but is in residence for the purpose of completing his thesis, should enroll for "Completion of Thesis" (cf. p. 26, Fees).

Withdrawal If it is necessary for a student to withdraw from his enrollment he must request permission at that time from the Dean of the Graduate College in writing, stating the reason for his withdrawal.

Auditing Courses With the approval of the Dean and the instructor concerned, a student paying full tuition may audit courses without charge. Auditors have no claim on the time or service of the instructor and no entry will be made on the permanent record. Under no circumstances will credit be allowed for courses audited.

Summer and Evening Study Information regarding graduate course offerings may be obtained from the Office of Continuing Education. Enrollment in such courses for graduate credit does not imply admission to the Graduate College.

Dismissal A graduate student whose work or deportment is deemed unsatisfactory at any time may be requested by the Dean or the department concerned to withdraw from the Graduate College.

• GENERAL REQUIREMENTS

Each student is expected to be familiar with the general requirements and procedures of the Graduate College and with the specific degree requirements in his chosen field of study.

Acceptance to Candidacy Applicants for the master's degree may be accepted to candidacy concurrent with admission, or candidacy may be deferred pending a period of satisfactory graduate study at the University of Vermont. Acceptance to candidacy for the master's degree is granted only to those students who have fully met all undergraduate prerequisites for the courses that are required in his graduate degree program. The approval of the department and the Dean is required.

Candidacy for the doctoral degree requires a full year of graduate study in residence at The University of Vermont. A doctoral student is accepted to candidacy upon the approval of the student's Studies Committee, the department or departments concerned, and the Dean.

Minimum Residence Requirements Each candidate for the master's degree must satisfactorily complete at least twenty-two hours of graduate credit while in residence on The University of Vermont campus, either in the regular academic year or in summer sessions, or at the off-campus centers established at Lyndon and Castleton. Each candidate for the doctoral degree must satisfactorily complete a minimum of fifty hours in residence at The University of Vermont. Each doctoral candidate must spend one full year on The University of Vermont Campus and be available for and participate in departmental functions such as seminars and research within the department.

Teaching Requirement Each degree candidate must acquire appropriate teaching experience in his chosen field prior to the award of his degree. The nature and the amount of this teaching, for which no academic credit is allowed by the Graduate College, will be determined by the department concerned.

Language Requirements The language requirement is completed by satisfactory performance on the Educational Testing Service's Foreign Language Examinations. These are offered at least twice a year on the campus. There is no charge for the first examination; if this is not passed, the fee for subsequent examinations in the same language is borne by the student.

If the appropriate language is not available through the ETS, an examination may be requested by the student's department and administered in conjunction with the appropriate language department.

Grade Requirements Letter grades are used to indicate levels of performance in courses as follows: A, excellent; B, good; C, fair; F, failure. Designations of S, satisfactory and U, unsatisfactory are used to indicate levels of performance for credits received in Thesis Research and may be used to indicate levels of performance in Seminar.

A candidate for a graduate degree must complete his program with a minimum overall quality point average of 3.0. For the purpose of determining a quality point average, 4 points are allowed for each credit hour of A, 3 points for each credit hour of B, 2 points for each credit hour of C, and 0 points for each credit hour of F. A course may be repeated for credit only when failed and only once. Only the second grade is then considered.

A student may be dismissed from the Graduate College if he receives more than two grades below a B, if he receives a grade of F in more than one course, or if he receives the designation of U in Thesis Research or Seminar.

The designation "Inc" is used to indicate that the work of the course is incomplete for a reason approved by the Dean and must be completed within a specified time.

Maximum Time Limits A program leading to the master's degree must be completed within a span of three years if it is pursued on a full-time basis during the regular academic year; if the program is pursued on a part-time basis or in summer sessions, it must be completed within a span of seven years. A doctoral program must be completed within a span of nine years. This time limit applies both to study at The University of Vermont and to courses presented for transfer of credit. Individual departments may set deadlines within these time limits.

Withdrawal from Degree Program Students should notify the Graduate College in writing of their withdrawal from a degree program.

If a student does not register at the University of Vermont for course work or thesis research for a period of two years and does not notify his department or the Graduate College in writing, he will be considered to have withdrawn from his degree program and his deposit forfeited.

Transfer of Credit A maximum of eight hours credit in the case of master's candidates and twenty-five hours in the case of doctoral candi-

REGULATIONS OF THE GRADUATE COLLEGE

dates may be accepted in transfer for appropriate courses completed in residence in other institutions. Such courses must have been taken in a fully accredited college or university which offers graduate study and must be acceptable at that institution in partial fulfillment of its requirements for an advanced degree. Credit cannot be transferred for (1) courses which would not, if taken at The University of Vermont, receive graduate credit, (2) courses in which a grade lower than 80 (B-) was received, (3) extension courses, (4) correspondence courses, (5) courses which are inappropriate for inclusion in any degree program offered by the Graduate College, (6) courses which were taken more than seven years prior to the completion of a degree program, (7) thesis credits received at another university. No transfer of credit is possible prior to a student's acceptance to candidacy.

Extension Courses Not more than eight semester hours of credit toward the master's degree may be earned by taking extension courses offered by The University of Vermont. A maximum of three hours of graduate credit per semester is permissible for master's candidates who are full-time teachers in public schools. No credit for extension courses is allowable in a doctoral program.

Conferring of Degrees Degrees are conferred only at Commencement at the end of the academic year. If a student has completed all the requirements for a degree, he will be issued a letter certifying that he has completed his graduate degree program and that the degree will be conferred at the next Commencement. A candidate must be present at the Commencement unless he has been excused in advance by the Dean.

• REQUIREMENTS FOR MASTER'S DEGREE

All master's degree programs require a minimum of thirty semester hours of graduate credit. In programs that require a thesis, the number of credit hours to be earned in thesis research may vary between six (minimum) and fifteen (maximum); these credits are included in the minimum of thirty required for the degree.

MASTER OF ARTS AND MASTER OF SCIENCE

Field of Specialization At least twenty hours of graduate credit, including credit for the thesis and research leading to the thesis, must be earned in the field of specialization. All course credits included in these twenty hours must have been earned in courses which are numbered above 200.

Related Study A graduate program may include advanced courses outside the field of specialization. In order to be included as part of the master's program, these courses must be approved in advance by the department in which the student is specializing.

Studies Committee A Studies Committee will be appointed by the Department Chairman for each candidate for the master's degree. It shall be the responsibility of this committee to supervise the student's program and review his progress at regular intervals.

Language Requirement Certain departments require a reading knowledge of an appropriate foreign language. The method for satisfying the language requirement is described on page 16.

Research and Thesis Each candidate will undertake a problem of original research under the direction of a member of the department in which he is specializing. At the conclusion of the investigation the student must present a thesis which embodies the results of his work and which demonstrates his capability for independent research.

In order to be eligible for an advanced degree in a particular academic year, a master's candidate must submit the required copies of his thesis no later than *three* weeks before Commencement. However each department may stipulate an earlier deadline.

The thesis must be prepared and submitted in compliance with the detailed instruction sheet which is obtained in the Office of the Graduate College.

Examinations

- a. A written comprehensive examination (two hour minimum) in the field of specialization.
- b. An oral examination (one hour minimum) in defense of the thesis.

Success in the written examination is prerequisite to taking the oral examination. One re-examination only is permitted for any final comprehensive examination.

Copies of the thesis must be forwarded to the Dean of the Graduate College after the successful defense of thesis.

MASTER OF ARTS IN TEACHING

The program leading to the degree of Master of Arts in Teaching is designed primarily for teachers with the purpose of enhancing their teaching ability and strengthening their background in their subject matter field.

A minimum of thirty semester hours is required in courses numbered above 200, of which not less than six semester hours shall be in Education taken at The University of Vermont. No thesis is allowable in this degree program; a student must complete at least twenty hours, and usually twenty-four, in a single department offering courses for graduate credit or in any acceptable combination of such departments. In order to be accepted to candidacy for this degree, a student must have completed an undergraduate major within the area of his specialization, have submitted satisfactory scores on the Miller Analogies Test, and be acceptable to the department or departments concerned.

In his undergraduate program, a candidate is expected to have completed the necessary courses in education to meet minimum requirements for a teaching certificate. If candidates have not qualified for teaching certification, they cannot expect to complete the degree in one academic year. To qualify for the degree of Master of Arts in Teaching, the candidate must present at least eighteen semester hours in education in his combined undergraduate and graduate program. This requirement is specified to ensure that the degree recipient can meet minimum state certification requirements.

Examinations

- a. A written comprehensive examination (two hour minimum) in the field of Education.

- b. A written comprehensive examination (two hour minimum) or a comprehensive oral examination (one hour minimum) in the field of specialization. The choice between written and oral examination is to be determined by the department after consultation with the candidate. All examinations are taken on the University campus in Burlington.

One re-examination only is permitted for any final comprehensive examination.

MASTER OF EDUCATION

Before acceptance to candidacy for the degree of Master of Education, the student must present a satisfactory score in the Miller Analogies Test, and must demonstrate satisfactory proficiency in written composition. Before the degree is awarded, the candidate must have completed one year of successful teaching experience or other educational service.

The graduate program of each student admitted to candidacy for the degree of Master of Education is planned and supervised by an individual committee, which includes *ex-officio* the Deans of the Graduate College and the College of Education. Program planning takes into consideration the student's undergraduate curriculum, his professional experience, and his aims and purposes in pursuing the master's degree. Each program must include either thirty semester hours of approved course work or twenty-four hours earned in courses and six hours in thesis research. If a student's preparation is inadequate for him to begin study at the graduate level in certain aspects of his program, additional undergraduate courses will be required.

In order to insure effective planning of a graduate program for the degree of Master of Education, not more than twelve hours credit (fourteen if the maximum eight hours of transfer credit is offered) will be accepted in partial fulfillment of degree requirements for courses taken prior to acceptance to candidacy. A prospective candidate should therefore make application for acceptance to candidacy before his first semester of residence, or, if he has been a student in Summer Session, prior to his second summer in residence. Candidates must expect to earn on The University of Vermont campus a part of the credit to be applied to a graduate degree. In most cases candidates who are in residence during the regular academic year must also attend one or two summer sessions in order to have a suitable selection of available courses.

REGULATIONS OF THE GRADUATE COLLEGE

Examinations

- a. A written comprehensive examination (three hour minimum) in the field of Education.
- b. A comprehensive oral examination (one hour minimum) in the field of Education.

Success in the written examination is prerequisite to taking the oral examination. One re-examination only is permitted for any final comprehensive examination.

MASTER OF BUSINESS ADMINISTRATION

A minimum of thirty semester hours is required in courses numbered above 200. Specific course requirements include economics 207, 228, 252, and 289, a total of twelve hours. An additional twelve hours (4 courses) of approved electives plus six hours of thesis credit comprise the minimum of thirty credits. The twelve hours of elective credit provides the candidate with the opportunity of concentrating his study in an appropriate field.

Each candidate will pursue a thesis research topic consistent with his area of concentration and overall educational objective. At the conclusion of the research the student must present a thesis which embodies the results of his work and demonstrates his capability.

The thesis must be prepared and submitted in compliance with the detailed instruction sheet which is obtained in the Office of the Graduate College.

Examinations

- a. A written comprehensive examination (two hour minimum) with emphasis in the field of specialization.
- b. An oral examination in defense of the thesis.

Normally the comprehensive examination is written upon completion of all course work for the degree. Success in the written comprehensive is a prerequisite to taking the oral examination. One re-examination only is permitted for any final comprehensive examination.

Copies of the thesis must be forwarded to the Dean of the Graduate College after the successful defense of thesis.

Information on the M.B.A. evening program may be found in the University of Vermont Evening Division Catalogue.

After April 1, 1968, not more than six credit hours of graduate work completed prior to the date of becoming a candidate for the M.B.A. will be applied toward the degree requirements.

MASTER OF EXTENSION EDUCATION

A minimum of thirty hours is required in courses numbered above 200. Nine semester hours are required as follows: Political Science 241, Philosophy 214, Economics 204 (courses equivalent to Political Science 241 and Economics 204 may be substituted); a minimum of twelve semester hours of course credit in Agriculture and/or Home Economics or related basic courses; and a minimum of six semester hours of course credit in Agricultural Education, Extension Education, and/or Home Economics Education.

The candidate must have completed one year of successful professional experience before the degree is granted.

The candidate is at liberty to select the manner in which he or she will complete the requirements for the degree from the alternatives of: (1) a combination of three-week and six week summer sessions, (2) a combination of summer session and extension course offerings in the State, (3) full-time residence on the campus, and (4) a combination of one term of residence and summer sessions.

Examinations

- a. A written comprehensive examination (two hour minimum) in the technical and social science areas.
- b. A comprehensive oral examination (one hour minimum) in the field of specialization.

Success in the written examination is prerequisite to taking the oral examination. One re-examination only is permitted for any final comprehensive examination.

• *REQUIREMENTS FOR DEGREE OF DOCTOR OF PHILOSOPHY*

The degree of Doctor of Philosophy requires of candidates a minimum of seventy-five credit hours to be earned in courses and in thesis research.

Studies Committee Upon admission to the Graduate College, the prospective candidate for the Ph.D. degree will be assigned an interdepartmental Studies Committee by the Dean. This committee will meet at least once a semester with the candidate to advise him and to help plan his program of study. All courses taken in the program must be approved by this committee, the department chairman concerned, and the Dean of the Graduate College.

Courses At least forty hours must be earned in courses and seminars. The first year of each doctoral program consists almost entirely of required courses; in the following years appropriate courses are selected by the Studies Committee in consultation with the candidate. Details of each program can be obtained from the appropriate department chairman or from the Dean.

Language Requirements In order to satisfy the language requirements, each candidate must be able to comprehend the literature of his field in at least two foreign languages appropriate to his field in addition to English, or demonstrate fluent command (ability to read, write and converse) of one foreign language appropriate to his field in addition to English. The choice of the language is to be determined by the candidate's department. The method for satisfying the language requirements is described on page 16. The language requirements must be completed before the written comprehensive examination is taken.

Research and Thesis Each candidate, while in residence at The University of Vermont, must complete an acceptable original research project which contributes new knowledge or techniques in his academic field. Each candidate must enroll in a minimum of twenty credits of thesis research.

In order to be eligible for an advanced degree in a particular academic year, a doctoral candidate must submit the required copies of his thesis no later than *six* weeks before Commencement. However, each department may stipulate an earlier deadline.

The thesis must be prepared and submitted in compliance with the detailed instruction sheet which is obtained in the Office of the Graduate College.

Thesis Examining Committee Upon submission of the completed thesis, the Dean of the Graduate College will appoint a Thesis Committee for the oral examination of the candidate. The Committee shall consist of the Dean, the members of the Studies Committee, and at least two other faculty members nominated by the chairman of the department concerned. The acceptability of the thesis will be determined by the Thesis Examining Committee.

Examinations

- (a) A comprehensive written examination in the field of study must be passed by the candidate at least six months before the thesis is submitted. This examination will be prepared by the department concerned, in consultation with the candidate's Studies Committee. One re-examination only will be permitted.
- (b) An oral examination, in which the candidate will be expected to defend his thesis, will be scheduled no sooner than one month after the thesis has been submitted to the department. One re-examination only will be permitted.

Copies of the thesis must be forwarded to the Dean of the Graduate College after the successful defense of thesis.

Student Expenses

Application Fee All applications for admission must be accompanied by a \$10.00 application fee. This is non-refundable.

Deposit A deposit of \$35 is required of each student upon notification of his admission into the Graduate College (cf. p. 14, *Admission*). A student who is admitted in order to register in July or September, who later decides not to enter the College, will receive a refund of \$15 if the Dean is so notified prior to May 1; if admission is for January, the deadline is December 1. Any residue from this deposit will be returned to the student upon withdrawal from a degree program.

Tuition Rates for the academic year 1968-69 will be as follows: For Vermont residents, \$25 per credit hour, with a semester maximum of \$300.

For nonresidents of Vermont, \$75 per credit hour, with a semester maximum of \$900.

The lower rates for Vermont residents are made possible by a subvention to the University from the State of Vermont.

Completion of Thesis Fee A fee of \$25 per semester is charged each graduate student who has already paid tuition for all credits required in his degree program but who is in residence for the purpose of completing his thesis.

Library Fee A fee of \$15 per semester is required of each student enrolled in twelve credit hours or more; a fee of \$7.50 per semester is required of each student enrolled for less than twelve credit hours, but more than three credit hours.

Athletic Fee A fee of \$15 per semester is required of each student enrolled in twelve credit hours or more. Payment of the Athletic Fee gives each student the privilege of using the facilities in the University gymnasium and provides admission to intercollegiate home games.

Penalty Payment Failure to complete financial arrangements and registration by specified dates will result in a penalty of \$10.00.

Advanced Degree Fee A fee of \$35, payable during the semester prior to graduation, is charged each degree candidate. This fee includes the

STUDENT EXPENSES

cost of thesis binding and the academic hood. It is normally covered by the deposit.

Living Expenses At present there is no university housing for graduate students. The Housing Office, in the Military Science Building, maintains listings of available off-campus rental facilities. Students visiting the Housing Office may refer to these listings; no information from them is given by mail. Rents in the Burlington area vary widely, from \$11.00 per week for a single furnished room to \$120.00 per month for a furnished, two-bedroom apartment. A single student should expect overall living expenses of \$150.00 to \$175.00 per month. Meals may be obtained in University Dining Halls, if desired.

Time Payments The University offers a payment plan whereby total charges for tuition and fees may be divided into monthly payments. For further information contact the Bursar's Office.

Refunds In the event of withdrawal from the College after registration, refunds are made as follows: during the first week of any semester, the full tuition is refunded. Thereafter, 20 percent of tuition is deducted for each week that has elapsed.

Financial Aid

Students who wish to be considered for fellowships as well as admission must submit applications, with supporting material, by *March 1* for the academic year preceding that for which application is made. All applicants requesting fellowship and traineeship support must submit scores received on the Graduate Record Examination.

Application for fellowships should be made by completion of the appropriate section on the application form, except as otherwise indicated.

- **GRADUATE FELLOWSHIPS**

The Graduate College offers Graduate Fellowships of \$1,000 each, plus a full tuition scholarship. These fellowships are open to applicants in any field in which the University offers a graduate degree program. Holders of Graduate Fellowships are expected to carry a full-time graduate program towards an advanced degree.

- **GRADUATE TEACHING FELLOWSHIPS AND GRADUATE RESEARCH FELLOWSHIPS**

Graduate Teaching and Research Fellowships are awarded in departments offering graduate work. Graduate Teaching Fellows are usually appointed for nine months with an initial stipend of \$2,200, Graduate Research Fellows for eleven months with an initial stipend of \$2,640. Teaching and Research Fellows may enroll for a maximum of twelve hours per semester; they are eligible for reappointment. Fellowship award includes tuition scholarship.

A maximum of half-time assistance in the department is expected of Graduate Teaching Fellows and Graduate Research Fellows, and they must expect that more than one academic year will be necessary to complete the requirements for the master's degree. If a Teaching Fellow or Research Fellow is a candidate for the doctoral degree, he must expect to spend at least four calendar years before his academic program can be completed. While it is customary, it is not obligatory that Fellows select their fields of concentration in the departments in which they are appointed; for example, foreign-born students appointed Graduate

Teaching Fellows in the Department of Romance Languages may be accepted as degree candidates by the Department of English.

Appointments will be announced on or before April 1.

• *STUDENT PERSONNEL FELLOWSHIPS — RESIDENCE HALLS*

Graduate students, men and women, are eligible to apply for Student Personnel Fellowships. The candidates selected to fill these positions will normally be assigned administrative and advisory positions in the residence halls. Student Personnel Fellows have the opportunity to gain valuable experience in the areas of group advising, administration, personal advising and educational programming. Such positions are open to either married or single students who have been accepted for graduate work in any of the academic programs of the University of Vermont. Selection is based upon academic record, character, recommendations, and quality of related experiences. A personal interview is required. First year Student Personnel Fellows receive a stipend of \$2,200 plus a tuition scholarship for a nine-month period. Room and board is deducted from this stipend. Requests for applications and additional information should be addressed to the Dean of Men or Dean of Women, respectively. Applications received after March 20 will be considered only for unanticipated openings.

• *NATIONAL DEFENSE EDUCATION ACT FELLOWSHIPS*

The U. S. Department of Education supports fellows in several departments under provisions of Title IV of the National Defense Education Act. Fellowships will be available in the Departments of Biochemistry, Botany, Chemistry, Electrical Engineering, Physiology and Biophysics, Psychology and Zoology.

These awards are made to predoctoral students who are U. S. citizens or nationals. They carry stipends plus a dependency allowance and include payment of tuition and nonrefundable fees. Requests for NDEA Fellowships should be indicated on the application for admission.

• *NATIONAL AERONAUTICS AND SPACE ADMINISTRATION TRAINEESHIPS*

The National Aeronautics and Space Administration supports graduate traineeships in the Departments of Botany, Chemistry, Electrical Engineering, Physics, Psychology and Zoology. These awards, which are

FINANCIAL AID

available to U. S. citizens and nationals, carry stipends plus a dependency allowance and cover payment of tuition and nonrefundable fees. Requests for traineeships should be indicated on the application for admission.

• *NATIONAL SCIENCE FOUNDATION TRAINEESHIPS*

The University of Vermont participates in the Graduate Traineeship Program of the National Science Foundation. These traineeships are open to graduate students in the natural sciences, engineering and the quantitative social sciences who are U. S. citizens or nationals. They carry a stipend plus a dependency allowance and include payment of tuition and nonrefundable fees. Requests for NSF Traineeships should be indicated on the application for admission.

• *GRADUATE TRAINEESHIPS*

Graduate traineeships have been made available to certain departments through grants from various divisions of the U. S. Public Health Service. Traineeships are available to graduate students enrolled in the following departments: Biochemistry, Pharmacology, Physiology and Biophysics, and Speech. These traineeships generally carry stipends of \$2,400 upwards plus payment of tuition. The chairman of the department concerned should be contacted for information on the availability of these awards.

• *PROSPECTIVE TEACHER FELLOWSHIPS*

Under Title V of the Higher Education Act of 1965, the U. S. Office of Education supports graduate study for prospective teachers of English at the secondary level who are pursuing full-time study leading to the M.A. or M.A.T. degrees. Requests for such support should be indicated on the application for admission.

• *GEORGE H. WALKER DAIRY FELLOWSHIP*

The George H. Walker Dairy Fellowship, which is awarded periodically, provides a stipend plus a full tuition scholarship. It is available to graduate students who, during their undergraduate courses, have studied "agriculture, chemistry, and bacteriology" and who desire to study the problems relating to the production of a sanitary milk supply on com-

paratively small plants and farms. Applications should be addressed to the Chairman of the Department of Animal and Dairy Science.

- *OTHER SOURCES*

Students undertaking graduate work at The University of Vermont may apply for other awards such as the National Science Foundation Graduate Fellowships and National Institutes of Health Predoctoral Fellowships. Further information concerning these programs may be obtained from the respective granting agencies.

- *LOANS*

Graduate students may apply for National Defense Student Loans. Applications should be made through the Director of Financial Aid, Waterman Building, prior to April 1 for September enrollment.

Graduate students, after they have successfully completed one semester, are also eligible for university loans on the same basis as undergraduates. Details may be obtained from the Financial Aid Office.

Courses of Instruction

Course Numbering

Courses numbered 400 or above are limited to candidates for the degree of Doctor of Philosophy; courses numbered 300 to 399 are limited to graduate students; courses numbered 200 to 299 are graduate courses open to advanced undergraduates. Courses numbered 100 to 199 may not be taken for graduate credit except upon recommendation of a student's Studies Committee and with the authorization of the Dean. Under no circumstances will graduate credit be allowed for a course numbered below 100.

A separate number is used for each semester course. Odd numbered courses are usually offered the first semester, even numbered courses in the second.

The form 201, 202 indicates that each semester may be taken independently for credit.

The form 201-202 indicates that they may not be taken independently for credit and, unless otherwise stated, must be taken in the sequence indicated.

The number of credit hours *per semester* is indicated in each description.

All prerequisites cited refer to courses as numbered at The University of Vermont.

A student who lacks the stated prerequisites for a course, but is otherwise qualified to take it, may be permitted to enroll by the instructor.

While every attempt has been made to list only courses that actually will be offered, the College necessarily must reserve the right to withdraw scheduled offerings or substitute for them should circumstances make such changes necessary.

• AGRICULTURAL BIOCHEMISTRY

Professor Johnstone (Chairman); Associate Professors Foote and Racusen; Assistant Professors Sjogren and Weller.

A major research project is the study of biochemical events in leaf growth. The current effort is a study of leaf-protein synthesis and degradation using carbon-14 labelling. Work is also in progress to develop methods of protein isolation, measurement, and characterization. It is expected that research will be extended

to the synthesis of leaf-nucleic acids. Biochemistry research on microorganisms is concerned with carbohydrate and pigment synthesis, pesticide degradation, fluorescence, nitrogen fixation, and ribosome structure.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Chemistry or Biology which shall include courses in Organic Chemistry, Quantitative Analysis and Biochemistry. A course in Physical Chemistry is strongly recommended.

MINIMUM DEGREE REQUIREMENTS

Agricultural Biochemistry 201, 250, 381-384; Chemistry 237; thesis research (12-15 hours).

For the Master's program in Microbiology, see under Microbiology. Cf. also Medical Microbiology.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Chemistry 131-132 and 141-142, Mathematics 21, Physics 14-15 or their equivalents; a year course in a biological science and the Ph.D. candidacy requirements of the Graduate College. See similar program under Biochemistry (Medical).

MINIMUM DEGREE REQUIREMENTS

Biochemistry 301, 302, 303-304; satisfactory participation in biochemistry seminars during residency; advanced courses in Chemistry (10 hours); (10 hours) of courses other than Biochemistry and Chemistry; balance of course work from Agricultural Biochemistry and Medical Biochemistry; a reading knowledge of German and one other appropriate foreign language; and doctoral thesis research (30 hours).

COURSES OFFERED

201 GENERAL BIOCHEMISTRY Broad coverage of fundamentals of biochemistry for science students, including the chemistry of carbohydrates, proteins, lipids, vitamins, enzymes, and hormones and their relation to processes of biological significance. Basic principles of analytical procedures involved in biochemical methods. *Prerequisite:* Chemistry 131. Five hours. Mr. Weller.

250 ADVANCED BIOCHEMISTRY An advanced study of biochemical systems with emphasis on research methods and plant biochemistry. Laboratory sessions include the use of radioisotopes and chromatographic techniques. This course augments Agricultural Biochemistry 201 (General Biochemistry), the combined sequence providing a base for graduate research in biochemistry and related fields. *Prerequisite:* 201 or Medical Biochemistry. Five hours. Mr. Racusen.

254 MICROBIAL BIOCHEMISTRY An advanced course dealing with the chemical composition, energy utilization and metabolism of microbial cells. *Prerequisite:* 55, 201 or Biochemistry 301, permission of the department. Three hours. Offered alternate years, 1968-69. Mr. Sjogren.

AGRICULTURAL ECONOMICS

301 SPECIAL PROBLEMS IN BIOCHEMISTRY Reading, discussion, and laboratory research on a special problem. *Prerequisite:* Agr. Biochem. 201 and permission of the department. Credit as arranged. Staff.

381, 382, 383, 384 SEMINAR A topical seminar with discussion of assigned and collateral reading. Required of graduate students in agricultural biochemistry. One hour.

391 THROUGH 393 MASTER'S THESIS RESEARCH See under Biochemistry.

491 THROUGH 493 DOCTOR'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

• AGRICULTURAL ECONOMICS

Professors Sinclair, Sargent (Chairman) and Webster; Associate Professor Tremblay; Assistant Professor Fife.

The Department of Agricultural Economics is a department of the Vermont Agricultural Experiment Station and the Vermont Resources Research Center. Department members conduct research in agricultural production economics, farm management, marketing, regional development, recreation, electronic business records analysis, rural sociology, agricultural finance, and agricultural and resource policy.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

A major in some phase of Agriculture or in Economics; undergraduate courses in Agricultural Economics, Economics, and Mathematics.

MINIMUM DEGREE REQUIREMENTS

Advanced courses in Agricultural Economics, Economics, and related fields (15-24 hours); thesis research (6-15 hours).

COURSES OFFERED

201 FARM MANAGEMENT Organization and operation of a successful farm business. *Prerequisite:* Economics 11-12 or concurrent enrollment; junior standing. Four hours. Mr. Tremblay.

203 RESOURCE ECONOMICS The field of resource economics, benefit-cost analysis, economic appraisal of public resource development investments, water problems, the legal framework of resource development, economics of recreational land use, economic aspects of rural development, land classification, rural zoning, land use planning. *Prerequisite:* Economics 11-12, or Agricultural Economics 62. Three hours. Mr. Sargent.

207 AGRICULTURAL MARKETING AND PRICES Market structure, prices, and economic forces involved in the movement of farm products from

producers to consumers. Emphasis on the New England situation. *Prerequisite:* Economics 11-12 or permission of the instructor. Three hours. Mr. Webster.

208 AGRICULTURAL POLICY The role of government, farm organizations, and other institutions in the development of agricultural policy. An economic analysis of the price and income problems of American agriculture and alternative solutions. *Prerequisite:* Economics 11-12 or permission of the instructor. Three hours. Mr. Sinclair.

253 THEORY OF AGRICULTURAL PRODUCTION ECONOMICS Application of the theory of the firm to agricultural production units. Emphasis on resource allocation and production efficiency. Principles of marginal analysis applied to production problems in a static and dynamic economy. *Prerequisite:* twelve hours in Agricultural Economics and/or Economics, senior standing, and permission of the department. Three hours (either semester). Mr. Sinclair.

255, 256 SPECIAL TOPICS Readings and discussion of specific topics in agricultural economics at advanced level. *Prerequisite:* permission of the department. One to three hours. Staff.

303 ECONOMICS OF RESOURCE PLANNING A discussion of concepts of resource planning with special emphasis on economic base analysis, benefit-cost analysis, resource base analysis, and economic impact studies. Current literature and current problems will be discussed and each student will make a special study of the economic aspects of a resource development proposal and present it to the class. *Prerequisite:* 203. Three hours. Mr. Sargent.

381-382 SEMINAR Discussion of problems, research and theory in agricultural economics, resource economics, and other social sciences. One hour. Staff.

351 RESEARCH METHODS The scientific method, statistical methods, sampling methods, use of electronic computers, linear programming, reporting research results. *Prerequisite:* three hours of statistics. Three hours. Mr. Fife.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

2 World Food and Agriculture

51 Agricultural Finance

166 Small Business Management

103 Rural Sociology

• AGRICULTURAL EDUCATION

Assistant Professor Bice.

Research is designed to solve practical problems identified in the areas of adult education, psychology of learning, improvement of instruction, and other areas in the field of education in agriculture.

ANATOMY

The degree of Master of Arts in Teaching (see p. 20) is offered for those candidates who specialize in the field of Agriculture. Candidates for this degree work under the supervision of the Department of Agricultural Education.

COURSES OFFERED

251 TEACHING VOCATIONAL AGRICULTURE II Study of various advanced topics in the field. *Prerequisites:* 104 and 152, or permission of the department. Three hours. Mr. Bice.

253 METHODS OF TEACHING YOUNG AND ADULT FARMER GROUPS Needs, problems, and objectives for the education of farmers. *Prerequisites:* 104 and 152, or permission of the department. Three hours. Mr. Bice.

282 SEMINAR Evaluation of student teaching experiences. *Prerequisites:* 104, 155, 251 or 253. Mr. Bice.

301, 302, 303, 304 RESEARCH IN AGRICULTURAL EDUCATION Investigation of a research topic under the direction of an assigned staff member. Credit as arranged.

Undergraduate courses:

104 Leadership Training and Organization Methods	155 Directed Practice Teaching
102 Extension Methods	156 Methods and Materials of Vocational Education
152 Teaching Vocational Agriculture I	197, 198 Senior Research

• ANATOMY

Professors Dunihue, Newball (Emeritus), Stultz, and W. J. Young (Chairman); Associate Professor Ring; Assistant Professors Freedman and E. Wennberg; Demonstrator Boushey.

Research activities include a study of the developmental mechanics of the vertebrate form, utilizing embryos of the salamander, *Amblystoma punctatum*, and carried out by means of transplantation experiments on the limbs and nervous system (Mr. Stultz); an electron microscope study of the structure of the renal glomerulus and juxtaglomerular apparatus under various experimental conditions; an electron microscope study of the Purkinje-myocardial fiber junction (Mr. Dunihue); neural control of reproduction (Mr. Freedman); electron microscope study of hemopoietic tissues (Mrs. Wennberg).

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Academic requirements as agreed upon for each candidate.

MINIMUM DEGREE REQUIREMENTS

In Gross Anatomy: 301; 311; 322; 331; 341, 342, 381, 382; thesis research; Physiology and Biophysics 301.

In Histology: 311; 322; 351, 352; 383, 384; thesis research; Biochemistry 301-302.

In Neuroanatomy: 311; 322; 371, 372; 387, 388; thesis research; Biochemistry 301-302.

COURSES OFFERED

301 GROSS ANATOMY The course as given to medical students. Study of the gross structure of the human body by means of general dissection, cross-sections and special dissections. Seven hours. Messrs. Newhall, Ring and Stultz.

311 MEDICAL HISTOLOGY The regular medical course. Microscopic study of cells, tissues and organs using routine techniques. Three hours. Messrs. Dunihue, Freedman and Mrs. Wennberg.

322 NEUROANATOMY As designed for the regular medical curriculum. Gross and microscopic study of the central nervous system, by means of dissection of the brain, accompanied by microscopic examination of stained sections and reconstructions of the principal nervous pathways. The course is offered in conjunction with neurophysiology. Three hours. Messrs. Freedman and Dunihue.

331 SURFACE AND RADIOLOGICAL ANATOMY A course in Living Anatomy in which all available landmarks are studied and utilized in the placement of internal structures. A complete series of radiological plates is used to correlate radiological landmarks with the positions of deep structures. *Prerequisite:* 301. Two hours. Mr. Stultz.

341, 342 SPECIAL DISSECTIONS IN GROSS ANATOMY Special dissections of particular regions of the human body, utilizing either adult or fetal material, or investigative work designed to advance knowledge of some special structure or relationship. *Prerequisite:* 301. Credit as arranged. Mr. Stultz.

351, 352 SPECIAL TECHNIQUES IN HISTOLOGY A study of selected cells, tissues or organs by means of special techniques. Specific work as agreed upon by the instructors and the graduate student. *Prerequisite:* 311. Credit as arranged. Mr. Dunihue.

361, 362 SPECIAL DEVELOPMENTS IN EMBRYOLOGY The study of some particular embryological problem utilizing special techniques, with directed reading. *Prerequisite:* Undergraduate course in Comparative Embryology (such as Zoology 111) and, in particular cases, in Experimental Embryology (as Zoology 222). Credit as arranged. Mr. Stultz.

SEMINARS IN ANATOMY Attendance at departmental or sectional seminars. Review of the recent literature and findings in one or another of the various branches of Anatomy. *Prerequisite:* graduate standing. Credit as arranged. Seminars as follows:

381, 382 Gross Anatomy	385, 386 Embryology
383, 384 Medical Histology	387, 388 Neuroanatomy

ANIMAL AND DAIRY SCIENCE

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, designed to culminate in an acceptable Master's thesis. Credit as arranged. Staff.

• ANIMAL AND DAIRY SCIENCE

Professors Atherton and Smith (Chairman); Associate Professors Balch, Simmons, and Welch; Assistant Professors Duthie and Nilson; Lecturers Elliott and Gibson.

Research is directed toward the solution of basic and practical problems. The areas of study and research include livestock management; breeding; nutrition; physiology; dairy plant management; and the bacteriology and chemistry of milk and milk products.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An acceptable undergraduate major in Animal and Dairy Science, a related agricultural field, Chemistry or Biology.

MINIMUM DEGREE REQUIREMENTS

281, 282; additional courses in Animal and Dairy Science and related fields, thesis research (10-15 hours).

COURSES OFFERED

206 ANIMAL NUTRITION Nutrients, their function and utilization and requirements for growth, reproduction and lactation. *Prerequisite:* 55; and a course in organic chemistry. Three hours. Mr. Smith.

211 ICE CREAM AND FROZEN DAIRY PRODUCTS Fundamentals of ice cream manufacturing, the physio-chemical and biological factors involved; calculation of formulas; sherbets and specialties; merchandising, soda fountain management and sanitary control. *Prerequisite:* 104; credit or concurrent enrollment in 109. Three hours. Mr. Nilson. Alternate years, 1967-68.

251 DAIRY CATTLE AND MILK PRODUCTION Advanced principles of dairy cattle feeding and management. *Prerequisite:* 105. Three hours. Mr. Gibson. Alternate years, 1967-68.

256 DAIRY PLANT MANAGEMENT Organization and operation of milk processing and manufactured milk products plants. *Prerequisite:* 153, Economics 12. Three hours. Mr. Nilson. Alternate years, 1968-69.

260 ANIMAL BREEDING Theory and application of genetic principles to breeding of livestock. *Prerequisite:* 2, Zoology 115. Three hours. Mr. Balch. Alternate years, 1967-68.

271 ENDOCRINOLOGY Anatomy, physiology, glandular interrelationships, and assay methods of the endocrine glands and their hormones. *Prerequisite:* Zoology 1 and departmental permission. Three hours. Mr. Simmons.

275 **PHYSIOLOGY OF REPRODUCTION AND LACTATION** Fundamental principles of the physiology of reproduction and lactation with the primary emphasis on farm animals. Three hours. Mr. Simmons. Alternate years, 1968-69.

281, 282 **SEMINAR** Reports and discussions of problems and special investigations in selected fields. One-three hours. Maximum credit three hours graduate. Staff.

291, 292 **SPECIAL PROBLEMS** Reading, discussion, and special laboratory investigation in the field of animal and dairy science. Three hours. Staff.

294 **HISTORY OF NUTRITION** (See Home Economics 294). One hour. Miss Morse and Messrs. Donovan and Smith.

308 **EXPERIMENTAL TECHNIQUES IN NUTRITION** Methods of conducting research in nutrition with various animal species including humans. Physical, physiological and biochemical aspects considered. Experimental design and analyses. *Prerequisite:* A 200 level course in nutrition and in biochemistry. Two hours. Miss Morse and Messrs. Donovan and Smith.

391 THROUGH 393 **MASTER'S THESIS RESEARCH** Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

2 Introductory Animal Science	121 Sensory Evaluation of Milk and Milk Products
33 Introductory Dairy Technology	153 Milk Processing
44 Dairy Cattle Judging	177 Advanced Livestock Production
55 Fundamentals of Livestock Feeding	188, 189 Light Horse Production and Management
104 Dairy Testing and Quality Control	197, 198 Senior Research
109 Food Microbiology	
114 Manufactured Dairy Products	

• ANIMAL PATHOLOGY

Professor Bolton (Chairman); Associate Professor Durrell.

Research interests include causes of abortions and breeding problems in dairy cattle. Current studies involve the role of viruses as primary causative agents. Infectious bovine rhinotracheitis (IBR); bovine virus diarrhea (BVD); and parainfluenza-3 (PI-3) are of special interest. Fluorescent antibody techniques are being evaluated as diagnostic aids.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

The degree of Doctor of Veterinary Medicine.

BIOCHEMISTRY

MINIMUM DEGREE REQUIREMENTS

Pathology 301 or Medical Microbiology 201; additional courses in related fields; thesis research (12-15 hours).

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

105 Anatomy and Physiology
106 Animal Diseases

116 Poultry Diseases

• BIOCHEMISTRY

Professor Melville (Chairman); Associate Professors Gjessing, Lamden and Schein; Assistant Professors Meyer, Thanassi and Woodworth.

Current research includes studies concerned with the intermediary metabolism of amino acids in mammalian and microbial cells (D. B. Melville); proteolytic enzymes of the pancreas, and the mechanism of proenzyme-enzyme conversion (E. C. Gjessing); the effects of ascorbic acid on the metabolic activity of bone, cartilage, and other tissues (M. P. Lamden); hormonal and enzymatic control mechanisms in cartilage and muscle (W. L. Meyer); the relationship between nucleic acid structure and the resistance of cells toward ionizing radiation (A. H. Schein); the mechanisms of transamination and decarboxylation reactions catalyzed by vitamin B₆ compounds (J. W. Thanassi); and the nature of the binding sites of metals in metalloproteins, particularly the iron-binding proteins of blood plasma (R. C. Woodworth).

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Year courses in organic chemistry, physical chemistry, and physics (equivalent to Chemistry 131-132, Chemistry 141-142, and Physics 14-15); quantitative chemistry; mathematics through differential and integral calculus; a year course in a biological science.

MINIMUM DEGREE REQUIREMENTS

Biochemistry 301, 302, 303-304; additional courses in Biochemistry; thesis research; a reading knowledge of German or French.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Year courses in organic chemistry, physical chemistry, and physics (equivalent to Chemistry 131-132, Chemistry 141-142, and Physics 14-15); quantitative chemistry; mathematics through differential and integral calculus; a year course in a biological science. See similar program under Agricultural Biochemistry. Cf. also p. 32.

MINIMUM DEGREE REQUIREMENTS

Twenty hours from graduate courses offered by the Departments of Biochemistry and Agricultural Biochemistry, including Biochemistry 301, 302, 303-304, and participation throughout residence in Biochemistry Seminar; ten hours from graduate courses offered by the Department of Chemistry; ten additional hours from courses in physical or biological sciences; thirty hours of Doctoral Thesis Research; a reading knowledge of German and one other appropriate foreign language.

COURSES OFFERED

301 BIOCHEMISTRY I Lectures, conferences, and assigned reading in the area of molecular biochemistry: chemistry, structure, and metabolism of proteins, amino acids, nucleic acids, lipids, and carbohydrates; enzymes. *Prerequisite:* Chemistry 131-132 and permission of the department. Four hours. Staff.

302 BIOCHEMISTRY II Lectures, conferences, and assigned reading in the area of biochemistry of the whole organism, with special reference to man: respiration, hemoglobin, plasma proteins, and iron metabolism; acid-base balance, water balance, and mineral metabolism; vitamins; hormones. *Prerequisite:* 301 and permission of the department. Four hours. Staff.

303-304 BIOCHEMISTRY LABORATORY Experimental work designed to demonstrate important principles and to illustrate methods and techniques of modern biochemistry. *Prerequisite:* 301 and 302, or concurrent registration therein, and permission of the department. Three hours per semester. Messrs. Meyer and Woodworth.

311, 312 BIOCHEMICAL PREPARATIONS Laboratory procedures and techniques for the synthesis, isolation, and characterization of compounds of biochemical interest. *Prerequisite:* 301. Two hours per semester. Mr. Melville.

320 GENERAL ENZYMOLOGY A general consideration of enzyme nomenclature, purification, assay, introductory kinetics, mechanisms, cofactors, active sites, and the relationship of enzyme structure to the biological control of activity. *Prerequisites:* 301; Chemistry 141-142. Two hours. Mr. Meyer.

321 ENZYME KINETICS AND MECHANISMS Topics include kinetics, specificity, inhibitors, enzyme-substrate interactions, and their relation to enzyme structure. *Prerequisites:* 301; Chemistry 141-142. Two hours. Mr. Gjessing.

331 NUCLEIC ACIDS The structure and function of ribonucleic acids and deoxyribonucleic acids. *Prerequisite:* 301. Two hours. Mr. Schein.

371 PHYSICAL BIOCHEMISTRY Protein interaction, solubility and fractionation, electrophoresis, sedimentation, phase rule study, diffusion, viscosity, spectrophotometry, and related topics. *Prerequisites:* 301; Chemistry 141-142. Two hours. Mr. Woodworth.

BOTANY

381 THROUGH 389 SEMINAR A review of recent developments and current literature in the various fields of biochemistry. *Prerequisite:* permission of the department. One hour per semester.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Original research under the direction of an assigned staff member, culminating in an acceptable Doctoral dissertation. Credit as arranged.

• BIOMEDICAL ENGINEERING

A cooperative program offered by the Department of Electrical Engineering (W. Roth, *Chairman*) and the Department of Physiology and Biophysics (N. R. Alpert, *Chairman*). (Cf. p. 109.)

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited bachelor's degree in Electrical Engineering satisfies the principal requirements. Courses in biology and chemistry may be recommended as pre-requisites. Applicants with backgrounds other than Electrical Engineering will generally be required to make up undergraduate deficiencies.

MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301; twelve hours in Electrical Engineering, Physics and Mathematics; additional approved courses; thesis research (6-12 hours) in the Department of Electrical Engineering.

The doctoral degree program in Electrical Engineering offers an option in Biomedical Engineering.

• BOTANY

Professors Dodge, Gersboy, Hyde (Chairman), Klein, Marvin, Sproston and Taylor; Associate Professor Vogelmann; Assistant Professor Cook.

The Botany Department has active research projects in plant tissue culture and morphogenesis; the effects of light on sexual reproduction in ascomycetous fungi; the isolation and identification of naturally-occurring fungicides; translocation and other physiological problems of woody plants; forest ecology; pollen analysis; biosystematics of vascular plants; histochemical studies of the algae and studies of host parasite relationships between algae and aquatic fungi; physiology and pathogenicity of parasitic microorganisms; ultrastructural changes in the nucleus associated with development.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Six semester courses in Botany; supporting courses in other sciences and in Mathematics.

MINIMUM DEGREE REQUIREMENTS

15-21 hours in Botany and closely related fields; thesis research (9-15 hours).

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The following courses must have been satisfactorily completed: four semesters in Botany; two semesters in Zoology; a year in Organic Chemistry (Chemistry 131-132 at the University of Vermont or its equivalent); a year of Mathematics comparable to Mathematics 11-12 and in some cases Mathematics 21 or its equivalent; one year in Physics, *i.e.*, Physics 5-6 or its equivalent. In addition, a candidate must have completed one academic year, but not more than two years, in graduate study at the University of Vermont. (With the approval of the Dean of the Graduate College and the Department of Botany, a Master's degree may be accepted as partial or complete fulfillment of this requirement.) In addition, the candidate must have completed satisfactorily the general qualifying examination administered by the Department of Botany.

MINIMUM DEGREE REQUIREMENTS

The candidate is required to accumulate a minimum of 75 credits from course work and thesis research. The course requirements are as follows: a total of at least 40 credit hours of which at least 20 must be taken in Botany and at least 20 in other sciences. Supervised teaching to the extent of not less than 6 semester contact hours is also requisite. The specific language requirement for the candidate is to demonstrate ability to comprehend the contents of articles in the biological sciences in German and also in either French or Russian. This language requirement must be completed within the first two years after acceptance to the program.

COURSES OFFERED

205 MINERAL NUTRITION OF PLANTS This course is identical with Plant and Soil Science 205, see p. 113.

252 PLANT ANATOMY AND HISTOLOGY Development of the organism and accompanying integration of cellular tissues. Ontogeny of vegetative tissues; modification of the cell wall. *Prerequisite:* 2 or departmental permission. Four hours. Mr. Taylor. Alternate years, 1968-69.

253 FUNGI The reproductive processes of the common molds, yeasts, and actinomycetes and their classification. Physiological studies; antibiosis. *Prerequisite:* 103 or departmental permission. Four hours. Mr. Sproston. Alternate years, 1967-68.

BOTANY

255 GENETICS AND CYTOGENETICS Fundamental principles of genetics. Analysis of mendelian inheritance, recombination in higher plants and animals as well as microorganisms, chromosome aberrations, polyploidy. Gene action and introduction to molecular genetics. *Prerequisites:* 1 or Zoology 1; Zoology 115 and at least 8 additional hours of Botany or Zoology. Three hours. Mr. Hyde.

256 CYTOLOGY The dynamics of the protoplast; nuclear division, gamete formation, and syngamy. Ultrastructure of cell organelles; nucleocytoplasmic interaction. *Prerequisites:* 255 or Zoology 115; Chemistry 131-132 or 35 or departmental permission. Four hours. Mr. Hyde. Alternate years, 1967-68.

258 PLANT GROWTH The nutrition of plant cells, growth hormones, cyclic variation of environmental factors, morphogenesis. *Prerequisites:* 103; Chemistry 131-132 or permission of the department. Four hours. Mr. Marvin. Alternate years, 1967-68.

259 MORPHOLOGY AND EMBRYOLOGY Comparative study of body form, ontogeny of reproductive structures and phylogenetic relationships in the embryophytes; emphasis on seed plants. *Prerequisite:* 2 or departmental permission. Four hours. Staff. Alternate years, 1968-69.

260 PHYCOLOGY The morphology, classification, and general biology of the algae, with special consideration of the freshwater forms. Emphasis on the use of algae as experimental material for the investigation of general biological problems. *Prerequisites:* 2, and 2 courses in Zoology or Botany above 100. Four hours. Mr. Cook. Alternate years, 1967-68.

281, 282 BOTANY SEMINAR A topical seminar consisting largely of presentations of personal research by faculty and graduate students from within and outside the University. May be jointly sponsored with Zoology, Agricultural Biochemistry, Forestry, Plant and Soil Science, etc. Attendance required of botany graduate students and seniors in botanical research programs. Without credit. Staff.

381-386 SELECTED PROBLEMS IN MODERN BOTANY Subject matter varies but will stress recent botanical inquiries, particularly where they border on mathematics, physics, and chemistry. *Prerequisite:* departmental permission. One to three hours credit. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

1 Introductory Botany	110 Taxonomy
2 The Plant Kingdom	113 Plant Communities
S10 Field Botany	117 Plant Pathology
60 Plant Ecology	151 Plants and Man
103 Plant Physiology	197, 198 Senior Research

• CHEMISTRY

Professors Cook, Gregg and White (Chairman); Associate Professors Brown, Crooks, Flanagan, Kuehne, Krapcho and Whitcher; Assistant Professors Allen, Waters, Weltin and Wulff.

Current research in organic chemistry includes studies on organic sulfur compounds; the nucleophilic reactions of bivalent carbon species; the reactivity of spiro systems; studies in free radical chemistry; the synthesis of naturally occurring compounds; problems relating to biogenesis; mechanisms of aromatic rearrangements; molecular orbital correlation of reactivity; enzyme studies.

Physical chemistry research projects include heterogeneous kinetics; the thermodynamics of hydrogen-palladium systems; electrochemical studies; aqueous and non-aqueous solution thermochemistry; cryogenic calorimetry; and quantum mechanical calculations for small molecules.

Research in inorganic chemistry includes investigations of complexes of transition metals, especially gold, and studies of the syntheses, structures, reactivities, and spectroscopic properties of phosphorus-nitrogen and sulfur-nitrogen compounds.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

The requirements for admission to candidacy for the master of science degree are: (1) proficiency in the four areas of chemistry evidenced by the biannual qualifying examinations or completion of designated courses at this university; (2) reading knowledge of German; (3) one semester of residence; (4) at least fifteen hours of formal course work including (a) six hours of graduate-level courses in the chemical field of specialization, (b) three hours of graduate-level chemistry courses not in the area of concentration, (c) Chemistry 371-372, (d) Chemistry 381-382 (Seminar), and (e) Chemistry 212; and (5) maintenance of an overall point-hour ratio of 3.00. Students studying in the master of science degree program are advised to take the cumulative examinations in their specialty.

MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

The above prerequisites for admission to candidacy must be supplemented by: (1) completion of a research problem and submission of a thesis; (2) at least thirty hours of graduate credit (courses and research); and (3) Chemistry 383-384 (Seminar).

CHEMISTRY

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

It is expected that a student will ordinarily complete the following requirements for admission to candidacy by the end of his second year of residence: (1) at least fifteen hours of research (Chemistry 491-499); (2) satisfactory performance in the cumulative examinations in his specialty field; (3) demonstration of basic competence in the four fields of chemistry (analytical, inorganic, organic, and physical) through the biannual qualifying examinations or completion of prescribed courses at the University of Vermont; (4) proficiency in two foreign languages (German, French and/or Russian); (5) three hours of teaching; (6) one year of residence; (7) at least thirty hours of formal course work including (a) three hours of graduate-level physical chemistry, (b) six hours of graduate-level chemistry courses in his area of specialization, (c) six hours of graduate-level chemistry courses *not* in his specialty, (d) Chemistry 371-372, (e) Chemistry 381-384 (Seminar), (f) Chemistry 212, and (g) nine hours of course work outside the chemistry department; and (8) maintenance of an overall point-hour ratio of 3.25.

MINIMUM REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

In addition to the above requirements a student must: (1) complete his doctoral research, write an acceptable thesis, and defend it; (2) finish the Graduate School course and minor area requirements; and (3) make an oral and written presentation of an original research proposal (at least six months prior to the submission of the thesis).

COURSES OFFERED

212 ADVANCED INORGANIC CHEMISTRY Electronic structure of atoms and molecules; valence bond and molecular orbital treatments of chemical bonding; inorganic stereochemistry; ionic crystals; inorganic thermochemistry; inorganic equilibria in solution; theories of acids and bases. *Prerequisite:* 141 or the equivalent. Three hours. Mr. Allen.

213 ADVANCED INORGANIC CHEMISTRY Descriptive chemistry of the elements and of various classes of inorganic compounds; electron deficient compounds; organometallic chemistry; inorganic reaction mechanisms. *Prerequisite:* 212 (or equivalent.) Three hours. Mr. Waters.

224 INSTRUMENTAL ANALYSIS Theory and practice of optical, electro-metric, chromatographic, and radiochemical methods of analysis. *Prerequisite:* 11-12 or 123, 141 and credit for or concurrent enrollment in 142. Four hours. Mr. Whitcher.

229 SPECIAL TOPICS IN ANALYTICAL CHEMISTRY Discussion of selected topics in analytical chemistry. *Prerequisite:* Departmental permission. Credit as arranged. Offered as occasion warrants. Staff.

231 PHYSICAL ORGANIC CHEMISTRY—PRINCIPLES Structure-reactivity relationships, quantum organic chemistry, molecular properties and their interpretation, kinetics and catalysis. *Prerequisites:* 132; 142 or 247 or permission of instructor. Three hours. Alternate years, 1968-69. Mr. White.

233 PHYSICAL ORGANIC CHEMISTRY—MECHANISMS Methods and results of investigations of mechanisms of common organic reactions. *Prerequisites:* 132; 142 or 247 or permission of instructor. Three hours. Alternate years, 1967-68. Mr. Krapcho.

247 INTRODUCTION TO QUANTUM MECHANICS General considerations of quantum mechanics. Development of techniques pertinent to the application of quantum mechanics to chemical problems. *Prerequisite:* 141-142 or equivalent. Three hours. Mr. Weltin.

248 CHEMICAL THERMODYNAMICS Systematic study of the application of thermodynamics to chemical problems. Concepts of statistical thermodynamics to be introduced. *Prerequisite:* 141-142 or equivalent. Three hours. Mr. Wulff.

249 CHEMICAL STATISTICAL MECHANICS Development of statistical mechanics and its application to problems of chemical interest. *Prerequisite:* 141-142 or equivalent; 247 recommended. Three hours. Mr. Flanagan.

251, 252 ADVANCED ORGANIC CHEMISTRY A detailed discussion of systematic organic chemistry with emphasis on important synthetic methods and stereochemistry. Kinetic and stereochemical approaches to reaction mechanisms will be introduced. *Prerequisites:* Chemistry 131-132, credit or concurrent enrollment in Chemistry 141-142, Chemistry 251 for 252. Three hours. Messrs. Kuehne and Krapcho.

332 NATURAL PRODUCTS—THE ALKALOIDS The major classes of alkaloids will be surveyed from a biogenetic point of view. Classical and modern degradation methods, total syntheses and biosynthetic incorporation of labeled compounds will be discussed. *Prerequisite:* credit or concurrent enrollment in 252 or permission of the instructor. Three hours. Alternate years, 1967-68. Mr. Kuehne.

334 NATURAL PRODUCTS—THE TERPENES The chemistry of monosesquidi- and triterpenes, including degradations, structure proofs, total syntheses, rearrangement reactions and biogenesis. *Prerequisite:* credit or concurrent enrollment in 252 or permission of the instructor. Three hours. Alternate years, 1968-69. Mr. Kuehne.

336, 338 SPECIAL TOPICS IN ORGANIC CHEMISTRY Advanced level discussion of specific topics in organic chemistry of current interest such as photochemistry, carbenes, bio-organic chemistry, magnetic resonance, etc. *Prerequisite:* permission of instructor. Credit as arranged. 336 and 338 offered in alternate years. Staff.

CHEMISTRY

342 CHEMICAL KINETICS Fundamentals of chemical kinetics: collision theory, absolute rate theory, applications to organic and physical chemistry. *Prerequisite:* 247 and 248 or 249 or permission of the instructor. Three hours. Alternate years, 1968-69. Messrs. Flanagan and Krapcho.

344 QUANTUM CHEMISTRY—Applications of quantum mechanical techniques to problems of chemical interest. *Prerequisite:* 247. Three hours. Alternate years, 1968-69. Mr. Weltin.

345, 346, 347 SPECIAL TOPICS IN PHYSICAL CHEMISTRY Advanced level discussion of specific topics in physical chemistry and chemical physics; group theory, solid state theory, irreversible thermodynamics, solution theory. Credit as arranged. Offered as occasion warrants. Staff.

350, 351 SPECIAL TOPICS IN INORGANIC CHEMISTRY Advanced theoretical treatment of bonding and of physical properties of transition metal complexes; detailed consideration of the chemistry of various classes of inorganic compounds; detailed treatment of inorganic reaction mechanisms. Credit as arranged. Offered as occasion warrants. Staff.

371, 372 METHODS OF CHEMICAL INVESTIGATION Introduction to advanced modern chemical methods. Primarily for chemistry doctoral students. *Prerequisite:* permission of department chairman. Two hours. Staff.

380 RESEARCH PROBLEM CONCEPTION AND SOLUTION Independent origination of research problems and the methods of their solution. Required of all doctoral candidates. *Prerequisites:* two years of graduate work and permission of department chairman. One hour. Staff.

381, 382, 383, 384 SEMINAR Current problems and literature. One hour. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Original research under the direction of an assigned staff member, culminating in an acceptable Doctoral dissertation. Credit as arranged. Staff.

Undergraduate courses:

1-2 Introductory Chemistry
3-4 Outlines of Chemistry
11-12 General Chemistry
13-14 The Chemical Bond
16 Introductory Organic Chemistry
123 Elementary Quantitative Analysis
108 Inorganic Preparations
131-132 Organic Chemistry
134 Organic Chemistry Laboratory

135 Advanced Organic Chemistry Laboratory
140 Physical Chemistry for Biological Science Majors
141-142 Physical Chemistry
143 Molecular Structure
144 Physical Chemistry Laboratory
145 Advanced Physical Chemistry Laboratory

• CIVIL ENGINEERING

Professor Milbank (Chairman); Associate Professors Fay and Knight; Assistant Professors Stearns and Downer; Instructors Bartholomew and Dunham.

The Department of Civil Engineering is presently conducting research in water resources; thermal stresses in flat plates; and safety factors against failure of alluvial soils.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

A Bachelor's degree in Civil Engineering, or its equivalent.

MINIMUM DEGREE REQUIREMENTS

Advanced courses in Civil Engineering, Mathematics, additional approved courses; thesis research (6 hours).

COURSES OFFERED

231 MECHANICS OF MATERIALS II The study of stresses and strains at a point under plane and three-dimensional loading using Mohr's circle; failure theories; energy methods; plastic design; buckling of plates and shells. *Prerequisites:* 176 or concurrent enrollment. Three hours. Mr. Stearns.

232 ADVANCED DYNAMICS The study of Coriolis acceleration; gyroscopic forces; dynamic measurements; vibrations, earthquakes, and blast shocks on structures. *Prerequisites:* 130; Mathematics 211. Three hours. Staff.

234 ADVANCED MECHANICS OF MATERIALS The theory of elasticity with applications to curved beams, combined stresses, torsion of non-circular sections; relaxation procedures. *Prerequisites:* 131; Mathematics 212. Three hours. Mr. Stearns.

235 PHOTOELASTICITY Development of the theories of photoelastic stress analysis; model similitude; correlation with other stress analysis techniques. Laboratory work on two-dimensional applications such as stress concentrations around holes, notches, and fillets. *Prerequisites:* 131; Mathematics 211. Three hours. Mr. Fay.

250 CIVIL ENGINEERING SYSTEMS ANALYSIS Applications of systems engineering techniques to civil engineering problems. Presentation of current developments. *Prerequisite:* Senior or graduate standing, and consent of the instructor. Three hours. Staff.

261 HYDROLOGY The basic theory of precipitation, run-off infiltration and ground water; precipitation and run-off data; application of the data for use in development of water resources. *Prerequisite:* 162 or Mechanical Engineering 142. Three hours. Mr. Downer.

262 WATER POWER ENGINEERING Hydrologic, hydraulic, and geologic studies of water power sites; selection of turbines and equipment; economic considerations. *Prerequisite:* 162 or Mechanical Engineering 142. Three hours. Staff.

263 ADVANCED HYDROLOGY Application of recent developments to problems in engineering hydrology; the concept and use of the instantaneous unit hydrograph; study of models using a numerical solution of the de Saint Venant equations; flow through porous media. *Prerequisites:* 261, Mathematics 211. Three hours. Mr. Downer.

264 OPEN CHANNEL FLOW Application of the basic laws of fluid mechanics to flow in open channels; boundary layer theory; design of channels and transition structures; non-uniform flow; use of characteristics in the solution of unsteady; non-uniform, spatially varied flow problems. *Prerequisites:* 162, Mathematics 211. Three hours. Staff.

265 WATER TREATMENT PROCESSES A rigorous study of the theoretical concepts involved in the operation of water and waste-water treatment processes. *Prerequisite:* 166, Mathematics 211. Three hours. Mr. Downer.

273 SOIL MECHANICS II Index and engineering properties of soils with emphasis on current research problems. Critical evaluation of the theories of ground water movement, frost action, consolidation, shearing strength, and stress distribution. Case histories and comparison of failure conditions with predictions based on laboratory tests. *Prerequisite:* 173. Three hours. Mr. Knight.

274 SOIL ENGINEERING Applications of soil mechanics to special problems of earth structures and foundations. Topics considered include bearing capacity evaluation, earth pressures, stabilization, effects of vibratory loading, earth dam and roadway construction. *Prerequisite:* 273. Three hours. Mr. Knight.

275 INDETERMINATE STRUCTURES II Analysis of trusses with redundant members, elastic weights and column analogy methods for indeterminate frames, energy methods for curved frames and closed rings, arch theory and cable analysis. *Prerequisite:* 175. Three hours. Mr. Stearns.

276 ULTIMATE STRENGTH DESIGN Development of ultimate load theory; virtual work and statical methods of analysis. Design of structural steel and reinforced concrete structures by ultimate load methods; consideration of shear, axial force, buckling, and rotation capacity. *Prerequisites:* 155, 175. Four hours. Staff.

280 HIGHWAY AND AIRPORT PAVEMENT DESIGN Structural design of flexible and rigid pavements; types of wheel and axle configurations; tire pressures; soil classification; compaction of soils; frost action; subsurface drainage; design of bases and subbases; soil stabilization; theory of stresses in flexible pavements; plate bearing, triaxial and CBR methods of design; mix-design methods; Westergaard analysis for rigid pavements; design of joints and reinforcing steel; rigid pavement pumping; pavement evaluation; pavement selection criteria; and test roads. *Prerequisite:* 173. Four hours. Mr. Knight.

ECONOMICS AND BUSINESS ADMINISTRATION

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

24 Statics	155 Reinforced Concrete
51, 52 Surveying	158 Substructure Analysis and Design
113 Concrete and Bituminous Laboratory	162 Hydraulics
114 Mechanics of Materials Laboratory	165 Water Supply Engineering
130 Dynamics	166 Sewerage and Sewage Treatment
131 Mechanics of Materials I	168 Hydraulics Laboratory
140 Statically Determinate Structures	173 Soil Mechanics I
151 Engineering Contracts	174 Transportation Engineering
	175 Indeterminate Structures I
	176 Advanced Structural Design
	180 Engineering Investigation

• ECONOMICS AND BUSINESS ADMINISTRATION

Professors Dellin, Greif, Nadworny (Chairman) and Nyquist; Associate Professors Alnasrawi, Diamond and Severance (Interim Chairman); Assistant Professors Bayer, Campagna, Chase, Michael, Mills, Nargund, Schiller, Squire and Wass; Instructor Singleton.

BUSINESS ADMINISTRATION

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION

Appropriate courses in accounting, marketing, industrial management, micro theory, macro theory, and six hours of statistics are required. Transcripts will be evaluated on an individual basis.

MINIMUM DEGREE REQUIREMENTS

Economics 207, 228, 252, and 289; twelve hours chosen in the candidate's field of concentration; thesis research (6 hours).

After April 1, 1968, not more than six credit hours of graduate work completed prior to the date of becoming a candidate for the MBA will be applied toward the degree requirements.

For course listings, see under *Economics*.

ECONOMICS

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Twenty-four hours in Economics, including eighteen hours in courses numbered above 100; twelve hours in a related field, including six hours in courses numbered above 100; six hours in History; a reading knowledge of a modern foreign language.

ECONOMICS AND BUSINESS ADMINISTRATION

MINIMUM DEGREE REQUIREMENTS

Twenty-four in approved courses in Economics numbered above 200, including 286, 295 and 377; thesis research (6 hours).

COURSES OFFERED

201 MONEY AND BANKING Commercial and central banking with special attention given to the Federal Reserve System. Monetary theory and policy. *Prerequisite:* 12. Three hours. Messrs. Mills and Wass.

203 ECONOMICS OF TAXATION Revenues and expenditures of federal, state, and local governments and their effects upon individuals, business institutions, and the national economy. *Prerequisite:* 11-12. Three hours. Mr. Campagna.

204 STATE AND LOCAL FINANCE Revenues, expenditures and debt management problems of state and local governments; including an analysis of state and local fiscal relationships. *Prerequisite:* 11-12. Three hours. Mr. Mills.

205 INTERNATIONAL TRADE AND FINANCE Empirical basis of international trade; theory of international values; mechanism of adjustment of international balances; mechanics of international finance; foreign exchange theory. *Prerequisite:* 11-12. Three hours. Messrs. Alnasrawi and Wass.

206 SECURITIES MARKETS Operation of organized and over-the-counter securities markets; types of securities; primary and secondary markets in the process of capital formation; securities price behavior; government and self-regulation of securities markets. *Prerequisites:* 11-12 and 13-14. Three hours. Messrs. Mills and Wass.

207 CORPORATE FINANCE A study of the sources of financing and the efficient utilization of funds by corporations. Topics include capital budgeting, capital structure, dividend policy, and problems of financing new business ventures, large and small. *Prerequisites:* 12 and 14. Three hours. Mr. Michael.

216 ECONOMIC DEVELOPMENT Theories of economic growth applied to underdeveloped areas of the contemporary world, including the political and social determinates of economic progress. *Prerequisites:* 11-12; 193 recommended. Three hours. Messrs. Alnasrawi and Nargund.

228 CURRENT MARKETING DEVELOPMENTS Modern marketing theory and practice. Topics include: the nature of consumer changes; urban and suburban trading centers; the distribution cycle; marketing legislation; functional and institutional changes. *Prerequisite:* 122. Three hours. Messrs. Greif and Diamond.

229 MARKETING MANAGEMENT Integration and coordination of the marketing function; planning and developing the product; testing, branding, packaging and labeling; sales program and campaign; sales organization and management; control of sales functions. *Prerequisite:* 122. Three hours. Mr. Greif.

238 ECONOMIC HISTORY OF MODERN EUROPE A comparative historical study of the process of the economic growth as experienced in Britain, France, Germany, and Russia since 1760. For the economic history of pre-industrial Europe see History 237. *Prerequisites:* 12 and History 12. Three hours. Mr. Schiller.

241 MANPOWER IN AN ADVANCED ECONOMY Fundamental changes in the structure of the American labor force; income, education, occupational distribution, and unemployment factors. Implications and impacts of Manpower Development and Training Act, Economic Opportunity Act, and other programs on manpower training and allocation. Income maintenance and manpower. *Prerequisite:* 141. Messrs. Chase and Nadworny.

242 COLLECTIVE BARGAINING The subject matter, problems, and issues of union-management relationships. The structure and functions of collective bargaining in the economy. The grievance process and arbitration. The laws of collective bargaining. *Prerequisite:* 141. Three hours. Messrs. Nadworny and Chase.

251 PERSONNEL ADMINISTRATION Selecting and training employees; job analysis and evaluation; evaluating employees; wage and wage administration; problems of morale; human relations in the supervision of personnel. *Prerequisite:* 141. Three hours. Mr. Nadworny.

252 EXECUTIVE DECISION-MAKING Synthesis of the management and operation of a firm in terms of production, marketing, personnel, and finance; the process of decision-making; the planning and execution of policies. *Prerequisites:* 121 and 143; a course in finance, or consent of instructor. Three hours. Messrs. Nadworny and Squire.

254 SCIENTIFIC MANAGEMENT AND LABOR Development of scientific management, and the reactions and relationship of organized labor to it; long range effects of scientific management on the structure and policies of industry and organized labor. *Prerequisite:* 143. Three hours. Mr. Nadworny.

256 AMERICAN BUSINESS HISTORY Evolution of firms and industries from relatively small and undifferentiated establishments to large, highly complex institutions of the present day. Selected studies in textiles, machinery, transportation, steel, coal, electric machinery, insurance, communication, retail, and others. The roles of Federal and state governments and of legislation. Developments in American management. *Prerequisite:* 143 or consent of the instructor. Three hours. Mr. Nadworny.

258 PROBLEMS OF COMMUNISM A comparative study of economic and political problems of applied communism with particular emphasis on current developments in selected Communist countries. *Prerequisites:* 11-12 and six hours of political science or six hours of European history. Three hours. Mr. Dellin.

ECONOMICS AND BUSINESS ADMINISTRATION

271 AUDITING The theory and practice of auditing applicable to the work of the internal and external auditor, including auditor's responsibility, types of audits, and audit programs. *Prerequisite:* 162. Three hours. Mr. Nyquist.

272, 273 COST ACCOUNTING The nature of manufacturing costs and conventional methods of accumulating, summarizing, and interpreting them. Special problems in job order, process and standard costs. Second semester, joint and by-product costs; problems of waste and spoilage; inventory planning, capital budgeting; accounting systems including EDP; statistical methods and operations research. *Prerequisite:* 14, 272 for 273. Three hours. Mr. Nyquist.

276 C.P.A. PROBLEMS Review of questions and problems from past C.P.A. examinations, including partnerships, corporations, financial statements, auditing, cost accounting, insolvencies, receiverships, liquidations, consolidations, estates, trusts, governmental and institutional accounting methods. *Prerequisite:* 162. Three hours. Mr. Nyquist.

277 INTRODUCTION TO OPERATIONS RESEARCH Application of quantitative techniques to the formulation and solution of economic and business problems. Topics include demand and cost analysis, forecasting methods, linear programming, inventory and queuing theory. *Prerequisite:* 188. Three hours. Mr. Diamond.

285 COMPARATIVE ECONOMIC SYSTEMS Major economic systems, their theoretical models, basic institutions and practical varieties, from a comparative point of view. *Prerequisites:* 11-12 and six hours in another social science. Three hours. Mr. Dellin.

286 MICROECONOMIC THEORY Analysis of demand, supply, market price under competitive conditions and monopolistic influences; the theory of income distribution. *Prerequisites:* 11-12 and one other semester course. Three hours. Mr. Wass.

289 QUANTITATIVE METHODS IN BUSINESS The application of statistical tools to industrial problems. Topics covered include control charts, sampling plans, index numbers and measurement of trends. *Prerequisites:* 187; Mathematics 8 or 11. Three hours. Mr. Nargund.

290 THE SOVIET ECONOMY An analysis of the economic development of the USSR, its structure, performance, and direction. *Prerequisites:* 11-12; twelve additional hours in economics, political science or European history. Three hours. Mr. Dellin.

291 ECONOMIC PATTERNS AND POLICIES OF EASTERN EUROPE An area approach to the resources, organization, and domestic and foreign economic policies of the Communist countries of Eastern Europe, with special emphasis on recent changes. *Prerequisites:* 11-12; twelve additional hours in economics, political science or European history. Three hours. Mr. Dellin.

292 INTERNATIONAL ECONOMIC PROBLEMS AND POLICIES Changing patterns of the international economy; important aspects of international cooperation and conflict in the economic sphere; growth and stability on global basis; regional and interregional developments. *Prerequisite:* 11-12. Three hours. Messrs. Alnasrawi and Wass.

295 DEVELOPMENT OF ECONOMIC THOUGHT Development of economic ideas. The pre-Classical, Classical, Socialist, Neo-classical, Keynesian Schools and individual theoreticians. *Prerequisite:* 286 or concurrent enrollment. 193 recommended. Three hours. Messrs. Dellin and Schiller.

297, 298 SEMINAR Review of recent books and periodical literature; discussions and reports on topics of contemporary interest. *Prerequisite:* permission of the department. Three hours. Staff.

300, 301 INDEPENDENT READING AND RESEARCH A course designed to meet the special research problems of graduate students. *Prerequisite:* twelve graduate credits. Credit as arranged. Staff.

341 MANAGERIAL ECONOMICS AND OPERATIONS RESEARCH Techniques used in management decision making and forward planning. Operations research techniques and advanced quantitative methods applied to operating problems in business. *Prerequisites:* Economics 289, 193 and 286. Three hours. Messrs. Diamond and Campagna.

353 BUDGET PROCEDURE AND CONTROL Principles and procedures to be applied in preparing budgets and in analyzing performance under a budgetary program. *Prerequisites:* 161, 272. Three hours. Mr. Nyquist.

367 ADVANCED ECONOMIC STATISTICS AND ECONOMETRICS Theories and techniques of statistical analysis; probability, sampling, design of experiments, tests of statistical hypotheses, statistical estimation, regression, correlation, statistical demand and cost functions, econometric methods and models as tools of structural analysis, and economic projections. *Prerequisites:* Math 110 and Economics 188 or its equivalent and Mathematics 7, 8 or 11, 12. Three hours. Messrs. Campagna and Nargund.

377 ADVANCED ECONOMIC THEORY Advanced macroeconomic models presented and analyzed. The impact of Government policies on economic performance. *Prerequisites:* 193, 286. Three hours. Mr. Campagna.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

11, 12 Principles of Economics
13-14 Principles of Accounting
15, 16 Economic History of the
United States

109, 110 Business Law I
121 Principles of Marketing
122 Problems in Marketing
123 Personal Selling in the Economy

EDUCATION

127 Research Methods in Marketing	161-2 Intermediate Accounting
130 Sales Management and Promotion	164 Basic Federal Taxes
132 Fundamentals of Advertising	181 Transportation and Public Utilities
141 Labor Economics	183 Government and Business
143 Industrial Management	188 Elementary Statistics
160 Introduction to Integrated Data Processing and Computers	193 Macroeconomic Theory

The ECONOMICS RESEARCH CENTER is an agency for conducting fundamental and practical research in the area of economic development and a clearing house for the compilation, analysis, and dissemination of economic information. Studies such as measurement of prices, industrial output, transportation, and other trends in the State, as well as of marketing trends, labor force, employment changes, industrial development, business location, economic growth, and allied areas in the State or region or the nation will be undertaken. The Economics Research Center is intended as a resource organization for the disciplined conduct of research as well as an established source of information for University personnel, governmental, and private groups.

• EDUCATION

Professors Baker (Chairman), Hunt, Rippa and Steeves; Associate Professors Boller, Ratcliffe, Redmond and Sekerak; Assistant Professors Lang, McKenzie, Peterson, Petrusich and Riley.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF EDUCATION

Eighteen hours of Education and Psychology; see also p. 21.

MINIMUM DEGREE REQUIREMENTS

Eighteen hours in courses in Education numbered above 200; 12 additional hours in approved courses or six additional hours and thesis research (6 hours); a year of successful experience in teaching or in a related educational activity.

COURSES OFFERED

202 PHILOSOPHY OF EDUCATION Educational theory and philosophy past and present; contributions of leading educational philosophers; the inter-relationships of education, society, and philosophy. *Prerequisite:* 12 hours in Education and Psychology. Three hours. Miss Boller.

205 HISTORY OF AMERICAN EDUCATION History of principles and practices in American education as they relate to social, economic, political, and cultural developments. *Prerequisite:* 12 hours in Education and Psychology or a major in History. Three hours. Mr. Rippa.

211 EDUCATIONAL MEASUREMENTS The essential principles of measurement in education. Topics include measures of achievement, analysis of standard tests, construction of objective tests and inventories. *Prerequisite:* 12 hours in Education and Psychology. Three hours. Staff.

217 SECONDARY SCHOOL CURRICULUM Principles and problems in curriculum development. An analysis of recent curricular innovations in American secondary schools. *Prerequisite:* 12 hours in Education and Psychology. Three hours. Staff.

222 IMPROVEMENT OF READING INSTRUCTION IN THE ELEMENTARY SCHOOL A comparative analysis of current and emerging philosophies, programs and practices for teaching reading in the elementary school. Examination and evaluation of basal textbook, individual, and specialized reading programs. *Prerequisite:* 12 hours in Education or Psychology including an introductory course in Reading. Three hours. Mrs. Lang.

223 READING PROGRAMS IN SECONDARY SCHOOLS AND COLLEGES Relationship of reading to learning; study of organization, procedures and materials for developing reading improvement programs for secondary school and college students; reading in content areas. *Prerequisites:* 12 hours Education and/or Psychology or consent of instructor. Three hours. Mrs. Lang.

231 SECONDARY SCHOOL PRINCIPALSHIP Duties of the secondary school principal, organization and administration of the secondary school, the secondary school curriculum, pupil personnel services, problems of the teaching staff, school-community relations. *Prerequisite:* 12 hours in Education and Psychology. Three hours. Mr. Redmond.

248 EDUCATIONAL MEDIA Modern instructional arts, theory and practice. Educational media related to the psychology of teaching and learning. *Prerequisite:* 12 hours in Education and Psychology. Three hours. Mr. Sekerak.

250 GUIDANCE IN EDUCATION Introduction to guidance as an organized function of education; bases of modern guidance practices; the school testing program; relationship of guidance to the curriculum; current approaches to guidance problems of the intellectually gifted; counseling techniques for classroom teachers. *Prerequisite:* 12 hours in Education and Psychology. Three hours. Mr. Peterson.

275 ANALYSIS OF READING AND RELATED LANGUAGE DIFFICULTIES An inter-disciplinary approach to the analysis and evaluation of learning difficulties with an emphasis on reading and writing. Examination of the nature of difficulties; procedures and materials used for the assessment of reading performance. Practice with children is required. *Prerequisites:* 12 hours in Education and Psychology including course in reading or consent of instructor. Three hours. Mr. Hunt.

276 LABORATORY EXPERIENCES IN READING AND RELATED LANGUAGE INSTRUCTION A study of various approaches and materials used for the prevention and correction of reading and written language difficulties. Supervised teaching of individuals and small groups experiencing severe difficulties in reading and related language skills. Apprenticeships in a variety of reading instructional programs. *Prerequisite:* 275 or consent of the instructor. Three hours. Mr. Hunt.

EDUCATION

277 SEMINAR IN EDUCATIONAL PSYCHOLOGY A review of basic and current research in educational psychology and a study of the contributions of this research to theory and practice in the teacher-learning situation. *Prerequisite:* 12 hours in Education and Psychology. Three credits. Staff.

282 ADMINISTRATION AND ORGANIZATION OF GUIDANCE PROGRAMS Consideration is given to policies and procedures for organizing guidance services at all school levels and to guidance functions and relationships of school staff, including administrators, teachers, and guidance specialists. Procedures for instituting and carrying out programs of in-service training and evaluation of guidance activities are examined. *Prerequisites:* an introductory course in guidance and 12 hours in Education and Psychology. Three hours. Mr. Riley.

284 COUNSELING A study of the process and technique of counseling with special emphasis on the sociological and psychological bases. Counseling will be presented as a specialized form of teaching with consideration of its various techniques: interviews, group work, test interpretation, and analysis of case material. *Prerequisite:* graduate standing, 12 hours in Education and Psychology, and a course in guidance and/or testing. Three hours. Mr. Peterson.

285 INDIVIDUAL TESTING This course will concern itself with specific training in the techniques of the administration, scoring, and interpretation of individual intelligence tests suitable for application from the pre-school age through adult levels. Special emphasis will be placed on the Stanford-Binet Scale, L-M, and the Wechsler Adult Intelligence Scale. *Prerequisite:* graduate standing and 12 hours in Education and Psychology including an introductory course in testing. Three hours. Staff.

290 BASIC CONCEPTS IN MUSIC EDUCATION Disciplinary backgrounds; historical and philosophical foundations; fundamental considerations of the functions of music in the schools; development of a personal philosophy. Three hours. Staff.

291 PSYCHOLOGY OF MUSIC Psychological dimensions of tone and rhythm; the learning process in music; emotional and aesthetic response; musical ability; musical behavior and its measurement; American and European viewpoints and contributions. *Prerequisite:* 145-146 or Psychology 1 and 205. Three hours. Staff.

297, 298 PROBLEMS IN EDUCATION Individual work on a research problem selected by the student in consultation with a staff member. *Prerequisite:* 12 hours in Education and Psychology; endorsement by a sponsoring faculty member. Credit as arranged. Staff.

303-304 PROBLEMS AND RESEARCH IN TEACHING SECONDARY SCHOOL ENGLISH This course is identical with English 303-304, see p. 69.

378 ADVANCED STUDY AND RESEARCH IN READING AND RELATED LANGUAGE ARTS Survey of past and current research, compari-

son and evaluation of emerging programs, design and development of projects in reading through group and individual study. *Prerequisites:* 15 hours in Education including 9 hours in the field of reading and language education, or consent of the instructor. Three hours. Mr. Hunt.

379 SEMINAR IN READING INSTRUCTION Study of reading relative to total curriculum. Examination and analysis of significant trends and concepts related to specific problems and programs in reading and language arts instruction. Study of the role of the supervisor and the reading consultant. *Prerequisites:* 15 hours in Education including 9 hours in the field of reading and language education or consent of the instructor. Three hours. Mr. Hunt.

381 TEACHING INTERNSHIP Supervised teaching experiences on a full-time basis, with related seminars in teaching subject. *Prerequisite:* Permission of department. Three to six hours. Staff.

384 PRACTICUM IN COUNSELING Supervised experiences in individual and small-group counseling situations. Provides opportunity to relate counseling theory to actual situations and to develop counseling relationships; a minimum of 30 hours in actual counseling relationships, with analysis and evaluation of verbatim samplings. For students nearing completion of Master's in Guidance. *Prerequisite:* 284 and permission of the instructor. Three hours. Mr. Peterson.

390 ORGANIZATION AND ADMINISTRATION OF MUSIC EDUCATION A study of the organization and administration of vocal and instrumental music in the public schools. *Prerequisite:* graduate standing in music education and teaching experience or consent of instructor. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Thesis topic must be approved by a faculty committee. Credit as arranged. Staff.

• ADDITIONAL GRADUATE COURSES

The following courses (credits as indicated) are offered from time to time in Summer Sessions, and occasionally in the Evening Division Program. Candidates for the degree of Master of Education should plan to spend at least one Summer Session in residence. The Summer Session is normally of six weeks' duration, from the first week of July to the third week in August.

S201 ADMINISTRATION OF THE ATHLETIC PROGRAM	3
S203 PRINCIPLES OF PHYSICAL EDUCATION	3
S204 HISTORY OF EUROPEAN EDUCATION	3
S205 HISTORY OF AMERICAN EDUCATION	3
S206 COMPARATIVE EDUCATION	3

EDUCATION

S209	EDUCATION OF TEACHERS OF THE EDUCABLE MENTALLY RETARDED CHILD	3-6
S210	EDUCATION OF TEACHERS OF THE EDUCABLE MENTALLY RETARDED II	3-6
S212	CHILD DEVELOPMENT (Adolescent Development)	3
S213	STATISTICAL METHODS IN EDUCATION AND GUIDANCE	3
S214	THE SLOW LEARNER (Exceptional Child with Learning Disability)	3
S215	THE GIFTED CHILD	3
S216	HEALTH EDUCATION	6
S218	WORKSHOP IN CURRICULUM	4
S219	WORKSHOP IN ECONOMIC EDUCATION	4
S220	PERSONALITY DEVELOPMENT AND MENTAL HYGIENE	3
S225	SOCIAL SCIENCE EDUCATION IN THE SECONDARY SCHOOL	3
S227	TEACHING SCIENCE IN THE SECONDARY SCHOOL	3
S228	LITERATURE IN THE JUNIOR-SENIOR HIGH SCHOOL CURRICULUM (Literary Criticism for Teachers)	3
S229	COMMUNICATIVE ARTS IN SECONDARY SCHOOLS (Teaching English in Secondary Schools)	3
S230	THE ELEMENTARY SCHOOL PRINCIPALSHIP	3
S232	SCHOOL ADMINISTRATION	3
S233	ELEMENTARY SCHOOL SUPERVISION	3
S234	SECONDARY SCHOOL SUPERVISION	3
S235	SEMINAR IN EDUCATIONAL ADMINISTRATION (Supervision)	3
S237	PUBLIC RELATIONS IN EDUCATION	3
S241	SCIENCE METHODS (Science for Elementary Schools)	3
S242	MODERN TRENDS IN ELEMENTARY EDUCATION	3
S244	SOCIAL STUDIES IN THE ELEMENTARY SCHOOL	3
S252	TEACHING LATIN	3
S255	THE SCHOOL AS A SOCIAL INSTITUTION	3
S256	METHODS AND MATERIALS IN ELEMENTARY SCHOOL MATHEMATICS	3
S257	TEACHING MATHEMATICS IN THE SECONDARY SCHOOLS	3
S259	TEACHING FOREIGN LANGUAGE IN THE ELEMENTARY (Secondary) SCHOOL	3
S260	IMPROVEMENT IN TEACHING BOOKKEEPING AND BUSINESS SUBJECTS	3
S261	SEMINAR IN BUSINESS EDUCATION	3
S262	PRINCIPLES, PROBLEMS, AND TRENDS IN BUSINESS EDUCATION	3
S263	IMPROVEMENT IN TEACHING SECRETARIAL SUBJECTS	3
S264	BUSINESS EDUCATION CURRICULUM	3
S270	KINDERGARTEN METHODS AND ORGANIZATION	3
S271	LABORATORY EXPERIENCES IN KINDERGARTEN EDUCATION	4
S280	PROFESSIONAL PROBLEMS IN EDUCATION	3
S281	OCCUPATIONAL INFORMATION	3
S283	GROUP TESTING IN GUIDANCE	3
S286	TEST INTERPRETATION FOR SCHOOL COUNSELORS	3
S299	RESEARCH METHODS IN EDUCATION	3

• ELECTRICAL BIOPHYSICS

A cooperative program offered by the Department of Physiology and Biophysics (*N. R. Alpert, Chairman*) and the Department of Electrical Engineering (*W. Roth, Chairman*). (Cf. p. 109.)

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited Bachelor's degree in Electrical Engineering; a year course in Biology; a year course in Physical Chemistry.

MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301; twelve hours in physical sciences; additional approved courses; thesis research (10 hours) in the Department of Physiology and Biophysics.

• ELECTRICAL ENGINEERING

Professors Roth (Chairman) and Rush; Associate Professors Hoilman (Emeritus), Lai, Lambert, Shorey and Taylor; Assistant Professor Evering; Instructor Bradley.

Master of Science and Doctor of Philosophy programs are offered. Candidates normally have obtained the Bachelor of Science Degree in Electrical Engineering prior to application for admission but other applicants are encouraged to consider the program if they have extensive background in mathematics and the basic sciences. In such cases, it may be necessary for a student to complete his entrance qualifications without receiving credit toward his graduate studies. The general requirements for admission as outlined under the "Regulations of the Graduate College" must be met. Areas of research interests include control systems, biomedical engineering, statistical communications, electromagnetic fields and solid state physical electronics.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited Bachelor's degree in Electrical Engineering.

MINIMUM DEGREE REQUIREMENTS

Advanced courses in Electrical Engineering, Physics, and Mathematics (18-24 hours); thesis research (6-12 hours).

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Successful completion of Ph.D. comprehensive examinations. The majority of students will have completed the core program — comprising graduate courses in Controls, Fields, Solid State Circuits, Communications, Mathematics and Physics — before taking the comprehensive examination.

ELECTRICAL ENGINEERING

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

At least 48 credit hours in courses and seminars and 35 credit hours in thesis. Normally, 18 additional credit hours in an area of specialization are found necessary. The requirements specified under the "Regulations of the Graduate College" must also be met.

COURSES OFFERED

202 NETWORK ANALYSIS Time-domain and frequency-domain analysis of passive and active networks. Topological Analysis. State-variable methods. Analysis by computers. *Prerequisites:* 122 and 171. Three hours. Mr. Lai.

205, 206 NETWORK SYNTHESIS Realizability. General principles for synthesis of one-port and two-port networks. The approximation problem. Synthesis of networks with active elements. Computer-aided design. *Prerequisite:* 202. Three hours. Staff.

211 ELECTRIC UTILITIES Organization of the electrical utility, elementary corporate finance; economics of location, conductor size, station and line costs; rate structures; regulatory bodies. *Prerequisites:* senior standing in electrical engineering and departmental permission. Three hours. Staff.

212, 213 POWER TRANSMISSION SYSTEMS Line parameters for single phase, three phase, and multiple circuit lines, current and voltage regulations. Generalized circuit constants. Representation of power systems. Network equations and solutions using Matrix Algebra for digital computation. Load-flow studies. Economic operation of power systems. Symmetrical faults. Symmetrical components and unsymmetrical faults. Power system stability. *Prerequisites:* Senior standing, 212 for 213. Three hours. Mr. Hoilman.

214 INDUSTRIAL POWER APPLICATION Design and application of d-c and a-c motor drives for industrial plants; magnetic and electronic controls; duty cycles; acceleration, retardation and braking; power supplies and distribution systems. *Prerequisites:* 102 or 113; and departmental permission. Three hours. Staff.

221 TRANSISTORS The fundamental principles of semi-conductor operation. P and N type conductivity; the PN junction; construction of the junction transistor. Circuit analysis of transistor operation in terms of hybrid parameters. Equivalent circuits for high frequency operation; oscillators and pulse switching circuits. *Prerequisite:* 123. Three hours. Staff.

230 DIGITAL COMPUTER LOGIC, CIRCUITS & SYSTEMS The logical design of digital computers. Boolean algebra as an aid to circuit design. Circuits and components for the transmission, storage and modification of information and their combination into arithmetic units, memory devices, program controls and other major mechanisms. *Prerequisites:* 123 or Physics 117. Three hours. Staff.

232, 233 HYBRID COMPUTERS System design concepts and use of interconnected analog and digital computers as an engineering tool are stressed.

Selected problems from mathematics, biological and physical sciences are solved on a hybrid computer. The use of logic and decision as well as analog/digital and digital/analog conversion are stressed. *Prerequisite:* 123 or departmental permission. Three hours. Mr. Taylor.

238 RADIATION ELECTRONICS A study of electronic techniques for the detection and measurement of radioactivity; ionization chambers, Geiger counters, proportional counters, scintillation counters, neutron counters, coincidence circuits, ratemeters, and scalers. *Prerequisite:* Physics 28 or departmental permission. Three hours. Staff.

239 TRANSIENT PHENOMENA Study of complex variable basis of Laplace and Fourier Transforms; applications to transient behavior of lumped and distributed parameter systems, root locus, Nyquist criterion and two dimensional field problems. *Prerequisite:* 4. Three hours. Mr. Rush.

240 BOUNDARY VALUE PROBLEMS IN ELECTROMAGNETISM Solution of classical problems of Electromagnetism using images, conformal mapping and separation of variables methods. *Prerequisite:* 144. Three hours. Mr. Rush.

242 THEORY AND APPLICATIONS OF TIME-VARYING FIELDS Maxwell's equations, boundary conditions for time varying systems, skin effect and internal impedance of a conductor. Propagation and reflection of electromagnetic waves, guided electromagnetic waves, resonant cavities, and microwave networks. *Prerequisite:* 240 or departmental permission. Three hours. Mr. Evering.

272 INFORMATION THEORY Introduction to probability concepts of information theory; entropy of probability models; theoretical derivations of channel capacity; coding methods and theorems, sampling theorems. *Prerequisite:* Mathematics 291. Three hours. Staff.

281, 282, 283, 284 SEMINAR Presentation and discussion of advanced electrical engineering problems and current developments. *Prerequisite:* senior or graduate engineering enrollment. One hour. Staff.

285 CREATIVE ENGINEERING Creative techniques and applications to typical problems of commercial importance in fields of process control, biomedical engineering, communications, circuit design. *Prerequisites:* Graduate standing in EE or departmental permission. 3 hours. Mr. Roth.

287, 288 SPECIAL TOPICS Formulation and solution of theoretical and practical problems dealing with electrical circuits, apparatus, machines or systems. *Prerequisite:* 4. Three hours. Staff.

311, 312 ADVANCED CONTROL SYSTEMS Multiple input-output control system analysis. State space techniques, sampled-data and nonlinear control systems. Design utilizing optimal control theory. *Prerequisites:* 111 311 for 312. Three hours. Mr. Taylor.

ELECTRICAL ENGINEERING

314, 315 NONLINEAR SYSTEM ANALYSIS Study of the principal methods of solving nonlinear problems. Topological, analytical, graphical, and numerical methods; the general theory of nonlinear oscillation and stability; application of theory to numerous oscillatory problems. *Prerequisites:* Mathematics 211 or EE 4 and degree in physical sciences or engineering. Three hours. Staff.

316 POWER SYSTEMS Machine and line transients; steady state and transient stability of power systems; relay systems; circuit breakers; lighting; fault studies; coordination of power and telephone systems. *Prerequisites:* senior standing in electrical engineering and departmental permission. Three hours. Staff.

340, 341 SPECIAL TOPICS IN ELECTROMAGNETIC FIELD THEORY For advanced students in the field of electromagnetism. Topics selected from special interests of staff with lectures and readings from current literature. Three hours. Staff.

342, 343 MILLIMETER WAVE OPTICS Optical and microwave theory applicable to the millimeter and submillimeter region. Generation and detection of radiation; dispersion, scattering, and refraction; interference and interferometers; antennas, diffraction and diffraction gratings. Application to lasers, diffraction anomalies, atmospheric transmission and millimeter wave astronomy. *Prerequisite:* 242 or departmental permission. Three hours. Mr. Evering.

360 SOLID STATE THERMODYNAMICS Introduction to Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein distribution functions. Application of these functions to problems in solids. Development of the Planck radiation law and the Debye theory of lattice vibrational energies. Introduction to density matrix and negative temperatures. *Prerequisite:* Graduate standing in EE or Physics. Three hours. Mr. Lambert.

361 TRANSISTOR ENGINEERING Introduction to energy band theory and the effective mass concept. Analysis of the transport properties of holes and electrons. Characteristics of PN junctions. Theory of transistors as developed from drift and diffusion properties of carriers. Charge control model of transistor switch. *Prerequisite:* Graduate standing in EE or Physics. Three hours. Mr. Lambert.

363, 364 INTRODUCTION TO SOLID STATE THEORY Crystal structures in terms of the Bravais lattice and the Miller indices description. Band theory and the concept of Brillouin zone, Quantum theory of solids. Vibrational, transport, and other fundamental problems associated with ordered solids. *Prerequisites:* Introductory statistical thermodynamics; 363 for 364. Three hours. Equivalent to and alternates with Physics 341, 342. Mr. Lambert.

365 LASERS AND MASERS Conditions for operation and photon flux amplification. Modes of operation and measurement of power and beam characteristics. CW and pulsed lasers. Light modulation and detection. *Prerequisite:*

Bachelor's Degree in Engineering or physics or departmental permission. Three hours. Mr. Lambert.

366, 367 SOLID STATE THEORY Quantum mechanical free electron theory of metals. Quasi-free electron theory for periodic structures. Calculation of energy bands for the most common crystal structures employing the tight binding approximation. Development of thermal and magnetic properties of crystals. Calculation of cohesive energy of crystals. Presentation of generation and recombination mechanisms in semiconductors including photon absorption and emission. Introduction to the Boltzmann transport equation and its application to semiconductor problems. *Prerequisites:* 364, 366 for 367. Three hours. Mr. Lambert.

370 SIGNAL THEORY Analysis and representation of non random signals, signal space concepts. The Fourier representation. Orthogonal functions. Analysis and representation of random signals. Random processes, correlation and power spectral density. Gaussian random process. *Prerequisite:* Graduate standing in EE. Three hours. Mr. Lai.

372 ADVANCED COMMUNICATION ENGINEERING Principles of optimum receiver: Design and implementation. Implementation of coded communication systems. Models of communication channels: Bandpass channels and fading channels. Modulation systems: AM, FM, PAM, PPM, PWM and PCM. *Prerequisite:* Graduate standing in EE. Three hours. Mr. Lai.

374 THEORY OF SIGNAL DETECTION Testing of hypothesis. Detection of known and unknown signal. Detection by multiple observations. The estimation of signal parameters. Detection of signals of unknown arrival time. Signal resolution. *Prerequisite:* Graduate standing in EE. Three hours. Mr. Lai.

376 CODING AND SIGNALING The coding problem. Linear codes and nonlinear codes. Error-correction capabilities of linear codes. Important linear codes. Cyclic codes. Bose-Chaudhuri codes. Burst-error-correcting codes. Recurrent codes. Parity-check codes. Decoding methods. Efficient signaling for message sequences. *Prerequisite:* Graduate standing in EE. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of research topic under the direction of an assigned staff member culminating in an acceptable thesis. Credit as arranged.

Areas of research include control systems, instrumentation, electromagnetic fields, biomedical engineering, solid state materials and devices.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Investigation of research topic under the direction of an assigned staff member culminating in an acceptable doctoral dissertation. Credit as arranged.

ENGLISH

Undergraduate courses:

4 Engineering Analysis III	122, 123 Electronics II, III
102 Electrical Engineering Principles	144 Electromagnetic Field Theory
111 Control Systems	171 Signals and Systems
113 Energy Conversion	

• ENGLISH

Professors Bandel, Bogorad (Chairman), Hughes, Jones, Pope, and Trevithick; Associate Professors Caswell, Cochran, Long, Manchel, Orth, and Woodruff; Assistant Professors Broughton, Poger, Leonard, and Shepherd; Instructors Affsprung, Clark, A. I. Dickerson, M. J. Dickerson, Hall, Howe, C. Jarrett, D. Jarrett, Johnson, Kobler, McNallie, Miller, Picoff, Sheridan, Tillingbast, True, and Twitchell.

The research interests of the faculty of the Department of English and the library resources for research enable graduate students to undertake thesis subjects in virtually all the fields represented by the course offerings of the Department.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in English or its equivalent; satisfactory scores on the Graduate Record Examinations; demonstration of proficiency in writing by a detailed statement concerning the purpose in pursuing graduate study in English.

MINIMUM DEGREE REQUIREMENTS

Eighteen hours in English; 6 additional hours in English or a related field; thesis research (6 hours); reading knowledge of a foreign language, normally French or German.

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20. Satisfactory scores on the Graduate Record Examinations are prerequisite for acceptance to candidacy for this degree.

Note: The written comprehensive examination for the degrees of Master of Arts and Master of Arts in Teaching covers both English and American literature.

COURSES OFFERED

202 MEDIEVAL LITERATURE The forms (in translation) of medieval literature and Middle English texts, excluding Chaucer. *Prerequisites:* 27, 28. Three hours. Miss Hughes.

206 ELIZABETHAN DRAMA A study of drama in England from its beginning to 1642, exclusive of Shakespeare. *Prerequisites:* 27, 28. Three hours. Alternate years, 1968-69. Mr. Long.

207-208 SHAKESPEARE Literary study and textual interpretation of most of Shakespeare's works. *Prerequisites:* 27, 28. Three hours. Miss Bandel.

209, 210 ELIZABETHAN PROSE AND POETRY The major writers of the Tudor and Stuart periods; English prose from the early humanists to the Restoration. English poetry from Wyatt and Surrey to Donne and his followers, including the development of Elizabethan lyric poetry. *Prerequisites:* 27, 28. Three hours. Alternate years, 1967-68. Mr. Long.

212 MILTON *Paradise Lost*, *Paradise Regained*, *Samson Agonistes*, some of the minor poems, and selections from the prose works. *Prerequisites:* 27, 28. Three hours. Mr. Bogorad.

217 RESTORATION AND EIGHTEENTH-CENTURY DRAMA English drama from Dryden to Sheridan. The literary and theatrical qualities of representative plays. *Prerequisites:* 27, 28. Three hours. Alternate years, 1968-69. Mr. Bogorad.

218 RESTORATION AND EIGHTEENTH-CENTURY PROSE AND POETRY The works, including selected novels, of significant writers from Dryden to Johnson. Particular emphasis on the development of the essay, the satires of Pope and Swift, and the works of the Johnson-Boswell circle. *Prerequisites:* 27, 28. Three hours. Alternate years, 1968-69. Mr. Bogorad.

221, 222 THE ROMANTIC PERIOD First semester: development of the Romantic Movement through Wordsworth and Coleridge; second semester: Byron, Shelley, Keats, and other Romantic poets and prose writers. *Prerequisites:* 27, 28. Three hours. Mr. Jones.

227, 228 ENGLISH NOVEL English fiction from its origins through the nineteenth century. Masterpieces are stressed and read critically. *Prerequisites:* 27, 28. Three hours. Mr. Woodruff.

231, 232 VICTORIAN LITERATURE A study of the lives and the works, except the novels, of the significant writers from 1832 to 1900. *Prerequisites:* 27, 28. Three hours. Alternate years, 1968-69. Mr. Long.

233 MODERN AMERICAN NOVEL Representative American novelists since 1915. *Prerequisites:* 27, 28. Three hours. Mr. Cochran and Mr. Shepherd.

234 MODERN BRITISH NOVEL Representative British and continental novelists. *Prerequisites:* 27, 28. Three hours. Mr. Woodruff.

235 MODERN BRITISH DRAMA British and continental plays representing the principal trends in the dramatic renaissance of the late 19th and 20th centuries. *Prerequisites:* 27, 28. Three hours. Mr. Caswell.

236 MODERN AMERICAN DRAMA American plays representing the principal trends culminating in contemporary drama. *Prerequisites:* 27, 28. Three hours. Mr. Caswell.

239 MODERN BRITISH POETRY A study of selected British poets since World War I. *Prerequisites:* 27, 28. Three hours. Mr. Caswell.

ENGLISH

240 MODERN SHORT FICTION Critical study of short stories and novellas of outstanding modern writers; recent techniques and trends. *Prerequisites:* 27, 28. Three hours. Mr. Cochran.

244 MODERN IRISH LITERATURE A study of Irish literature from 1890 to the present, with emphasis on Yeats and Joyce. *Prerequisites:* 27, 28. Three hours. Alternate years, 1967-68. Mr. Caswell.

251, 252 AMERICAN NOVEL OF THE NINETEENTH CENTURY Masterpieces of nineteenth-century American fiction selected on the basis of literary merit. Lectures, class discussions, oral and written reports. First semester: Hawthorne, Melville, and others; second semester: Mark Twain, Howells, James, and others. *Prerequisites:* 27, 28. Three hours. Mr. Trevithick.

254 EMERSON, THOREAU, AND THEIR CIRCLE Special attention to the essays, journals, and poetry of Emerson, and to Thoreau's *Walden*. Minor writers in the group will receive briefer treatment. *Prerequisites:* 27, 28. Three hours. Alternate years, 1967-68. Mr. Trevithick.

256 REGIONAL WRITING IN AMERICA Selected works by Cooper, Harte, Garland, Twain, Faulkner, and others, including units on local color and Southwest humor. Lectures, discussions, and reports. *Prerequisites:* 27, 28. Three hours. Alternate years, 1967-68. Mr. Cochran.

257 AMERICAN POETRY TO WORLD WAR I Major American poets from the eighteenth century to the First World War, including Poe, Whitman, Dickinson, and others. *Prerequisites:* 27, 28. Three hours. Mr. Cochran.

258 MODERN AMERICAN POETRY Major American poets since World War I. *Prerequisites:* 27, 28. Three hours. Mr. Poger.

261 STRUCTURE OF THE ENGLISH LANGUAGE Descriptive study of the structure of modern American English. *Prerequisites:* 27, 28. Three hours. Mrs. Clark.

262 HISTORY OF THE ENGLISH LANGUAGE The principles of historical linguistics and their application to English. *Prerequisites:* 27, 28. Three hours. Alternate years, 1968-69. Mr. Dickerson.

273 TECHNIQUE AND CRITICISM OF POETRY Poetic theory, with close analysis of selected poems to show their organic structure, the relation between poetic effect and sense, mood, tone, imagery, stanzaic form, and meter. *Prerequisites:* 27, 28. Three hours. Mr. Bogorad.

275 HISTORY OF CRITICISM Principles and theories of criticism from Aristotle to the twentieth century. *Prerequisites:* 27, 28. Three hours. Alternate years, 1967-68. Mr. Orth.

276 CONTEMPORARY CRITICISM A seminar in selected contemporary critical methods and interests; discussion and criticism of selected works, both

contemporary and traditional, with emphasis on criticism of a major modern work. *Prerequisites:* 27, 28. Three hours. Mr. Poger.

277-278 ADVANCED CREATIVE WRITING The development of extended projects in creative writing such as a novel, a group of short stories or plays, or a sequence of poems. *Prerequisites:* 27, 28; 17. Three hours. Mr. Broughton.

282 SEMINAR FOR PROSPECTIVE TEACHERS OF ENGLISH Grammar and language; literary interpretation and criticism; allied problems useful to teachers of English. *Prerequisites:* 27, 28; and 261. Three hours. Mr. Manchel.

301 CHAUCER Study of the principal works of Chaucer, with emphasis on Chaucer's literary scope, talents, and position in medieval literature. Three hours. Miss Hughes.

302 GRADUATE SEMINAR A seminar for graduate students only. The topic varies from year to year, depending on the faculty member assigned to the course. Recommended for all first-year graduate students in English. Three hours.

303-304 PROBLEMS AND RESEARCH IN TEACHING SECONDARY SCHOOL ENGLISH Consideration of problems, curricular materials, teaching procedures and research methods in secondary school language, literature, and composition. *Prerequisites:* 12 hours of Education; acceptance as qualified to earn graduate credit in English. Three hours. Mr. Manchel.

371 BIBLIOGRAPHY Methods of literary study, research, and scholarship. Recommended for all first-year graduate students in English. Three hours. Mr. Pope.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

1-2 Freshman English	133, 134 Development of American Literature
16 Expository Writing	135, 136 Canadian Literature
17, 18 Creative Writing	192 Major Developments in English Literature
27, 28 Sophomore Literature	
101 Chaucer	

• FORESTRY

Professor W. W. Christensen (Chairman); Associate Professors Post, Whitmore, and Zai; Assistant Professors Fuller, Hannab, and McCormack.

Investigations at the Vermont Research Forest include the development of management plans for native and exotic conifers adapted to sandy soils; the

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effect of micro-weather and other site factors and stand density upon tree growth; provenance tests of exotic conifers; and the utilization and marketing of small and inferior tree species.

Other investigations include the relationship between soil and other site factors and tree growth of planted conifers and natural seeded commercial native hardwoods throughout Vermont; influence of soil and other site factors, nutrition, and cultural practices on Christmas tree quality; volume table construction for native timber; the marketing of forest products by timberland owners and wood processors; and habitat management and population dynamics of wood ducks. Cooperation in Northeastern Regional Research in forest tree improvement, and forest oriented recreation.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Successful completion of a four-year Forestry curriculum or a strong Forestry undergraduate major.

MINIMUM DEGREE REQUIREMENTS

Forestry 381, 382; advanced Forestry and related courses (9 hours); thesis research (6 hours).

COURSES OFFERED

205 MINERAL NUTRITION OF PLANTS This course is identical with Plant and Soil Science 205, see p. 113.

208 BIOLOGICAL STATISTICS The application of statistics to the analysis of biological data. Interpretation of statistical analysis. *Prerequisite:* Mathematics 9. Three hours. Mr. Post.

222 ADVANCED SILVICULTURE Scientific bases for silvicultural practices for specific forest types. *Prerequisite:* 123. Three hours. Mr. McCormack.

242 ADVANCED FOREST MENSURATION Advanced mensuration principles in forest land management. Current developments in the science of forest mensuration. *Prerequisite:* 141. Three hours. Mr. Zai.

252 FOREST VALUATION Principles and methods of appraisal of forest land, growing stock and other forest resources. Damage appraisals. *Prerequisite:* 136 and 151 or concurrent enrollment. Two hours. Staff.

282, 284 SEMINAR Review and discussion of current research literature. Required of Forestry seniors and graduate students. One hour. Staff.

381, 382 SPECIAL TOPICS Review and discussion of assigned forestry research literature. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

1 Introduction to Forestry	141 Forest Mensuration II
5 Dendrology	142 Forest Photogrammetry
24 Foundations of Silviculture	151 Forest Economics
31 Forest Fire Control	152 Forest Policy and Administration
100 Forestry Problems	161 Wood Technology
103 Woodland Management	163 Timber Harvesting and Milling
122 Silvics	164 Forest Products
123 Silviculture	171 Principles of Wildlife Management
130 Forest Management Planning	172 Practice of Wildlife Management
133 Forest Recreation Management	197, 198 Senior Research
136 Forest Management	
140 Forest Mensuration I	

• FRENCH

Professors Daggett and Johnston; Associate Professors Julow (Chairman), and Parker; Assistant Professors Kobler and Preston; Instructors Crispin, de Loesch-nigg, M. Geno, T. Geno, Heitkamp, Lascoumes, Radcliffe and Serra.

Opportunities for thesis research in French literature are offered in all areas from the 17th through the 20th centuries, with particular emphasis on the 18th and 20th centuries and on the 19th century novel.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in French, including a year course in literature and a year course in advanced composition and conversation.

MINIMUM DEGREE REQUIREMENTS

French 381, 382; additional courses in French; an advanced course in another literature (6 hours); thesis research.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

203, 204 FRENCH LITERATURE: TWENTIETH CENTURY Principal literary movements from 1900 to the present, with emphasis on outstanding works in the novel, drama, and poetry. *Prerequisites:* 101-102; 203 for 204. Three hours. Mr. Johnston.

211 FRENCH LITERATURE: EIGHTEENTH CENTURY Main currents of the literature of the century, with emphasis on Montesquieu, Diderot, Voltaire and Rousseau. Lesage, Marivaux, and Beaumarchais will be studied in the drama. *Prerequisite:* 101-102. Three hours. Alternate years, 1967-68. Mr. Johnston.

213 FRENCH LITERATURE OF THE BAROQUE AGE Selected works of the period from Montaigne to Pascal with emphasis on d'Aubigné, Jean de

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Sponde, Malherbe, Hardy, Mairat, Rotrou, Corneille, Tristan, Saint-Amant, d'Urfé, Scudéry and Scarron. *Prerequisite*: 102. Three hours. Mr. Parker. Alternate years, 1968-69.

214 FRENCH LITERATURE: SEVENTEENTH CENTURY Selected works of the century, with emphasis on Corneille, Molière and Racine. *Prerequisite*: 101-102. Three hours. Alternate years, 1968-69. Mr. Julow.

215 FRENCH MEDIEVAL LITERATURE A study of important works of the medieval period: Chansons de geste, romans courtois, Roman de Renart, Roman de la Rose, religious and comic theatre. Works studied in original text and in modern French versions. *Prerequisite*: 102. Three hours. Mr. Daggett. Alternate years, 1968-69.

216 FRENCH LITERATURE SIXTEENTH CENTURY Selected works of the period, with emphasis on Rabelais, Montaigne, and the Pléiade. *Prerequisite*: 101-102. Three hours. Alternate years, 1968-69. Mr. Daggett.

217 SPECIAL STUDIES IN FRENCH LITERATURE Selected authors representative of French thought and literary merit. *Prerequisite*: 101-102. Three hours. Alternate years, 1967-68. Mr. Johnston.

220 THE NOVEL FROM 1850 TO 1900 Study of theory and practice in the realistic-naturalistic novel in France from midnineteenth century to approximately 1900, with emphasis on Flaubert, the Frères Goncourt, Zola, Maupassant, Daudet. *Prerequisite*: 102. Three hours. Mr. Julow. Alternate years, 1967-68.

223-224 ADVANCED COMPOSITION AND CONVERSATION Translation into French of difficult English prose; free composition and discussion of questions of style. Practice in advanced conversation. Required of those who wish to be recommended to teach French. *Prerequisite*: 121-122. Three hours. Messrs. Kohler and Daggett.

227, 228 LINGUISTIC STRUCTURE OF FRENCH. An analysis of present day French, with emphasis on phonetics, phonemics, morphology, and syntax of the language. Considerable language laboratory practice is expected. Required for all who seek certification for teaching. *Prerequisites*: 121-122 and junior standing: 227 for 228. Three hours. Miss Radcliffe.

301 MARCEL PROUST, *A La Recherche du Temps Perdu* A study in depth of Proust's novel and of the various waves of criticism devoted to Proust and his work. Lectures, discussions, reports. Three hours. Alternate years, 1967-68. Instructor: Mr. Parker.

302 EMILE ZOLA'S *Rougon-Macquart* A thorough study of Emile Zola's *Rougon-Macquart* series, his theories of naturalism and critical estimate of his work. Lectures, discussions, reports. Three hours. Alternate years, 1968-69. Instructor: Mr. Julow.

381, 382, 383, 384 SEMINAR Offered for resident candidates for the Master of Arts degree; further opportunities for independent work are provided. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

1-2 Elementary French

121-122 Composition and Conversation

11-12 Intermediate French

101-102 French Literature:
Nineteenth Century

• GEOGRAPHY

Professor Miles (Chairman); Assistant Professors Barnum, D. Gade, and Meeks; Instructor M. Gade.

No Master's degree program offered.

201 HISTORICAL GEOGRAPHY OF THE UNITED STATES (Same as History 201) An examination of the physical setting within which the drama of American history has unfolded. Emphasis is placed on the sequence of peoples and cultures which have occupied the land and on their varied appreciation of its resource base. *Prerequisites:* History 23 or 28 plus 9 additional hours in geography, history, or other social science. Three hours. Mr. Miles.

202 HISTORICAL GEOGRAPHY OF EUROPE (Same as History 202) An analysis of European geography within a framework of past times; the historical development and distribution of settlement, economic and political patterns. *Prerequisite:* History 12 or 13, plus six additional hours in geography, history or other social science. Three hours. Mr. Barnum.

257 POLITICAL GEOGRAPHY (Same as Political Science 257) The characteristics of the political unit as a geographic area: location, resources, and the distributional relationships of the variety of cultural or human factors as they have a bearing on the structure and functioning of the modern political unit. The relationship between geopolitics and political geography. *Prerequisites:* 12 hours in geography and political science, or permission of instructor. Three hours. Mr. Miles.

262 CULTURAL GEOGRAPHY The elements of the cultural landscape, their evolution and distribution, including settlement, technology, domesticated plants and animals; as well as the spatial implications of language, religion, and cultural attitudes. *Prerequisite:* 2 and nine additional hours in geography, anthropology, or other social sciences. Three hours. Mr. Gade.

GEOLOGY

281 DEVELOPMENT OF GEOGRAPHIC THOUGHT Nature and development of geography as a discipline and a profession. *Prerequisite:* twelve hours in geography. Three hours. Staff.

Undergraduate courses:

1, 2 Introduction to Geography	103 Geography of the Soviet Union
3 World Geography	104 Geography of Asia
51 Climate	105 Geography of Europe
71 Cartography	106 Geography of Latin America
101 Geography of Africa	107 Geography of the United States
102 Geography of Canada	

• GEOLOGY

Associate Professors Doten, Hunt, Stanley (Chairman); Assistant Professors Grant, Wagner.

Research programs are oriented in the following areas: Selected problems in mineralogy including meteorites; selected problems in igneous and metamorphic petrology and ore genesis; sedimentary and metamorphic stratigraphy of New England and nearby areas; structural geology of sedimentary, metamorphic, and igneous terrains, including structural analysis of strain features of various sizes; petrofabric studies of strain features in selected minerals; geologic history and recent sedimentation of Lake Champlain; evolution, ecology and ontogeny of invertebrate fossils; glacial geology of Green Mountains and Champlain Lowland; ground water and geomorphic problems in northern Vermont, laboratory flume and stream table analysis of field problems; studies of lake ice.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Geology, year courses in Chemistry, Physics or Biology, and Mathematics. Open to undergraduate majors in physics, chemistry, biology, engineering or mathematics who have accumulated 20 semester hours in geology.

MINIMUM DEGREE REQUIREMENTS

Thesis and advanced courses in Geology must total at least thirty semester hours. Advanced courses in related sciences may be substituted for some selected Geology courses on approval by the department chairman. A reading knowledge of an approved foreign language is required.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

211 X-RAY CRYSTALLOGRAPHY The theory and practice of X-ray powder diffraction techniques for the identification of crystalline materials; single crystal methods and X-ray spectrography. *Prerequisites:* junior or senior standing with a concentration in a physical science, engineering, or mathematics. Three hours. Mr. Grant.

216 GLACIAL GEOLOGY The Quaternary history of North America, with emphasis on the origin, mechanics and effects of past and present glaciations. *Prerequisite:* 105. Three hours. Alternate years, 1968-69. Mr. Wagner.

224 STRATIGRAPHY The sequential development and distribution of the sedimentary rocks. *Prerequisites:* 106, 116. Three hours. Alternate years, 1967-68. Mr. Hunt, Mr. Stanley.

242 FOREIGN REGIONAL GEOLOGY An examination and comparison of the geology of selected portions of the world. *Prerequisites:* 106, 116. Three hours. Alternate years, 1968-69. Mr. Stanley, Mr. Doten.

251 GEOLOGY OF ORE DEPOSITS The origins and geologic associations of ore deposits. The classification and structure of such deposits and the application of physical and chemical methods for their discovery. *Prerequisite:* 106. Three hours. Alternate years, 1967-68. Mr. Doten.

271, 272, 273, 274 TOPICS IN GEOLOGY A synthesis of geologic processes and evolution of North America and selected portions of the world. Topics cover a wide range of subjects, with emphasis on current problems. *Prerequisites:* 106, 115, 116. One hour. Staff.

312 ADVANCED MINERALOGY Selected topics in mineralogy including crystal chemistry experimental mineralogy, and current problems in mineralogy. *Prerequisite:* 211. Three hours. Alternate years, 1967-68. Mr. Grant.

321 IGNEOUS GEOLOGY Paragenesis of igneous rocks; laboratory work on selected suites of specimens. *Prerequisite:* 106. Three hours. Alternate years, 1967-68. Mr. Doten.

324 METAMORPHIC GEOLOGY The origin of metamorphic rocks with emphasis on the concepts of metamorphic facies, analysis and interpretation of mineral assemblages, and the spacial relationship of metamorphism to tectogenesis. *Prerequisites:* 106, 211. Three hours. Alternate years, 1967-68. Mr. Stanley, Mr. Grant.

326 SEDIMENTARY PETROLOGY Origin and interpretation of sedimentary rocks. Topics include mechanics of transportation and deposition, recent depositional environments, interpretation of surface textures, methods of statistical analysis, theoretical aspects of rock classification, and sedimentary tectonics. Thin section study and individual projects. *Prerequisites:* 106. Three hours. Mr. Hunt.

330 ADVANCED GEOMORPHOLOGY Examination of stream, wind, glacier, and wave mechanics and the resultant land forms. Emphasis is given to recent field and laboratory studies. *Prerequisite:* 103. Three hours. Mr. Wagner.

335 ADVANCED STRUCTURAL GEOLOGY The geometric relationship and origin of various structural features in the different tectonic environments of the earth's crust. Emphasis is placed on field investigations, laboratory re-

GERMAN

sults, and theoretical models that provide insight into the deformational behavior of rocks in different parts of the earth's crust and the relationship between geologic structure and the dynamic configuration in which they have formed. *Prerequisite:* 116. Three hours. Mr. Stanley.

342 **ADVANCED PALEONTOLOGY** Problems in biogeology, paleoecology, and stratigraphic paleontology. The use of fossils in determining the origin, depositional environment, and age of rocks. Consideration is given to biogenic sedimentation, to taxonomic, adaptive, and biogeographic methods of paleoecological interpretation, and to geochronologic measures. *Prerequisite:* 121. Three hours. Mr. Hunt.

371, 372 **ADVANCED READINGS** Readings and research problems intended to contribute to the program of graduate students in phases of geology for which formal courses are not available. *Prerequisite:* graduate standing in geology. One to three hours. Staff.

391 THROUGH 393 **MASTER'S THESIS RESEARCH** Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

1-2 Introductory Geology
11-12 Mineralogy
21 Geology for Engineers
103 Geomorphology
105, 106 Petrology

115 Field Geology
116 Structural Geology
121 Paleontology
130 Geology of Mineral Resources
197, 198 Research in Geology

• GERMAN

Professor White (Chairman); Associate Professor Webster; Assistant Professors Kahn and Wurthmann; Instructors Ganz and Noble.

Current research interest concerns the linguistic structure of German; history of the German language; medieval German literature; literature of the eighteenth, nineteenth and twentieth centuries; the modern novel; and stylistics.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in German, including a year course in literature and a year course in advanced composition and conversation or the equivalent.

MINIMUM DEGREE REQUIREMENTS

German 381, 382; additional courses in German; advanced courses in a related field (6 hours); thesis research (6-12 hours).

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

205, 206 **GOETHE** Life and works of the poet through the Italian journey (205). Goethe in the years of his maturity: 1790-1832 (206). *Prerequisite:* 101-102 or the equivalent. Three hours. Alternate years, 1968-69. Messrs. Webster and White.

207 **NINETEENTH CENTURY PROSE** Masterpieces of narrative prose by representative authors such as Mörike, Keller, O. Ludwig, C. F. Meyer, Stifter, Raabe and the early Thomas Mann will be read. *Prerequisite:* 101-102 or the equivalent. Three hours. Mr. White.

208 **NINETEENTH CENTURY DRAMA** Works by Kleist, Büchner, Grillparzer, Hebbel, O. Ludwig, Wagner and the early Hauptmann will be read. *Prerequisite:* 101-102 or the equivalent. Three hours. Alternate years, 1968-69. Mr. White.

209, 210 **THE TWENTIETH CENTURY** Selected works in poetry, prose and drama by Brecht, George, Hauptmann, Hofmannsthal, Kafka, Thomas Mann, Rilke, and others will be read. *Prerequisite:* 101-102 or the equivalent. Three hours. Alternate years, 1967-68. Mr. White.

221-222 **ADVANCED COMPOSITION AND CONVERSATION** Guided conversation, discussion and advanced oral and written drill in German. Study of modes of expression and stylistic devices of modern German based on analysis of selected texts. Problems in translating literary and technical English prose into German. *Prerequisite:* 121-122 or equivalent. Three hours. Mr. Kahn.

232 **HISTORY OF THE GERMAN LANGUAGE** Introduction to Germanic linguistics, the comparative method, and linguistic reconstruction. The linguistic development of German from Indo-European to the present. No knowledge of older stages of the language is presupposed or required. *Prerequisite:* 121-122 or the equivalent. Three hours. Mr. White.

235 **THE STRUCTURE OF GERMAN** Linguistic analysis of the phonological, morphological, and syntactic structure of modern German with special attention to problems useful for teachers. *Prerequisite:* 121-122 or the equivalent. Three hours. Mr. White.

281-282 **SEMINAR** Special readings and research. One hour. Staff.

381, 382 **GRADUATE SEMINAR** Readings, conferences, and reports in connection with the work of candidates for the Master's degree. Credit as arranged. Staff.

391 THROUGH 393 **MASTER'S THESIS RESEARCH** Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

1-2 **Elementary German**

11-12 **Intermediate German**

81-82 **Scientific German**

101-102 **Introduction to German**

Literature

121-122 **Composition and
Conversation**

195-196 **Special Topics**

GREEK

• GREEK

Professor Gilleland; Associate Professors Ambrose, Bliss and Davison.

Current research interests include Early Greek Literature; the Attic orators; Greek drama; archaeology; philosophy; Mycenaean and Homeric Greece; Hellenistic economics; political theory.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Eight semesters of Greek or their equivalent; a year course in Latin; a course in Greek History; a reading knowledge of French, German, or Modern Greek.

MINIMUM DEGREE REQUIREMENTS

Eighteen hours of advanced courses in Greek; 6 additional hours in Greek, Latin, History, or Philosophy; thesis research (6 hours).

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

201 GREEK ORATORS Selected speeches of Lysias and Demosthenes. *Prerequisite:* 11-12. Three hours. Alternate years, 1967-68. Mr. Gilleland.

202 GREEK COMEDY Two plays of Aristophanes. *Prerequisite:* 11-12. Three hours. Alternate years, 1968-69. Mr. Bliss.

203 GREEK HISTORIANS Thucydides, Books I and II; selections from Herodotus and Xenophon's *Hellenica*. *Prerequisite:* 11-12. Three hours. Alternate years, 1968-69. Miss Davison.

204 GREEK TRAGEDY Sophocles' *Antigone* and Euripides' *Medea*, or two equivalent plays. *Prerequisite:* 11-12. Three hours. Alternate years, 1967-68. Mr. Ambrose.

205 GREEK PHILOSOPHERS Plato, *Republic*, Books I and II; selections from the Pre-Socratics and from Aristotle. *Prerequisite:* 11-12. Three hours. Alternate years, 1968-69. Mr. Ambrose.

381, 382 SEMINAR Intensive study at the graduate level of Greek authors not read in the candidate's undergraduate program. Credit as arranged. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

1-2 Elementary Greek

11-12 Intermediate Greek

111-112 Greek Prose Composition

151 Greek Drama in Translation

153 Greek Historians in Translation

• HISTORY

Professors Daniels (Chairman), Evans and Schultz; Associate Professors Davison, Felt, Hand, Heussler, and Schmokel; Assistant Professors Berger, Gard, Hennequin (Visiting), Spinner, Stout and True; Instructors Andrea, Briggs, Metcalfe and Muller.

Research interests include American history of the colonial, early federal, Civil War, and twentieth-century periods; American social and legal history; American foreign relations; Vermont history; Medieval Europe; the Renaissance; French history; English history (Tudor-Stuart and recent); twentieth-century German and Russian history; the Communist movement and Soviet foreign policy; Canadian history; Latin American history; African history; Far Eastern history; European economic history; music history. For ancient history, see Latin and Greek.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in history, or in a related field of the social sciences or humanities with the equivalent of a minor in history. Competency in a foreign language as appropriate to the student's intended program.

Applicants must take the Graduate Record Examination (aptitude and advanced history), and submit a sample independent research paper or term paper written in the course of undergraduate study.

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours in History, including thesis research (six hours); six additional hours in History or a related field.

The Department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

(Note: All graduate courses have the prerequisite of a specified survey course plus six additional hours of history or other social science. The first semester of any two-semester course is a prerequisite for the second semester, except by permission of the instructor.)

201 HISTORICAL GEOGRAPHY OF THE UNITED STATES This course is identical with Geography 201, see p. 73.

202 HISTORICAL GEOGRAPHY OF EUROPE This course is identical with Geography 202, see p. 73.

203, 204 LATIN-AMERICAN HISTORY Political, social, and economic development. First semester, colonial period; second semester, national period. *Prerequisite:* 11 and 12, or 13. Three hours. Mr. True.

211 THE RENAISSANCE Political, economic, and cultural developments in Europe, 1250-1517, with emphasis on Italian humanism. *Prerequisite:* 11 and 12, or 13, or 33 and 34. Three hours. Mr. Andrea.

HISTORY

212 THE REFORMATION Political, economic, and cultural developments in Europe in the sixteenth century. Particular attention will be devoted to the religious movements, and to the evolution of Northern European humanism. *Prerequisite:* 11 and 12, or 13. Three hours. Staff.

213, 214 CANADIAN HISTORY Canadian development from the French exploration and settlement to the present; evolution of self-government and relations with the United States; historical foundations of the problems of biculturalism. *Prerequisite:* 11 and 12, or 13. Three hours. Mr. Muller, Mr. Metcalfe.

221 THE AMERICAN COLONIES The colonial period of American history from the earliest explorations to 1763. *Prerequisite:* 11 and 12 or 13, or 23 and 24 or 28. Three hours. Mr. Stout.

222 THE AMERICAN REVOLUTION History of the War for Independence, the confederation, and the making of the U. S. Constitution, 1763-1789. *Prerequisite:* 11 and 12 or 13, or 23 and 24 or 28. Three hours. Mr. Stout.

231, 232 FRENCH HISTORY History of France in modern times: first semester, seventeenth century to 1848; second semester, 1848 to the present. *Prerequisite:* 11 and 12, or 13. Three hours. Mr. Hennequin.

233, 234 GERMAN HISTORY History of Germany in modern times: first semester, seventeenth century to 1850; second semester, 1850 to the present. *Prerequisite:* 11 and 12, or 13. Three hours. Mr. Schmokel.

237 ECONOMIC HISTORY OF PRE-INDUSTRIAL EUROPE Development of economic institutions and technology from the late Roman Empire to the eighteenth century. *Prerequisite:* 11 and 12, or 13. Three hours. Mr. Stout. (For Economic History of Europe since The Industrial Revolution see Economics 238.)

241, 242 ERA OF THE FRENCH REVOLUTION AND NAPOLEON French history from 1789 to 1815 with special attention to the impact of French ideas and power upon Europe. *Prerequisite:* 11 and 12, or 13, and reading knowledge of French. Three hours. Mr. Evans.

243 SOVIET RUSSIA The USSR from the Revolution of 1917 to the present. This course is intended as a general introduction to the study of Russia and Communism, including: historical and ideological background, Soviet political and economic institutions, Soviet foreign policy and international Communism. *Prerequisite:* 11 and 12, or 13, or 51 and 52. Three hours. Mr. Daniels.

244 TSARIST RUSSIA History of Russia from the Middle Ages to the Revolution of 1917, with emphasis on the period since Peter the Great. *Prerequisite:* 11 and 12, or 13. Three hours. Mr. Gard.

253, 254 ENGLISH HISTORY Political and social history of England and its role in world history. First semester, Middle Ages to 1715; second semester,

1715 to the present. *Prerequisite:* 11 and 12, or 13. Three hours. Mr. Metcalfe, Mr. Spinner.

257, 258 AMERICAN STATESMEN Thought and practical politics of American statesmen. *Prerequisite:* 23 and 24, or 28. Three hours. Mr. Schultz.

259 THE LINCOLN ERA A history of the United States, 1830-1865, with emphasis on the sectional conflict of the 1850's, the Civil War and the life of Lincoln. *Prerequisite:* 12 hours of history, including the equivalent of History 23. Three hours. Mr. Schultz.

261 VERMONT HISTORY *Prerequisite:* 23 and 24, or 28. Three hours. Mr. Muller.

265, 266 AMERICAN SOCIAL AND INTELLECTUAL HISTORY Selected topics in the social and intellectual history of the United States since 1783. *Prerequisite:* 23 and 24, or 28. Three hours. Mr. Felt.

267, 268 HISTORY OF U. S. FOREIGN RELATIONS International relations from the eighteenth century to the present, with major emphasis on the foreign policies of the United States. First semester 1763-1893; second semester 1893-present. *Prerequisite:* 12, 13, 24, or 28. Three hours. Mr. Berger.

277 GOVERNMENT OF THE USSR Theoretical background, structure and development of the Soviet state and the Communist Party; economic, social, and cultural policies; comparative survey of other Communist governments; current changes. *Prerequisite:* 243, or six hours of Political Science including 72. Three hours. Mr. Daniels.

278 FOREIGN POLICY OF THE USSR Theoretical background; history of Soviet foreign relations; development of the international Communist movement and the Communist bloc; factors and instruments of policy; current problems of relations between Russia and the West and among the Communist countries. *Prerequisite:* 243 or six hours of Political Science including 51. Three hours. Mr. Daniels.

281, 282, 283, 284 SEMINAR Advanced study in a selected field. The Department presently offers seminars in the fields of American, Canadian, European, and Ancient History. *Prerequisite:* 18 hours of history and permission of the department. Three hours. Staff.

301 HISTORIOGRAPHY Techniques of historical research and the development of the various philosophies of history. Designed to provide a professional orientation for graduate students. Required for all beginning graduate students. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of an individual research topic. Required of all candidates for the MA. Normally arranged for two semesters at three hours each. Staff.

397, 398 SPECIAL READINGS AND RESEARCH Readings on research topics, with conferences and reports, to provide graduate students with back-

HOME ECONOMICS

ground and specialized knowledge in an area not appropriately covered by an existing course. Three hours. Staff.

Undergraduate courses:

1 Introduction to European History	40 Biography
11, 12 European Civilization	51, 52 Contemporary History
13 European Thought and Institutions	61, 62 History of Science
23, 24 History of the United States	71, 72 Asian Civilization
28 American Thought and Institutions	91 Historiography
31, 32 Ancient History	116 Introduction to African History
33, 34 Medieval Europe	123 American History since 1945
	130 Chinese History

• HOME ECONOMICS

Professor Samenfink; Associate Professors Brown, Caldwell, Knowles, Morse and Williams (Chairman); Assistant Professors Atwood, Ellis, Lepeschkin, Livak, Pechmann, Powell, Prior, Quackenbush, Webster and Whittlesey; Instructors Beadle and Henry.

Research in Foods and Nutrition may include work on controlled diet experiments, basic human nutrition, nutritional status studies and food analysis. The department offers the Master of Science degree, specializing in fields of Food and Nutrition. In addition, more general programs leading to the Master of Arts in Teaching and the Master of Extension Education are available: Cf. p. 20 and p. 23.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Food and Nutrition or equivalent.

MINIMUM DEGREE REQUIREMENTS

Twenty hours major credit may be chosen from advanced courses in Foods, Nutrition, Biochemistry or related fields; thesis research (6-15 hours); minor credits up to ten hours.

COURSES OFFERED

219 HOME FURNISHINGS II Studies in interior design with special emphasis given to period furnishing, its present use and influence upon modern furnishing. *Prerequisite:* 130. Three hours. Miss Caldwell.

221 COSTUME DESIGN AND DRAPING Analysis of current fashion. Development of original design by draping techniques. *Prerequisite:* 15, 122. Three hours. Miss Caldwell.

229 CLOTHING, TEXTILES AND RELATED ART SEMINAR Theory and research in the field of Clothing, Textiles and Related Art; analysis of current problems; review and discussion of recent research, books and publications; individual studies. *Prerequisites:* 117, 221, 219 or equivalent. Three hours. Staff.

- 235 RECENT ADVANCES IN FOOD AND NUTRITION Interpretation, application and communication of the recent trends in Foods and Nutrition as evidenced through current literature and research. *Prerequisites:* 35, 135, 137 or equivalent; Chemistry 1 and 2, or 3 and 16. Three hours. Staff.
- 236 INTRODUCTION TO FOOD RESEARCH Methods and techniques used in experimental work in foods. Independent laboratory study of problems in food preparation. *Prerequisite:* 135. Three hours. Mrs. Livak.
- 237 READINGS IN FOODS A critical survey of the literature on the recent developments in food research. *Prerequisites:* 135; Agricultural Biochemistry 201. Two or three hours. Staff.
- 238 WORLD DIETARY PROBLEMS The complex interrelationships which are responsible for the nutritional status of persons living in selected countries. A background for the understanding of the causes of malnutrition in various areas of the world and the study of the techniques used, and agencies working to alleviate the problems. *Prerequisites:* 135, 144, Sociology 21, or permission of department. Three hours. Miss Williams.
- 239 INSTITUTIONAL MARKETING & ACCOUNTING Advanced course in institutional management. Units on advanced management, marketing, accounting, equipment, floor plans, layouts and related material on design and furnishings in the different types of food services. *Prerequisites:* 138, 139. Four hours. Alternate years, 1967-68. Staff.
- 243 ADVANCED NUTRITION The principles of human nutrition; the value of foods with application in calculating food requirements and diets for children, adults and family groups. *Prerequisites:* Agricultural Biochemistry 201; Zoology 52. Three hours. Miss Morse.
- 244 DIET THERAPY The adaptations of the normal diet in conditions affected by or affecting the utilization of food. *Prerequisite:* 243. Three hours. Miss Powell.
- 248 READINGS IN NUTRITION A critical survey of the literature on recent developments in nutrition. *Prerequisite:* 243 or permission of instructor. Two or three hours. Staff.
- 249 NUTRITION SEMINAR A review of the recent developments in human nutrition in reference to the individual and to the nutritional problems on a world-wide basis. *Prerequisite:* a college course in principles of nutrition. Two to three hours. Staff.
- 251 ADVANCED HOUSING Investigation of housing data and current problems including studies of environmental factors, technological developments and governmental programs. *Prerequisites:* 51, Economics 12 and Sociology 21. Three hours. Miss Knowles.
- 256 HOME MANAGEMENT PROBLEMS Application of economic and sociological principles to some problems of the home and family. *Prerequisites:* 56; Economics 12; Psychology 1. Three hours. Miss Knowles.

HOME ECONOMICS

258 FAMILY ECONOMICS The consumer and the market, use of credit, savings and investments, insurance and estate planning for the family. *Prerequisites:* 56 or equivalent, Economics 12. Three hours. Miss Knowles.

263 SEMINAR IN FAMILY RELATIONS AND HUMAN DEVELOPMENT Theory and research on the family. *Prerequisites:* 163, and/or Sociology 51. Three hours. Alternate years, 1967-68. Mr. Samenfink.

264 THE AMERICAN WOMAN Focuses on recent literature regarding the role of women and the unique tasks they face in maintaining stability in a dynamic 20th century world. *Prerequisite:* 163 and/or Sociology 51. Three hours. Alternate years, 1968-69. Mr. Samenfink.

265 FAMILY LIFE EDUCATION IN THE SCHOOL AND COMMUNITY Practical and theoretical approach to the family as an interacting unit and as an institution. Teachers, social workers, nurses, guidance and extension specialists and others, are offered an opportunity to develop a philosophy basic to family life education. *Prerequisites:* 63, 163, or equivalent. Three hours. Mr. Samenfink.

266 PERSONALITY AND DEVELOPMENT IN EARLY CHILDHOOD An intensive study and application of the principles of child development in relationship to preschool education, nursing and other areas. *Prerequisite:* 63 and 163 or equivalent. Three hours. Mr. Samenfink.

272 TEACHING ADULTS Problems of organization and of teaching classes in home economics to meet the needs of adults; supervised experience in techniques of teaching adults. *Prerequisites:* 171; either Education 145, 146 or Agricultural Education 104. Two hours. Miss Brown.

273 OCCUPATIONAL EDUCATION Role of the Home Economics teacher in organizing and implementing wage earning educational units at the secondary school level. *Prerequisite:* 171 or experience in secondary home economics education. Three hours. Staff.

294 HISTORY OF NUTRITION Foremost investigators and methods involved in the development of present day nutritional knowledge. *Prerequisites:* three hours of nutrition. One hour. Miss Morse, and Messrs. Donovan and Smith.

297, 298 PROBLEMS IN EDUCATION—HOME ECONOMICS This course is identical with Education 297, 298, see p. 58.

307 ADVANCED CONCEPTS IN NUTRITION This course is identical with Poultry Science 307, see p. 117.

308 EXPERIMENTAL TECHNIQUES IN NUTRITION This course is identical with Animal and Dairy Science 308, see p. 39.

301 READINGS IN FAMILY ECONOMICS Critical survey of the literature and of recent research in Family Economics. *Prerequisites:* 258. Statistical

Methods and one other advanced Economics course (may be taken concurrently). Three or four hours. Miss Ellis.

370 ADVANCED HOME ECONOMICS EDUCATION A study of recent trends, philosophy and objectives in methods of teaching homemaking at the secondary school level. Opportunity will be provided for individuals to work on problems related to their own situations. *Prerequisites:* 171, degree in Home Economics, teaching experience. Three hours. Miss Brown.

386, 387 GRADUATE SEMINAR Designed for graduate students concentrating in the department. Advanced study in a special field; opportunities for independent work are provided. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

20 Introduction to Textiles and Clothing	116 Weaving
15 Design	71 Introduction to Home Economics Education
22 Clothing Selection and Construction	117 History of Costume
35 Basic Concepts of Food and Nutrition	123 Tailoring
51 Housing	119 Home Furnishings I
54 Household Equipment	135 Advanced Food Preparation
61 The Family, Community and Preschool	137 Meal Management
63 Human Development and Personality	144 Applied Normal Nutrition
65 Experience with Preschool Families	156 Home Management Residence
82 Creative Curriculum Activities for Preschool and Kindergarten I	189 Preschool Practicum
17 Costume Design	168 Social Work in the Community
122 Pattern Design and Advanced Construction	163 Dynamics of Family Development
56 Principles of Home Management	164 Introduction to Parent Education and Family Consulting
155 Experimental Equipment	171 Methods of Teaching
151 House Planning	175, 176 Special Problems in Home Economics Education
184 Early Childhood Education	172 Student Teaching
166 Social Welfare as an Institution	173 Communication Methods
167 Social Welfare as a Profession	120 Advanced Textiles
115 Textile Design	183 Creative Curriculum Activities for Preschool and Kindergarten II
	138 Quantity Food Production
	139 Institutional Administration
	192 Introduction to Research

LATIN

• LATIN

Professor Gilleland, (Chairman); Associate Professors Ambrose, Davison and Bliss.

Current research interests include Cicero's rhetorical works; Vergil; Caesar; lyric and elegiac poetry; the Roman conquest of Greece; Roman provincial administration; Etruscology; urban topography; Petronius.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major or its equivalent in Latin; a course in Roman History; a reading knowledge of French, German, or Italian.

MINIMUM DEGREE REQUIREMENTS

Eighteen hours of advanced courses in Latin; 6 additional hours in Latin, Greek, History, or Philosophy; thesis research (6 hours); one year of Greek (if not completed as an undergraduate).

A program is also offered leading to the Degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

203 REPUBLICAN PROSE Extensive reading in Caesar and Sallust, and in the speeches of Cicero. *Prerequisite:* 101-102. Three hours. Mr. Gilleland.

204 EPIC POETS Extensive reading in Lucretius, Vergil, Ovid, and others. *Prerequisite:* 101-102. Three hours. Mr. Ambrose.

227 ROMAN LYRIC POETS Selections from the works of Catullus, Horace, Propertius, Tibullus. *Prerequisites:* Latin 203 or concurrent enrollment therein. Three hours. Alternate years, 1968-69. Mr. Bliss.

251 ROMAN LETTERS Selected letters of Cicero, Pliny and Fronto. *Prerequisite:* 203, 204 or concurrent enrollment therein. Alternate years, 1967-68. Mr. Gilleland.

252 COMEDY Two plays of Plautus and Terence. Study of the precursors of this literary form. *Prerequisites:* 203, 204 or concurrent enrollment therein. Three hours. Alternate years, 1967-68. Mr. Bliss.

253 ROMAN ORATORY Selections from Cicero's *De Oratore*, *Orator*, and *Brutus*, and from his speeches. Historical development of forensic and other rhetorical canons. *Prerequisite:* 203, 204 or concurrent enrollment therein. Three hours. Alternate years, 1967-68. Mr. Gilleland.

255 HISTORIANS OF THE EMPIRE Augustus, *Res Gestae*; Tacitus, *Annals*, I-IV; selections from Suetonius and Ammianus Marcellinus. *Prerequisites:* 203, 204, or concurrent enrollment therein. Three hours. Alternate years, 1968-69. Miss Davison.

256 SATIRE Selections from Horace and Persius; Juvenal, *Satires* I, III, X. Study of the development of this literary form. *Prerequisites:* 203, 204, or

concurrent enrollment therein. Three hours. Alternate years, 1967-68. Mr. Gilleland.

271 SILVER LATIN Extensive reading of post-Augustan authors not included in other advanced courses. *Prerequisites:* 203, 204, and 6 additional hours in courses numbered above 200. Three hours. Alternate years, 1968-69. Mr. Gilleland.

381, 382, 383, 384 SEMINAR Intensive study at the graduate level of Latin authors not read in the candidate's undergraduate program. Credit as arranged. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

1-2 Elementary Latin	111-112 Latin Prose Composition
11-12 Intermediate Latin	152 Roman Epic in Translation
32 Etymology	154 Roman Satire in Translation
101-102 Survey of Latin Literature	

• MATHEMATICS

Professors Meserve, Riggs and Schoonmaker (Chairman); Associate Professors Chamberlain, Dwork, Izzo, Lightball, Moser and Nicholson; Assistant Professors Hill, Khazanie, Sylvester, Wenner and Wright; Instructors Burns, Dickson, Marn, Nevin, Roney, Stein and Stewart.

Current research interests include applied mathematics; computer theory; foundations of mathematics; infinite series; linear programming; modern algebra; real variables; statistics; probability; topology; game theory and differential equations.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Thirty semester hours beyond intermediate calculus, including a year of advanced calculus.

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours in advanced Mathematics courses; thesis research (6 hours).

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

207, 208 ADVANCED CALCULUS The calculus beginning with limits, continuity, differentiation, and Riemann integrals; treatment of those topics not included in the earlier course as a foundation for more advanced courses in analysis and applied mathematics. *Prerequisites:* 102; 207 for 208. Three hours. Staff.

MATHEMATICS I

209 PROJECTIVE GEOMETRY The principle of duality, perspectivity, projectivity, harmonic sets, cross ratio, the theorems of Pascal and Brianchon, poles and polars. *Prerequisite:* 12. Three hours. Alternate years, 1968-69. Staff.

210 FOUNDATIONS OF GEOMETRY Geometry as an axiomatic science; various non-Euclidean geometries; relationships existing between Euclidean plane geometry and other geometries; invariant properties. *Prerequisite:* 12. Three hours. Staff.

211 DIFFERENTIAL EQUATIONS Solutions of linear ordinary differential equations, the Laplace transformation, and series solutions of differential equations. *Prerequisite:* 21. Three hours. Staff.

212 APPLIED MATHEMATICS I Boundary-value problems; orthogonal functions; vector analysis. *Prerequisites:* 24 and 211. Three hours. Mr. Dwork.

213 APPLIED MATHEMATICS II Partial differential equations and their solutions applied to mathematical physics; the functions of a complex variable. *Prerequisite:* 212. Three hours. Staff.

214 APPLIED MATHEMATICS III Calculus of variations; difference equations; integral equations. *Prerequisite:* 213. Three hours. Staff.

220 VECTOR ANALYSIS Introduction to vector methods, including the elements of vector algebra and vector calculus, with applications to physics and mechanics. *Prerequisite:* 21. Three hours. Staff.

222 GEOMETRY FOR ELEMENTARY SCHOOL TEACHERS Informal Euclidean geometry, classical constructions, coordinate geometry, inductive and deductive reasoning, convexity, and an introduction to topology. Not open to mathematics majors. *Prerequisite:* 126. Three hours. Mr. Izzo.

225, 226 TOPOLOGY The elements of point set topology: closed sets and open sets in metric spaces, continuous mappings, connection, Peano curves, separation theorems and homotopy. *Prerequisites:* 102; 225 for 226. Three hours. Alternate years, 1968-69. Staff.

227 DIFFERENTIAL GEOMETRY Analytic metric differential geometry of curves and surfaces in ordinary three dimensional space; curvature, torsion, Frenet formulas, involutes, evolutes, developable and ruled surfaces, geodesic curves. *Prerequisite:* 21. Three hours. Alternate years, 1967-68. Staff.

228 NUMBER THEORY Divisibility, prime numbers, Diophantine equations, congruence of numbers, and methods of solving congruences. *Prerequisite:* 21. Three hours. Staff.

231, 232 FUNCTIONS OF A COMPLEX VARIABLE Differentiation and integration of a function of a complex variable, mapping of elementary functions, infinite series, properties of analytic functions, analytical continuation, calculus of residues, contour integration, integral functions, meromorphic functions, Riemann surfaces, and conformal representation. *Prerequisites:* 208; 231 for 232. Three hours. Alternate years, 1968-69. Staff.

233, 234 THEORY OF FUNCTIONS OF REAL VARIABLES Point sets and measure, transfinite numbers, Riemann and Lebesgue integrals, and sequences of functions. *Prerequisites:* 208; 233 for 234. Three hours. Alternate years, 1967-68. Staff.

235, 236, 237 SPECIAL TOPICS IN ANALYSIS For advanced students in the field of analysis. Lectures, reports and directed readings on advanced topics in analysis. *Prerequisites:* 232 or 234 and consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

241, 242 MODERN HIGHER ALGEBRA Fundamental concepts of abstract algebra. Sets, mappings, groups, rings, integral domains, fields, homomorphisms, isomorphism, linear transformations and vector spaces. *Prerequisites:* 12, 102 highly desirable; 241 for 242. Three hours. Staff.

243 THEORY OF GROUPS The study of the various kinds and structures of groups. *Prerequisite:* 241. Three hours. Alternate years, 1967-68. Staff.

244 GALOIS THEORY The study of Galois theory leading to the insolubility of general quintic equations by radicals and theorems on constructions with ruler and compasses. *Prerequisite:* 243. Three hours. Alternate years, 1967-68. Staff.

245, 246, 247 SPECIAL TOPICS IN ALGEBRA For advanced students in the field of algebra. Lectures, reports and directed readings on advanced topics in algebra. *Prerequisites:* 241 and consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

249 NUMERICAL ANALYSIS Error analysis, evaluation of functions by power series, Chebyshev series, continued fractions. Numerical evaluation of integrals by various methods. Other topics. Assigned problems on IBM 1620 or 1130. *Prerequisites:* 21 or 23, 31 or knowledge of Fortran programming, 24 desirable. Three hours. Mr. Riggs.

251 THE THEORY OF DIGITAL COMPUTING MACHINES AND NUMERICAL ANALYSIS Mathematical theory underlying digital computing machines including assigned problems on the IBM 1620 or 1130, including programming in machine language and Fortran languages. About half of the course is devoted to elementary numerical analysis. *Prerequisite:* 21, 24 highly desirable. Three hours. Staff.

252 ADVANCED NUMERICAL ANALYSIS Finite difference methods, numerical solutions of differential equations, numerical solutions of systems of linear equations, linear programming and approximations of various types. Problems solved on the IBM 1620 or 1130. *Prerequisites:* 251 and credit or concurrent enrollment in 24. Three hours. Staff.

253 ADVANCED PROGRAMMING Assembly language programming, subroutines, structure of operating systems and compilers. *Prerequisite:* 31 or knowledge of Fortran programming. Three hours. Staff.

MATHEMATICS

255, 256, 257 SPECIAL TOPICS IN GEOMETRY For advanced students in the field of geometry. Lectures, reports and directed readings on advanced topics in geometry. *Prerequisites:* 209 or 227 and consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

259, 260 MATHEMATICAL LOGIC Truth tables, axiomatic propositional calculus, independence, first order quantification theory, completeness theorems, prenex normal forms, decidability. Formal number theory, recursive functions, Gödel numbers, recursive undecidability, axiomatic set theory, ordinal numbers, the axiom of choice, effective computability, undecidable problems. *Prerequisite:* 102 or permission of instructor; 259 for 260. Three hours. Staff.

261, 262, 263 SPECIAL TOPICS IN COMPUTER SCIENCE For advanced students in the field of computer science. Directed reading and research on topics in the area of computers. *Prerequisites:* 252 and 253. Credit as arranged. Staff.

265, 266, 267 SPECIAL TOPICS IN TOPOLOGY For advanced students in the field of topology. Lectures, reports and directed readings on advanced topics in topology. *Prerequisites:* 226 and consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

270, 271 ORDINARY DIFFERENTIAL EQUATIONS Linear and non-linear systems, approximate solutions, existence, uniqueness, stability, asymptotic behavior of solutions. *Prerequisites:* 208 or consent of instructor; 270 for 271. Three hours. Mr. Chamberlain.

275, 276 FUNCTIONAL ANALYSIS L^2 spaces and L^p spaces, Hilbert and Banach spaces, linear functionals and linear operators, completely continuous operators, Fredholm alternative, completely continuous symmetric operators, Hilbert-Schmidt theory, unitary operators, Bochner's Theorem, Fourier-Plancherel and Watson transforms. *Prerequisites:* 234; 275 for 276. Three hours. Staff.

281 THROUGH 286 SEMINAR Members of the staff and approved students meet weekly to study contemporary advances in mathematics and for reports on current research. One hour. Staff.

291 PROBABILITY THEORY Permutations and combinations, probability, stochastic variables, discrete and continuous distribution, joint distributions, binomial, Poisson and normal distributions, moments, measures of central tendency and of variability. *Prerequisite:* 12. Three hours. Staff.

292 MATHEMATICAL STATISTICS Sampling distributions, testing hypotheses, use of chi-square, Student's t and F distributions in significance tests, point and interval estimation, regression and correlation. *Prerequisite:* 291. Three hours. Staff.

293 ADVANCED MATHEMATICAL STATISTICS Sampling theory, analysis of variance, regression and correlation analysis, multiple correlation, analysis of covariance, nonparametric test. *Prerequisite:* 292. Three hours. Staff.

294 DESIGN OF STATISTICAL EXPERIMENTS Experimental design, analysis of experimental models and decision processes. *Prerequisite:* 293 or consent of instructor. Three hours. Staff.

295 MEASURE THEORY Sets and classes, inner and outer measure, Lebesgue-Stieltjes measure, measurable functions, absolute continuity, Radon-Nikodym theorem, convergences, and applications in theoretical probability. *Prerequisite:* 208 or consent of instructor. Three hours. Mr. Khazanie.

298 APPLIED STOCHASTIC PROCESSES Random walk models, Markov chains, Poisson process, Brownian motion, probability generating functions, discrete branching processes, homogeneous birth and death processes, diffusion processes, and first passage times. *Prerequisite:* Consent of instructor; credit or concurrent enrollment in 292. Three hours. Mr. Sylwester.

341, 342 ABSTRACT ALGEBRA Groups, rings, integral domains, extensions of rings and fields, factorization theory, groups with operators (Jordan-Hölder theorem, Krull-Schmidt theorem), modules, chain conditions, Hilbert basis theorem, Noetherian rings, linear spaces, tensor products of modules. *Prerequisite:* 242. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

- | | |
|---|---|
| 2 Plane Trigonometry | 21 Sophomore Mathematics |
| 4 Mathematics of Finance | 24 Linear Algebra |
| 7, 8 Fundamentals of Mathematics | 31 Programming and Elementary Numerical Methods |
| 9 College Algebra | 102 Fundamental Concepts of Mathematical Analysis |
| 11 Plane Analytic Geometry and Calculus | |
| 12 Analytic Geometry and Calculus | |

• MECHANICAL ENGINEERING

Professors Nabavandi (Chairman), Outwater and Tuthill; Associate Professors Carpenter, Duchacek, Hundal, Marshall, and Martinek; Instructor Mastro.

Research includes: dynamic analysis of boiling hydraulic loops, two-phase flow, thermal fluid system transients, space and time dependent analysis of complex thermal systems, transient and accident analyses of nuclear power plants, flow induced vibration, non-linear vibrations of structures, deep submergence problems, the effect of compressive loading of brittle materials, fracture mechanics of composite materials, mechanical forces on the human body—their measurement and implications, and surface fatigue of glass.

MECHANICAL ENGINEERING

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited Bachelor's degree in Mechanical Engineering, or its equivalent, including either Mechanical Engineering 262 and 266, or 252.

MINIMUM DEGREE REQUIREMENTS

Mathematics 212; Electrical Engineering 210; Mechanical Engineering 202; *either* Mechanical Engineering 243, 244 and 267 *or* Mechanical Engineering 211, 222, 272, 274; additional approved courses; thesis research.

At the present time a two-year period is required for completion of the Master's degree program.

COURSES OFFERED

202 ADVANCED MECHANICS Development of the foundations of mechanics leading to Hamilton's principle and LaGrange's equations; vibration and stability of systems with many degrees of freedom; gyroscopic effects in mechanical systems; systems with variable coefficients and non-linear systems. *Prerequisite:* 133. Three hours. Mr. Hundal.

211 ADVANCED MECHANICAL STRUCTURES I Statically indeterminate problems in bending; general expression of strain energy; theorem of Castigliano and its application to statically indeterminate problems; the reciprocal theorem and influence lines; theory of curved bars; beams on elastic foundation; combined direct compression and lateral loaded beams; continuous beams; theory of thin plates and shells with their applications. *Prerequisite:* Senior Standing. Three hours. Mr. Outwater.

222 ADVANCED MECHANICAL STRUCTURES II Stress and strain at a point in three dimensions; the theory of elasticity with two-dimensional examples; development of strain energy method with applications to beams, curved bars and plates; elastic bodies in contact. *Prerequisite:* 211. Three hours. Mr. Outwater.

243 ADVANCED FLUID MECHANICS Foundations of fluid dynamics; thermodynamics and concepts of compressible flow; isentropic flow; normal shock waves; flow in ducts with friction and with heating or cooling; generalized solution of combined effects. *Prerequisites:* 142 and Mathematics 211. Four hours. Mr. Duchacek.

244 COMPRESSIBLE FLOW Introduction to flow in two and three dimensions; steady irrotational flow; small perturbations; the hodograph method; the Karman-Tsien, Prandtl-Glauert, and Gothert's methods; supersonic airfoils; the method of characteristics; oblique shocks; shock waves and boundary layer interaction. *Prerequisite:* 243. Three hours. Mr. Duchacek.

246 AERODYNAMICS Application of the principles of fluid mechanics to the design and performance of aircraft; fluid dynamics; experimental facilities; airfoil characteristics; aspect ratio and plan-form influences; viscosity phenomena as applied to boundary layer; transition and separation on various shapes;

compressibility phenomena; the optimum airfoil; performance. *Prerequisite:* 142. Three hours. Mr. Duchacek.

252 MACHINE DESIGN II A continuation of 135 with emphasis on the dynamics and vibration of machines. Design problems correlating various engineering fundamentals and considering practical limitations. *Prerequisites:* 53, 135. Four hours. Mr. Carpenter.

262 THERMAL SYSTEMS Application of engineering thermodynamics to the analysis of thermodynamic machines and processes; problems on gas turbine, jet propulsion, nuclear power plants, energy conversion devices and other areas of current interest. *Prerequisite:* Senior Standing. Four hours. Mr. Tuthill.

266 HEAT TRANSFER Fundamental principles of heat transfer; conduction, convection, radiation; steady and unsteady state; the electric analogy; applications to heat transfer equipment. *Prerequisites:* 111 or 113; Mathematics 211. Three hours. Mr. Duchacek.

267 ADVANCED THERMODYNAMICS A rigorous, detailed study of the laws of thermodynamics and of ideal and actual thermodynamic processes. *Prerequisites:* 111 or 113, Mathematics 211. Three hours. Mr. Tuthill.

271 INDUSTRIAL MATERIALS I Fundamentals of ferrous and non-ferrous physical metallurgy, and non-metallic materials. The correlation of the microscopic structure and physical properties of metals, alloys and plastics with their heat treatments and uses. *Prerequisites:* Chemistry 2; Physics 16 or 28. Three hours. Mr. Outwater.

272 MECHANICAL BEHAVIOR OF MATERIALS Elastic and plastic behavior of single crystals and polycrystals; dislocations; approximate plastic analysis; anisotropic materials; hardness; residual stress; brittle, transitional and ductile fractures; fatigue; damping; creep and surface phenomena. *Prerequisite:* Senior Standing. Four hours. Mr. Outwater.

274 INDUSTRIAL MATERIALS II Geometrical Crystallography; packings in crystals; formation and transformations in crystals; structure of metals, semiconductors, and insulators. *Prerequisite:* 271. Three hours. Mr. Outwater.

281, 282 SEMINAR Presentation and discussion of advanced mechanical engineering problems and current developments. *Prerequisite:* senior or graduate engineering enrollment. One hour. Staff.

284 ADVANCED HEAT ENGINES Application of engineering science to specific types of heat engines according to the interest of the students. *Prerequisites:* 111, 142, 266. Three hours. Staff.

294 ENGINEERING DESIGN ANALYSIS AND SYNTHESIS Application of the fundamental concepts and principles of mathematics, physics, mechanics, electricity, thermodynamics, fluid dynamics and heat transfer combined with economic considerations and decision-making processes to the rigorous training

MEDICAL MICROBIOLOGY

in the design, analysis and synthesis of engineering systems and their components. *Prerequisite:* Senior Standing. Four hours. Mr. Hundal.

301 ADVANCED ENGINEERING DESIGN ANALYSIS AND SYNTHESIS Application of the fundamental concepts and principles of advanced mathematics, physics, mechanics, electricity, thermodynamics, fluid dynamics and heat transfer combined with economic considerations and decision-making processes to the rigorous training in the design, analysis and synthesis of complex engineering systems and their components. *Prerequisite:* Graduate Standing in ME. Four hours. Mr. Nahavandi.

302 ENGINEERING ELASTICITY General analysis of stress and strain; stress-strain relationships; equations of equilibrium and compatibility using Cartesian tensors; two-dimensional stress problems. Airy's stress function solutions using Fourier series, Fourier integral, and approximate methods; simple three dimensional problems; axisymmetric stress distribution; thermoelastic problems; energy principles of elasticity and their application; torsion of beams; theory of unsymmetrical beams; stress waves in elastic media. *Prerequisite:* Graduate Standing in ME. Four hours. Staff.

385, 386 SPECIAL TOPICS IN MATERIALS Lectures, reports, and directed readings on advanced topics on materials. *Prerequisite:* graduate enrollment. Three hours. Staff.

387, 388 SPECIAL TOPICS IN ENERGY CONVERSION Lectures, reports, and directed readings on advanced topics on energy conversion. *Prerequisite:* graduate enrollment. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

- | | |
|--------------------------------------|-------------------------------|
| 1, 2 Engineering Graphics | 135 Machine Design I |
| 53 Manufacturing Processes | 137 Systems Control |
| 84 Mechanical Instrumentation | 142 Fluid Mechanics |
| 92 Thermodynamics I | 164 Environmental Engineering |
| 111 Thermodynamics II | 174 Industrial Engineering |
| 113 Thermodynamics and Heat Transfer | 175 Methods Engineering |
| 133 Kinematics and Dynamics | 176 Plant Organization |

• MEDICAL MICROBIOLOGY

Professor W. R. Stinebring (Chairman)

Research Activities are in microbial physiology; microbial genetics; pathogenic bacteriology; immunology; and virology.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

One year of biological science; Mathematics 12 or equivalent; Physics 5 and 6 or equivalent; Chemistry 1 and 2, 123, 131 and 132 or equivalent.

MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 201; Microbiology 381-384; Thesis Research; Medical Biochemistry 301, 302, 303-304 (At the discretion of the Department other biochemistry courses may be substituted); enough credits from the following courses to complete thirty credit hours: Advanced Agricultural Biochemistry 250 and 254; Medical Microbiology 312, 322 and 324; or appropriate courses in Mathematics, Physics or Chemistry.

For another Master's program in this field, see under Microbiology.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY*

One year of organic chemistry, one year of biology, and sufficient Mathematics and Physics to provide background for the candidate's program. One year of residence and passage of a general examination in Microbiology.

MINIMUM DEGREE REQUIREMENTS

Agricultural Biochemistry 254; Medical Microbiology 201, 312, 322 and 324, and 381-389. Language requirements as described on page 24.

Course requirements may be completed by electing from the following: graduate courses offered by the preclinical departments of the College of Medicine; and courses numbered 200 or more offered by the Departments of Agricultural Biochemistry, Botany, Chemistry, Mathematics, Physics and Zoology.

A minimum of twenty hours and a maximum of thirty-five hours for thesis research will be allowed for the degree.

COURSES OFFERED

201 MEDICAL MICROBIOLOGY The fundamentals of microbiology; general principles of infection and resistance to infection; a systematic study of the various groups of disease producing microorganisms. *Prerequisite:* permission of the Department. Four hours. Staff.

301 SPECIAL PROBLEMS IN BACTERIOLOGY Minor investigations in Bacteriology designed to serve as an introduction to research. *Prerequisite:* 201. Two hours. Staff.

302 SPECIAL PROBLEMS IN IMMUNOLOGY Minor investigations in Immunology designed to serve as an introduction to research. *Prerequisite:* 201. Two hours. Staff.

312 GENETICS OF MICROORGANISMS Current theories of the chemical nature of genetic materials, the structure of the gene, gene action, allelism, crossing over, mutagenesis and cytoplasmic inheritance will be discussed in the light of recent contributions from the field of microbiology. Techniques de-

* Program operated jointly with the Department of Microbiology.

MEDICAL TECHNOLOGY

veloped for the study of microbial genetics will be emphasized. *Prerequisite:* Permission of the instructor. Three hours.

322 IMMUNOLOGY A one-semester course designed to provide the student with a comprehensive theoretical and practical knowledge of immunity and immunochemistry. *Prerequisite:* permission of the instructor. Two hours.

324 IMMUNOLOGY LABORATORY *Prerequisite:* Permission of the instructor. One hour.

381-389 SEMINAR Discussion of current problems and literature in the field. *Prerequisite:* Permission of the department. One hour per semester. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Original research under the direction of an assigned staff member, culminating in an acceptable Doctoral dissertation. Credit as arranged.

• MEDICAL TECHNOLOGY

Professor Coon, Director of Program (Chairman, Department of Pathology); Associate Professor Couch, Associate Director of Program; members of Pathology staff.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Undergraduate major in Medical Technology; certification (or eligibility) as MT(ASCP), minimum of one year's experience as a medical technologist.

MINIMUM DEGREE REQUIREMENTS

Biochemistry 301, 302; Medical Microbiology 201; Seminar; additional approved courses in areas including Biochemistry, Microbiology, Hematology, Administrative and Educational Aspects of Medical Technology; thesis research (6 hours).

381 SEMINAR Review and Discussion of current problems and literature in the field of medical technology. One hour. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

• MICROBIOLOGY

Professor D. B. Johnstone (Chairman) [Agricultural Biochemistry]; Assistant Professor Sjogren

Microbiological research in the Department of Agricultural Biochemistry is concerned with the biochemistry of microbial syntheses: antibiotics, carbohydrate polymers, pigments and aquatic pesticide degradation. It involves fluorescence, nitrogen fixation, and heavy water and employs electrophoresis, chromatography, and infrared spectrophotometry.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in science, including an undergraduate course in Bacteriology and Chemistry 131-132.

MINIMUM DEGREE REQUIREMENTS

Agricultural Biochemistry 201, 250, 254; Medical Microbiology 201, 381-384; thesis research (10-15 hours).

For another Master's program in the field of Microbiology, see under Medical Microbiology.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY*

One year of organic chemistry and biology and sufficient mathematics and physics to provide background for the candidate's program and the Ph.D. candidacy requirements of the Graduate College.

MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 201, 312, 322, and 324; Agricultural Biochemistry 254; the balance of courses according to student's need as determined by a studies committee; participation in microbiology seminars throughout residency, a reading knowledge of German and French or Russian; doctoral thesis research twenty to thirty-five hours.

• MUSIC

Professors Lidral (Chairman), Bennett and Pappoutsakis; Associate Professor Kinsey; Assistant Professors Read, Schultz and Weinrich.

Research traditionally includes stylistic study and analysis of selected works with emphasis on structural organization. Graduate research is also conducted in the areas of historical studies, music education, development of performance techniques and pedagogy, and Americana.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An approved undergraduate major in Music or Music Education; satisfactory performing ability in an applied music area; satisfactory score on the Graduate Record Examination.

* Program offered jointly with Medical Microbiology.

MUSIC

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours in Music; participation in musical ensembles throughout the term of residence; thesis research (6 hours); a reading knowledge of French, German, or Italian.

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

201, 202 ADVANCED HARMONY AND HARMONIC ANALYSIS Contemporary harmonic practice and sonority organizations; traditional and contemporary analysis. *Prerequisite:* 105-106; 201 for 202. Three hours. Alternate years, 1968-69. Mr. Kinsey.

203, 204 ORCHESTRATION First semester: The characteristics of instruments: arranging for orchestra; second semester: advanced exercises in orchestral scoring. *Prerequisites:* 105-106; 203 for 204. Three hours. Mr. Pappoutsakis. 204 in alternate years, 1967-68.

205, 206 COUNTERPOINT First semester: tonal counterpoint; second semester: canon and fugue. *Prerequisites:* 105-106; 205 for 206. Three hours. Mr. Kinsey. 206 in alternate years, 1967-68.

207 PEDAGOGY OF THEORY Objectives, viewpoints, content, and specific approach to organization and the teaching of theory courses. *Prerequisite:* 18 hours in Theory. Three hours. Mr. Lidral. Alternate years 1967-68.

208 FORM AND ANALYSIS Creative approach to aural and sight analysis of musical construction. *Prerequisites:* 105-106; 205 recommended. Three hours. Mr. Kinsey.

209, 210 ARRANGING, VOCAL AND INSTRUMENTAL First semester: arranging for vocal ensembles of various sizes and functions including mixed groups, men's and women's glee clubs, and chamber groups; second semester: arranging for instrumental ensembles of various sizes including marching, concert, and school bands, and chamber groups. *Prerequisite:* 203. Three hours. Messrs. Lidral and Schultz. Alternate years, 1968-69.

211, 212 CONDUCTING First semester: technique of the baton, score reading, laboratory practice; second semester: preparation and performance of selected scores, including score reading at the piano and rehearsal procedures. Selected students will conduct university major ensembles. *Prerequisites:* 5-6; 211 for 212. Three hours. Mr. Pappoutsakis. 212 in alternate years, 1968-69.

215, 216 COMPOSITION Creative work in free composition with instruction according to the needs and capabilities of the individual student. *Prerequisite:* 205 and 208 or consent of instructor. Three hours. Messrs. Lidral and Read.

221, 222 HISTORY OF MUSIC Changes in musical structure and style, in relation to contemporaneous artistic, literary, religious, and social movements.

First semester: Gregorian chant to the Baroque era; second semester: Baroque to Modern. *Prerequisites:* 1, 2 and 5-6. Three hours. Mr. Bennett.

223, 224, 225, 226, 227, 228 MUSIC LITERATURE Advanced studies in the literature of music. *Prerequisites:* 105-106 and 221, 222. Three hours. Messrs. Bennett and Lidral.

245, 246 CHAMBER MUSIC LITERATURE Study through analysis and performance of masterworks for small groups leading to public performance. *Prerequisite:* 12 hours or the equivalent in applied field and consent of instructor. One hour. Staff.

251, 252 ADVANCED INDIVIDUAL STUDY Private study in keyboard instruments, voice, strings, woodwinds, brass, percussion, and harp leading to public recital performance. *Prerequisite:* Advanced standing in applied field. One or two hours. Staff.

271, 272 APPLIED MUSIC PEDAGOGY Methods of teaching voice, strings, woodwinds, brass or keyboard instruments and advanced class instruction in them. Research paper required. *Prerequisite:* Performing ability, teaching experience, and consent of instructor. Staff.

281, 282, 283, 284 INDEPENDENT STUDY Studies in theory, composition, history, or literature, under the direction of an assigned staff member for advanced students and candidates for honors. Credit as arranged.

381, 382, 383, 384 SEMINAR Study of special topics appropriate to student needs. One hour. Mr. Kinsey.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

1, 2 Survey of Musical Literature	71, 72 Class Study (Applied)
5-6 Theory I	74 Instrument Repair Class
9, 10 Introductory Music	105-106 Theory II
41, 42 Major Ensembles	112 Choral Literature
45, 46 Chamber Music	113 Vocal Literature
51, 52 Individual Study (Applied)	

• PATHOLOGY

Professors Coon (Chairman), Andrews, Korson and Kusserow; Associate Professors Clemmons, Couch, Luginbuhl, Stark and Trainer; Assistant Professors Botting, Kaye, Picoff, Smith, and Taylor; Instructor Wise.

The research interests are in the fields of anatomic, clinical and experimental pathology. Current studies include histo-chemistry, blood coagulation, extra

PHARMACOLOGY

corporeal heart pumps, reproductive physiology and pathology, biochemistry and pathology of connective tissue, electron microscopy, and neoplasia.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Anatomy 301, 311, 322; Physiology and Biophysics 301; Biochemistry 301, 302.

MINIMUM DEGREE REQUIREMENTS

Pathology 301, 302 (12 hours), Medical Microbiology 201 (4 hours), additional approved courses; thesis research (6-15 hours).

COURSES OFFERED

201 HISTOCHEMISTRY A survey of techniques used for chemical identification of cellular and tissue components, including discussion of underlying theories. *Prerequisite:* an acceptable course in cell structure (*e.g.*, Anatomy 311, Botany 256); Chemistry 131-132; permission of the department. A course in biochemistry is strongly recommended. Credit as arranged. Not offered each year. Dr. Korson.

301 GENERAL PATHOLOGY A study of the processes of injury, repair, neoplasia, degeneration, etc., as they affect cells, tissues, and the human patient. *Prerequisite:* permission of the department. Three hours. Staff.

302 SYSTEMIC PATHOLOGY An introduction to diseases and pathologic processes with particular reference to their effects on various organ systems. Instruction in clinical laboratory medicine is correlated with the work in systemic pathology. *Prerequisites:* 301 and permission of the department. Nine hours. Staff.

310, 311, 312 ADVANCED PATHOLOGY Supervised practical experience in handling, processing, and diagnosis of pathological materials. Participation in departmental seminars and conferences. *Prerequisite:* 301-302; permission of department. Credit as arranged. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

• PHARMACOLOGY

Professors Jaffe, Macmillan and Smith (Chairman); Associate Professors Boulton and Gans; Assistant Professors Doremus, McCormack and Reit; Instructor Wallace.

The research program covers several areas. Studies of the basic physiology and pharmacology of the central and autonomic nervous systems and cardiovascular system are emphasized. Chemotherapeutic agents, which might be effective against cancer and various micro-organisms (such as trypanosomes) are being studied with emphasis upon their biochemical mechanism of action.

Drug distribution and metabolic studies are accomplished utilizing the most advanced radioactive isotope techniques. Studies on the influence of drugs upon liver function are being conducted. A large Cobalt-60 source is used for study of both the physiology of radiation damage and drugs capable of protecting mammals against the effects of ionizing radiation.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Chemistry 131-132; Physics 5-6; Mathematics 11-12; a year course in Biology; additional supporting courses in science; a reading knowledge of a foreign language, preferably German.

MINIMUM DEGREE REQUIREMENTS

Pharmacology 301, 381, 382; supporting courses in Biochemistry and Physiology; thesis research (6-15 hours).

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Mathematics 21; Chemistry 131-132 and 141-142; Physics 14-15; a year course in a biological science; a reading knowledge of German and of one other appropriate foreign language. Cf. also p. 16.

MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301; Biochemistry 301, 302, 303-304; Pharmacology 301; 381 through 384; advanced courses in Pharmacology; at least ten additional hours in courses other than Pharmacology; doctoral thesis research (20-30 hours). Cf. also p. 24.

COURSES OFFERED

301 MEDICAL PHARMACOLOGY The basic mechanism of action of therapeutic agents, their pharmacological actions, their fates and toxicology. *Prerequisite:* permission of the department. Seven hours. Staff.

311, 312 PHARMACOLOGICAL TECHNIQUES Demonstration and laboratory exercises in selected procedures of pharmacological research, with special emphasis upon the cardiovascular system and neuropharmacology. *Prerequisites:* Pharmacology 301 or Physiology and Biophysics 301. Two hours. Staff.

320 DRUG METABOLISM A study of the manner by which absorption, distribution, metabolism and excretion alter drug activity. Recent developments in analytical methods employed in such studies are included. *Prerequisite:* 301. Two hours. Staff.

362 DRUG EVALUATION Techniques employed in the study of a new chemical agent from its initial synthesis to its release to the medical profession. *Prerequisite:* 301. Two hours. Staff.

372, 374, 376 SPECIAL TOPICS Topics of current interest and importance in pharmacology are considered in depth through presentations by graduate

PHILOSOPHY AND RELIGION

students and staff. During each year a specific theme of study will be developed. *Prerequisite:* Permission of the department. One hour. Staff.

381, 382, 383, 384 SEMINAR General and specific considerations of current developments and research in pharmacology are presented for critical discussion by students, staff and visiting scientists. *Prerequisite:* permission of the department. Two hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Original research under the direction of an assigned staff member, culminating in an acceptable doctoral dissertation. Credit as arranged.

• PHILOSOPHY AND RELIGION

Professor Dykhuizen; Associate Professors Hall (Chairman) and Sadler; Assistant Professors Beckett and Martin; Instructors Paden and Sobers.

PHILOSOPHY

Specialties include history of philosophy, with special emphasis on Plato and Kant, Symbolic Logic, Value Theory, Existentialism, Aesthetics, and Philosophy of Religion.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS IN PHILOSOPHY

Twenty-one hours in Philosophy or demonstrated proficiency in philosophy which would give assurance of success in graduate study.

MINIMUM DEGREE REQUIREMENTS

Eighteen hours of Philosophy; six additional hours in Philosophy or a related field; competence in a foreign language, usually French or German, demonstrated by examination; six hours of thesis research.

COURSES OFFERED

202 ANALYTIC PHILOSOPHY The significant problems of philosophy from the standpoint of the predominant contemporary philosophic movement in England and the United States. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1968-69. Mr. Beckett.

203 CONTEMPORARY ETHICAL THEORY An intensive study of the contributions of leading ethical philosophers since G. E. Moore in ethical theory and metaethics. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1968-69. Mr. Beckett.

204 THEORY OF KNOWLEDGE An examination of the principal sources of knowledge and our awareness of the external world. *Prerequisites:* Two ad-

vanced courses in philosophy. Three hours. Alternate years, 1967-68. Mr. Sobers.

206 SOCIAL PHILOSOPHY The meaning and values inherent in social life. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1968-69. Mr. Hall.

207 METAPHYSICS Current and traditional metaphysical problems such as the concept of change, the existence of God, the self, and the world. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1967-68. Mr. Sobers.

208 THEORY OF VALUE An analysis of the nature of value and the nature of experience of the various realms of value. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1967-68. Mr. Sobers.

209 AMERICAN PHILOSOPHY The thought of such leading American philosophers as Royce, Peirce, James, Santayana, and Dewey. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1967-68. Mr. Dykhuizen.

211 NINETEENTH-CENTURY PHILOSOPHY A systematic analysis of the contributions to philosophical thought since Kant of such thinkers as Fichte, Schelling, Hegel, Schopenhauer, Nietzsche, Mill, Kierkegaard, and Dilthey. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1968-69. Mr. Hall.

212 EXISTENTIALISM Existentialism, its sources and its relation to literature and to the arts; Heidegger, Sartre, Marcel, Jaspers and others. *Prerequisites:* Two advanced courses in philosophy. Three hours. Mr. Hall.

214 INTELLECTUAL BACKGROUNDS OF MODERN LIFE Intellectual movements which have influenced the thought and life of today. *Prerequisites:* Two advanced courses in philosophy. Three hours. Mr. Dykhuizen.

281, 282 SEMINAR Selected topics in philosophy, determined according to the interest of students and instructor. *Prerequisites:* Two advanced courses in philosophy. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate Courses

1, 2 Introduction to Philosophy
3 Logic
4 Ethics
51 Philosophy in Literature
(alternate years)
82 Philosophy of Science

101 Contemporary
Philosophic Thought
102 Philosophy of Religion
107, 108 History of Philosophy
113 Philosophy of the Arts
181 Symbolic Logic

RELIGION

No Master's Degree Program Offered

201 METHODS OF UNDERSTANDING RELIGION A systematic investigation of some of the major methodological contributions to the understanding and interpretation of religion since Tylor and Frazer. The course will conclude with an analysis of the contemporary phenomenological movement and its contribution to the methodology of religion. *Prerequisites:* Religion 1, 2. Three hours. Mr. Paden.

205, 206 AREA STUDIES IN RELIGION A study in depth of religion in a particular area of the modern world such as: the Indian sub-continent, Japan, the Middle East, Latin America. *Prerequisites:* 6 hours in Religion or consent of the instructor. Three hours each semester. Sadler.

211 CONTEMPORARY TRENDS Significant modern developments in the world religions. *Prerequisites:* Religion 1, 2. Three hours. Staff.

281, 282 PROBLEMS IN THE HISTORY AND PHENOMENOLOGY OF RELIGION Topics of special concern to historians of religions. *Prerequisites:* Religion 201 or consent of the instructor. Three hours each semester. Staff.

Undergraduate courses:

1, 2 Religions of the World

11 Bible

101 Religion and Society

112 Religious Experience

122 Myth and Ritual

• PHYSICS

Professors Crowell (Chairman), Juenker, and Nyborg; Associate Professors Detenbeck, Krizan and Scarfone; Assistant Professors Brown, Depatie, Sachs and Thurnauer.

The Department of Physics offers opportunities for both experimental and theoretical research. An active program in acoustics includes studies of the mechanics of nonlinear sound propagation, and of changes (physical, chemical and biological) produced by high amplitude sound on structures and rates of processes. Studies of the liquid state are also being conducted by ultrasonic methods.

Research in the physics of metals includes studies of the interaction of gas molecules with metal surfaces using ultra high vacuum, radiotracer, work function and thin film techniques. In addition investigations of the optical properties of metals and the mechanisms of photoelectric emission are being conducted.

Research in quantum optics concerned with the uses of scattered light from lasers for the study of inhomogeneities in liquids and solids is in progress. Low temperature studies of superfluids and phase transitions in solid hydrogen are also being initiated.

Opportunities for theoretical research in the statistical mechanics of interacting molecules near solid surfaces are available. Other studies in statistical mechanics include problems in plasma physics and relativistic corrections to statistical mechanics.

There is an active theoretical research program in relativistic and non-relativistic quantum mechanics emphasizing the study of solvable particle models and scattering theory.

There are opportunities for theoretical research in elementary particle and high energy physics as well as theoretical nuclear physics. In addition there is a program in theoretical solid state physics emphasizing problems in lattice dynamics in both metals and non metals.

Opportunities for collaborative research with other departments of the University, such as Chemistry, Physiology and Biophysics, and Electrical Engineering are also available.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Science, Engineering or Mathematics; Physics 116, 117 and 272; two additional semester courses in physics above the sophomore level; two semester courses in mathematics above the sophomore level; satisfactory scores in the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Twelve hours in Physics courses numbered above 200 including six hours in courses numbered above 300; thesis research; a reading knowledge of an approved foreign language.

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

In addition to the general prerequisites of the Graduate College and satisfactory scores on the Graduate Record Examination, the following courses must be completed: Physics 311, 314 and 362; at least one year of general chemistry and 4 semesters in mathematics beyond Math 21. In addition, the student must have passed his Comprehensive Examination for the Ph.D. degree and have satisfied the language requirements. The student's record shall be such as to convince the department of his ability to cope with graduate courses and to conduct scientific research.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Of the minimum of 40 credit hours earned in courses and seminars as established by the Graduate College, at least twenty must be in Physics and at least 12 in other disciplines. The courses Physics 311, 313, 314, 361, 362, 375 are required of all students. In accord with the general policy of the Graduate College, all doctoral students are required to participate in the department's undergraduate teaching program.

PHYSICS

COURSES OFFERED

203, 204 ADVANCED PHYSICS LABORATORY Selected experiments from the fields of modern physics: atomic nuclear and solid state physics, physics of radiation and plasmas. Students required to formulate details of objectives and procedure and to evaluate results. Intended to be taken concurrently with physics 271, 272 but may be taken independently with consent of department. *Prerequisite:* 27, Mathematics 21; 203 for 204. Three hours. Staff.

212 MECHANICS AND WAVE MOTION Applications of the principles and methods of mechanics to continuous media (solids, liquids and gases); elasticity, hydrodynamics and wave propagation. *Prerequisites:* 116; Mathematics 211. Three hours. Mr. Sachs.

222 ADVANCED BIOLOGICAL PHYSICS Sound and electromagnetic waves, the latter including light, micro-waves and x-rays; ionizing particles and radiation. Interaction of these physical agents with biological systems. Physical properties of macromolecules and their aggregates. *Prerequisites:* Chemistry 2; Mathematics 21; and experience in applying differential equations. Departmental permission required. Four hours. Mr. Nyborg.

225, 226, 227 SPECIAL TOPICS IN BIOLOGICAL PHYSICS For research students in the field of biological physics. Lectures, reports and directed readings related to the research of the department. *Prerequisite:* Mathematics 21 and consent of the department. Credit as arranged. Offered as occasion warrants. Mr. Nyborg.

231, 232, 233 SPECIAL TOPICS IN ACOUSTICS For research students in the field of acoustics. Lectures, reports and directed readings on problems of particular interest to the current research of the department. *Prerequisite:* 212 and consent of the department. Credit as arranged. Offered as occasion warrants. Messrs. Sachs and Nyborg.

251, 252, 253 SPECIAL TOPICS IN THE PHYSICS OF SURFACES For research students in the field of surface chemistry and physics. Background of particular interest to the current research of the Department is presented and discussed. *Prerequisites:* 173 or Chemistry 142 and Mathematics 212 and consent of the department. Offered as occasion warrants. Mr. Crowell.

271, 272 ADVANCED MODERN PHYSICS Relativity, electron physics, atomic structure and spectra, wave mechanics; molecular and solid state physics, X-rays, nuclear physics. *Prerequisites:* 116 or Chemistry 142; 271 for 272. Three hours. Mr. Juenker.

301, 302 MATHEMATICAL PHYSICS—Introduction to basic mathematical methods of theoretical physics; vector and tensor analysis, partial differential equations, orthogonal functions, complex variables and variational techniques presented with appropriate physical illustrations. *Prerequisites:* 116, 118 and Mathematics 212. Three hours. Mr. Krizan.

311, 312 ADVANCED DYNAMICS Classical Mechanics presented as the basis of the concepts and methods of modern physics. Variational, Lagrangian and Hamiltonian formulations, canonical transformations, continuous systems. Selected topics such as small oscillations, perturbation theory and special relativity. *Prerequisites:* 116, Mathematics 211; 311 for 312. Three hours. Mr. Nyborg.

313 ELECTROMAGNETIC THEORY Development of Maxwell's theory of electromagnetism with emphasis on the unity of electric and magnetic phenomena, both in their physical basis and in the mode of mathematical description. Boundary value problems in electrostatics, multipoles, electrostatics of macroscopic media, dielectrics, magnetostatics, time varying fields, Maxwell's equations, conservation laws, gauge transformations, wave equations, Green's functions are employed throughout. *Prerequisites:* 118, Mathematics 212 or 220. Three hours. Mr. Depatie.

314 CLASSICAL ELECTRODYNAMICS A continuation of electromagnetic theory. Plane electromagnetic waves, wave guides and resonant cavities, simple radiating systems and diffraction, magnetohydrodynamics and plasma physics, special theory of relativity, relativistic particle kinematics and dynamics, multipole fields. *Prerequisite:* Physics 313. Three hours. Mr. Brown.

321, 322, 323 SPECIAL TOPICS IN THEORETICAL PHYSICS For research students interested in pursuing topics of general and departmental research interest in theoretical physics such as classical and quantum field theory, relativity, group theory, plasma physics, many-body problem and scattering theory; material involved would not be presently covered in other courses. *Prerequisites:* Consent of instructor. Offered as occasion warrants. Credit as arranged. Theoretical Physics Staff.

341, 342 SOLID STATE PHYSICS Introduction to crystal structure and classification of solids and to x-ray and neutron diffraction in crystals. Ionic crystals. Introduction to elastic properties of crystals, lattice vibrations, infrared absorption and thermal properties of solids. Dielectric and magnetic properties of solids. Introduction to the free electron and band theories of solids. Phenomenological treatment of super conductivity and introduction to cooperative phenomena. Diffusion. Semiconductor physics. *Prerequisites:* 118, 173 and 272. Three hours. Offered in alternate years. 1967-68. Equivalent to and alternates with E. E. 363, 364. Mr. Brown.

343, 344 ADVANCED SOLID STATE PHYSICS Introduction to methods of calculating energy bands in solids. The second quantization formalism and the quasiparticle concept with applications to phonons in metals and dielectrics, magnons, and various other collective systems. Systematic discussion of the fermi surface in metals and the experiments which yield information about its properties. Many-electron screening effects in metals. Elements of the BCS theory of superconductivity. deHaas van Alphen effect and cyclotron resonance. Magnetoacoustic attenuation and ultrasonic attenuation. Neutron

PHYSICS

scattering studies in crystals. Introduction to the two-particle Green's function. *Prerequisites:* 342, 362, 314. Three hours. Offered as occasion warrants. Mr. Brown.

361, 362 **QUANTUM MECHANICS** Mathematical and physical foundations of non-relativistic quantum mechanics are presented from the unifying point of view of Dirac which includes the matrix and wave formulations. Applications include the theory of angular momentum, perturbation theory, the theory of radiative transitions and scattering theory. The role of symmetry operations and the essential algebraic structure of quantum mechanics are emphasized. *Prerequisites:* 116, 118, 272; 361 for 362. Three hours. Mr. Thurnauer.

363 **ADVANCED QUANTUM MECHANICS** Introduction to the mathematical and physical concepts of relativistic quantum mechanics. Topics include the Klein-Gordon equation, Dirac's theory of the electron, the relativistic hydrogen atom, Feynman's propagator theory and its applications. *Prerequisite:* 362. Three hours. Mr. Scarfone.

364 **ADVANCED QUANTUM THEORY** Quantization of free and interacting fields. Symmetry properties of fields and particles. The S-matrix and Feynman graphs. Soluble models and renormalization. The elements of Dispersion Theory. Applications in relativistic particle scattering. *Prerequisite:* 363. Three hours. Mr. Scarfone.

366, 367 **SOLID STATE THEORY** This course is identical with Electrical Engineering 366, 367, see p. 65.

372 **NUCLEAR AND PARTICLE PHYSICS** Discussion of the conservation principles following from space-time symmetries and their consequences for nuclear and particle physics. The nucleon-nucleon interaction, iso-spin, light nuclei, nuclear models, analysis of scattering experiments at low and high energies. Selected additional topics such as the interaction between nucleons and radiation, weak interactions, dynamical theories of fundamental particle interactions. *Prerequisites:* 311, 314, 362. Three hours. Mr. Thurnauer.

375 **KINETIC THEORY AND STATISTICAL MECHANICS** Review of thermodynamics. Elements of kinetic theory including the Boltzmann equation, H theorem and transport phenomena. Introduction to equilibrium statistical mechanics, both quantum and classical. *Prerequisites:* 173, 272. Three hours. Mr. Krizan.

376 **STATISTICAL MECHANICS** Applications of fundamentals of statistical mechanics to quantum and classical ideal and imperfect gases. Investigations of special topics such as the Ising model, relativistic statistical mechanics, physical adsorption and phase transitions. *Prerequisites:* 375 and 361. Three hours. Mr. Krizan.

391 THROUGH 393 **MASTER'S THESIS RESEARCH** Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Original research under the direction of an assigned staff member, culminating in an acceptable doctoral dissertation. Credit as arranged.

Undergraduate courses:

5-6 Elementary Physics	117 Electricity and Magnetism
17, 18, 27 General Physics	118 Electricity and Optics
28 Introductory Modern Physics	122 Biological Physics
101, 102 Intermediate Physics	173 Thermal Physics
Laboratory	191, 192 Senior Research
116 Mechanics	

• PHYSIOLOGY AND BIOPHYSICS

Professors Alpert (Chairman) and Sichel; Associate Professor Chambers; Assistant Professors Howe, McCrorey Parsons and Webb.

Current research activities involve both systemic and cellular investigations. Specific areas of interest include comparative electrophysiology of nerve and muscle; pharmacology of neuromuscular blocking agents; molecular physiology of synaptic and conducting membranes; transmission of activity in cardiac muscle; directional excitability in skeletal muscle; excitation-contraction coupling; ultrasonic effects on living cell membranes; cochlear AC and DC potentials; mechanics, thermodynamics and biochemistry of muscle contraction; congestive heart failure; hypertensive heart diseases; reproductive physiology and general endocrinology; exercise and respiratory physiology.

Preference in awarding financial support will be given to Ph.D. candidates.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Year courses in Biology, Chemistry and Physics. These requirements must be completed by the end of the first year of residency.

MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301; other graduate courses as arranged (3 hours minimum); thesis research (6-15 hours).

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Biology, 1 year; Chemistry, organic and physical; Physics, 1 year; Mathematics, through calculus. A reading knowledge of French or German is required. These requirements must be completed by the end of the first year of residency. A Master's degree is not a prerequisite for the Ph.D. degree.

MINIMUM DEGREE REQUIREMENTS

Physiology and Biophysics 301, additional approved courses amounting to at least 40 hours, 16 of which must be in the Department; thesis research, minimum 20 hours; a reading knowledge of two appropriate foreign languages.

PHYSIOLOGY AND BIOPHYSICS

COURSES OFFERED

301 PHYSIOLOGY AND BIOPHYSICS Function in the whole human organism, and at the cellular, tissue, and organ levels, considered biologically and physically. *Prerequisite:* permission of the department chairman. Ten hours. Staff.

303, 304, 305, 306 SPECIAL PROBLEMS IN PHYSIOLOGY Various problems are covered by means of lectures, reports and directed reading. *Prerequisite:* 301; permission of the department chairman. Credit as arranged. Staff.

308 BIOMETRICS AND APPLIED STATISTICS This course is designed as an introduction to the rational use and evaluation of statistical methods in the planning of experiments and the interpretation of biological data. Topics include measures of central tendency and dispersion; "t"-test and analysis of variance; correlation and regression; chi-square; non-parametric methods; experimental design. The course includes a biometrics laboratory. Course limited to ten students. *Prerequisite:* Math 110 or equivalent, and permission of instructor. Five hours. Mr. McCrorey.

309 SYNAPTIC AND CONDUCTING MEMBRANES The mechanisms of synaptic transmission and nerve and muscle conduction will be explored, with particular emphasis on molecular structure and function. *Prerequisites:* Physiology 301, Biochemistry 301-302, permission of the instructor. Three hours. Alternate years, 1967-68. Mr. Webb.

310 MOLECULAR BASIS OF BIOLOGICAL MOTILITY This is an advanced course dealing with the molecular basis of muscle contraction and biological movement. The problems of energetics, mechanics and chemistry of biological motility will be considered in detail. Special emphasis will be given to the contraction of skeletal muscle. There will be some discussion of pathology, pharmacology and the comparative physiology of muscle related to the areas designated above. Lectures and conferences. *Prerequisites:* Physiology 301, Biochemistry 301, 302, permission of the instructor. Three hours. Alternate years, 1968-69. Mr. Alpert.

311 SPECIAL SENSE RECEPTORS Function of receptor cells from the standpoint of stimulation and response. Specific sense receptors will be considered. Assigned reading in the research literature with seminar discussions. *Prerequisite:* Physiology 301, permission of the instructor. Three hours. Alternate years, 1967-68. Mr. A. Chambers.

313 EXPERIMENTAL ENDOCRINOLOGY This is an advanced course dealing with integrative endocrinology with emphasis upon the interrelationships between the various endocrine glands. The aspects of hormonal biosynthesis and activity upon various target organs, interactions between specific hormones, and homeostatic control on total body physiology will be considered in detail. Special emphasis will be given to laboratory techniques applicable to endocrine research. Lectures and laboratories. *Prerequisites:* Physiology 301 or Endo-

crinology 271, permission of instructor. Three hours. Alternate years, 1967-68. Mr. Howe.

314 PHYSIOLOGY AND BIOPHYSICS OF THE CIRCULATION This course deals with the principles underlying the regulation of circulation. Special emphasis will be given to a consideration of the physiological adjustments to exercise. The course will consist of reading and discussing articles, monographs and reviews. It will be a seminar type course limited to ten students. *Prerequisites:* Physiology 301, permission of the instructors. Three hours. Alternate years, 1967-68. Messrs. Tabakin, Hanson and Levy.

315 PHYSIOLOGY AND PHARMACOLOGY OF SYNAPSES A comparative study of synaptic connections in invertebrate and vertebrate species will be undertaken; with emphasis on their ultrastructure, pharmacology, and physiology. *Prerequisites:* Physiology 301, Biochemistry 311-312, permission of the instructor. Three hours. Alternate years, 1968-69. Mr. Parsons.

321, 322 CELLULAR PHYSIOLOGY AND BIOPHYSICS Fundamental physical and physicochemical properties of living cells. The reading of original scientific papers in the area covered will be stressed. *Prerequisite:* permission of the department chairman. Hours and credit as arranged. Staff.

381 THROUGH 389 SEMINAR Presentation and discussion by advanced students and staff of current developments and research in the field. *Prerequisite:* permission of the department chairman. One hour per semester.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable doctoral dissertation. Credit as arranged.

DIVISION OF BIOPHYSICS

Professor Sichel (Chairman); Associate Peterson.

COURSES OFFERED

311, 312, 313, 314 SPECIAL PROBLEMS IN BIOPHYSICS Lectures, reports and directed readings on current problems in biophysics and medical physics. *Prerequisites:* 301; permission of the division chairman. Credit as arranged. Staff.

331 ELECTRIC EXCITATION OF PHYSICAL AND BIOLOGICAL SYSTEMS The relation between stimulus and response in physical and in excitable biological systems will be considered in terms of membrane parameters. *Prerequisites:* Physiology 301, permission of instructor. Three hours. Alternate years, 1967-68. Messrs. Sichel and Peterson.

PLANT AND SOIL SCIENCE

371 THROUGH 379 SEMINAR Presentation and discussion by advanced students and staff of current developments and research in the field. *Prerequisite:* permission of the division chairman. One hour per semester.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable doctoral dissertation. Credit as arranged.

• PLANT AND SOIL SCIENCE

Professors Wiggans (Chairman), Bartlett and Hopp; Associate Professors MacCollom and Wood; Assistant Professors Boyce, Flanagan, McIntosh and Pellett; Lecturers Benoit, Calaban, Parker and Way.

Current research projects are concerned with the solution of both basic and applied plant and soil problems. Areas of research include winter hardiness of plants, apple virus identification and control, ornamental horticulture, chemical and environmental control of plant growth, soil-water-plant interrelationships, soil chemistry, soil fertility, plant establishment and management, fertilizer and crop variety testing, drainage of agricultural lands, and cultural and environmental interrelationships as they affect plant growth.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

At least twenty semester hours in the plant and soil sciences; supporting courses in other sciences and mathematics.

MINIMUM DEGREE REQUIREMENTS

Plant and Soil Science 281, 282, 283, 284 (4 hours); 15-20 hours in Plant and Soil Science and closely related fields; thesis research (8-12 hours).

Students may specialize in either *horticultural science*, *crop science* or *soil science*.

COURSES OFFERED

201 MICROMETEOROLOGY A theoretical and practical consideration of the micrometeorological factors that affect plant growth and response. The relationship of these factors to crop selection and agricultural practices. *Prerequisite:* 11 or equivalent. Three hours. Mr. Benoit. Alternate years, 1967-68.

204 PLANT RESEARCH TECHNIQUES Methods of conducting research with plants. Organizing and planning of experiments. The use of field and laboratory equipment. *Prerequisites:* 11, 61, and Botany 103 or equivalent. Three hours. Mr. Wiggans. Alternate years, 1967-68.

205 MINERAL NUTRITION OF PLANTS Classical work in solution culture; modern theories of ion accumulation. Colloidal chemistry of roots and the rhizosphere. Measurement of ion availability in relation to uptake and growth. *Prerequisites:* 11, 61, and Botany 103 or equivalent. Three hours. Mr. Bartlett and Botany, Forestry, and Plant and Soil Science Staff. Alternate years, 1967-68.

222 ADVANCED TREE FRUIT CULTURE Theory and practice of modern commercial fruit science. Basic principles involved in nutrition and responses to cultural and management practices. *Prerequisite:* 11. Three hours. Mr. Calahan. Alternate years, 1968-69.

261 SOIL FORMATION AND CLASSIFICATION A discussion of the development of soils throughout the world as influenced by soil forming factors. Detailed study of soils occurring in Vermont. Classification of soils, including the Unified System, 7th Approximation. *Prerequisite:* 61 or a total of 6 hours in ecology, geology, or geography. Two hours. Mr. Bartlett. Alternate years, 1968-69.

264 SOIL CHEMISTRY The chemistry and biology of soils as they affect plant growth. Colloidal properties of clays and organic matter in relation to soil acidity and availability of essential elements. Modern laboratory analysis of soils, fertilizers and plant tissue. *Prerequisites:* 61, Chemistry 1-2 or 11-12. Three hours. Mr. Bartlett. Alternate years, 1967-68.

266 SOIL PHYSICS The physical properties of soils. The mathematical and physical principles necessary to understand the soil-water-plant interaction and its relationship to production and management. *Prerequisites:* 61, Physics 5-6. Three hours. Mr. Benoit. Alternate years, 1968-69.

281 THROUGH 284 SEMINAR Presentation and discussion of papers on selected topics of current interest by students and staff. *Prerequisite:* senior standing. One hour. Staff.

381, 382 SPECIAL TOPICS Advanced readings and discussion of horticulture, agronomy, or soils research literature. Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

Undergraduate courses:

10 Home and Garden Horticulture	123 Vegetable Crops
11 Introduction to Plant Science	125 Ornamental Horticulture
61 Introduction to Soil Science	138 Plant Propagation
102 Natural Resource Conservation	141 Forage Crops
104 Principles of Plant Pest Control	144 Field Crops
106 Economic Entomology	145 Turfgrasses
108 Forest Entomology	161 Soil Fertility and Management
110 Forest Pathology	197, 198 Senior Research
122 Small Fruit Crops	

• POLITICAL SCIENCE

Professors Gould (Chairman), Haugen, Hilberg, G. T. Little and Nuquist; Assistant Professors Kirk, Pacy, Simon, Staron and Warner; Instructors Briggs, Brubaker and Eastman.

Research interests of the Department of Political Science and the various library resources available enable graduate students to undertake research in state and local government; public law; United States public policy formation and administration; defense policy; foreign policy; foreign governments; international relations; methodology.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Twelve hours of Political Science at the junior-senior level; supporting courses in other social sciences; satisfactory scores on the Graduate Record examination.

MINIMUM DEGREE REQUIREMENTS

An approved program of 24 hours in course work, including Political Science 283 and not more than 6 hours in related fields; thesis research (6 hours).

COURSES OFFERED

Admission to the following courses for graduate credit requires the approval of the Department.

211, 212 POLITICAL THOUGHT Development of political thought; recent political thought. Three hours. Mr. Staron.

216 AMERICAN POLITICAL THOUGHT The development of American political thought from the colonial period to recent times. Three hours. Mr. Simon.

221, 222 CONSTITUTIONAL LAW First semester: historical and analytic study of judicial review, federalism, the taxing power, the suffrage. Second semester; historical and analytic study of the war power, the executive power, due process of law, citizenship, Bill of Rights, and equal protection of the laws. Three hours. Mr. Gould.

225 COMPARATIVE ADMINISTRATIVE LAW A comparative analysis of the administrative law systems of Great Britain, France, Germany, and Russia. *Prerequisite:* 221 or 241. Three hours. Mr. Haugen.

226 ADMINISTRATIVE LAW A study of judicial decisions affecting the actions of public officials as they relate to the functions and policies of government. *Prerequisite:* 241 or 263. Three hours. Mr. Nuquist.

227, 228 INTERNATIONAL LAW Principles and applications of public international law. Three hours. Mr. Little.

231 THE LEGISLATIVE PROCESS Congressional and parliamentary organization and procedures. Three hours. Alternate years, 1967-68. Mr. Haugen.

232 **LAWMAKING AND PUBLIC POLICY** Influence of the executive and problems of congressional and parliamentary control. Three hours. Alternate years, 1967-68. Mr. Haugen.

235 **DEFENSE POLICY** Constitutional and historical frameworks; intelligence, R&D, procurement, manpower, and deployment; U.S.-Soviet discrepancies, developments, and dilemmas. Three hours. Mr. Hilberg.

241 **INTRODUCTION TO PUBLIC ADMINISTRATION** The role of the executive in fulfilment of public policy; theories of administrative organization and function. Three hours. Mr. Nuquist.

242 **ADMINISTRATIVE PROCEDURES** Factors governing administrative action in selected fields. *Prerequisite:* 241 or 263. Three hours. Mr. Nuquist.

251, 252 **AMERICAN FOREIGN POLICY** First semester: constitutional principles, institutional factors, and historic traditions in the formation of foreign policy. Second semester: contemporary policies toward specified countries. Three hours. Mr. Pacy.

253, 254 **WORLD POLITICS** Comparative analysis of the foreign policies of countries other than the United States; selected problems in Europe, Africa, Asia, and Latin America. Three hours. Alternate years, 1968-69. Mr. Little.

256 **INTERNATIONAL ADMINISTRATION** Theory and practice in international agencies. Three hours. Alternate years, 1967-68. Mr. Little.

257 **POLITICAL GEOGRAPHY** This course is identical with Geography 257, see p. 73.

258 **PROBLEMS OF COMMUNISM** This course is identical with Economics 258, see p. 53.

263 **STATE GOVERNMENT** Processes of basic policy formulation and popular control in the fifty states, the nationwide effort to improve governmental systems and the theoretical bases of the reform movements, and trends in the treatment of governmental problems. Three hours. Mr. Brubaker.

264 **STATE ADMINISTRATION** The effect of expansion in state activity, problems in policy determination, the responsibility and accountability of officers and agencies, the organization and maintenance of central services and controls, and the impact of study and investigation by legislative committees, interim commissions, councils, and citizens groups. *Prerequisite:* 241 or 263. Three hours. Mr. Haugen.

265, 266 **INTERGOVERNMENTAL RELATIONS** First semester: problems of the federal system; Second semester: national-state-local cooperative administration of selected public functions. Three hours. Alternate years, 1968-69. Mr. Haugen.

271, 272 **POLITICAL PARTIES AND PRESSURE GROUPS** Political parties; citizen participation and interest groups. Three hours. Mr. Kirk.

POULTRY SCIENCE

277 THE GOVERNMENT OF THE USSR This course is identical with History 277, see p. 81.

278 FOREIGN POLICY OF THE USSR This course is identical with History 278, see p. 81.

279 COMPARATIVE PUBLIC ADMINISTRATION Universal applicability of basic administrative concepts evident in the administrative systems and environments in selected countries in Europe, the Commonwealth, and elsewhere; problems and developments in established and in emergent countries. *Prerequisite:* 241. Three hours. Mr. Haugen.

281, 282 SEMINAR Research in special topics. By permission. Three hours. Staff.

283 SCOPE AND METHODS OF POLITICAL SCIENCE Approaches, sources of information, research methods, and systematization in the study of political phenomena. Three hours. Staff.

291, 292, 293, 294 READING AND RESEARCH Three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Staff.

Undergraduate courses:

11, 12 Introduction to Political
Science
21, 22 American Government
51, 52 International Relations
161, 162 Local Government

171, 172 Governments of Europe
173 Canada and the Commonwealth
174 Governments of Latin America
175, 176 Governments of Asia

• POULTRY SCIENCE

Professor Donovan (Chairman); Associate Professor Henderson.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An acceptable undergraduate major in Poultry Science, in a related field, or in Chemistry.

MINIMUM DEGREE REQUIREMENTS

281, 282 (2 hours); additional courses in Poultry Science and related fields; thesis research (6-15 hours).

COURSES OFFERED

281, 282, 283, 284 SEMINAR A review of recent developments and current literature in Poultry Science and related fields. *Prerequisite:* permission of the department. One hour. Staff.

294 HISTORY OF NUTRITION This course is identical with Home Economics 294, see p. 84.

307 ADVANCED CONCEPTS IN NUTRITION Study of chemistry and physiology of digestion, absorption, and metabolism of nutrients. Methods of estimating and meeting dietary requirements for maintenance, growth, and reproduction of several species. Genetic and nutritional interrelationships. Basic study of growth per se. *Prerequisites:* one of the following: Animal and Dairy Science 206; Home Economics 243, or a 200 level course in Biochemistry. Three hours. Mr. Donovan and Miss Morse. Alternate years, 1967-68.

308 EXPERIMENTAL TECHNIQUES IN NUTRITION This course is identical with Animal and Dairy Science 308, see p. 39.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

- | | |
|-------------------------------|---|
| 1 General Poultry Science | 103 Processing and Packaging Poultry Products |
| 58 Introductory Avian Biology | 190 Poultry Technology |
| 102 Incubation and Brooding | 197, 198 Senior Research |

• PSYCHOLOGY

Professors Ansbacher, Chaplin, and Forgays (Chairman); Associate Professor Perrine; Assistant Professors Howell, Lawson, Leitenberg, Mayhew, Musty, and Patterson.

Current research activities include the effects of dichoptic stimulation upon recognition thresholds in stereoscopic depth perception, psychophysical and electrophysiological studies of audition, the role of psychochemistry and central nervous mechanisms in the determination of innate behavior, arousal and internal inhibition, the development of new measures of verbal learning and the computer simulation of the free-recall paradigm, the effects of pre-experimental language habits upon verbal retention, the motivating properties of omission of reward as compared with the motivating properties of electric shock, attitudinal and personality factors related to driving behavior and traffic accidents, the positive reinforcing properties of an imprinting stimulus, the effect of early experiential deprivation upon behavioral development, the application of operant conditioning techniques to the measurement and treatment of behavior disorders, the distortive effects of sensory isolation by water immersion upon human behavior, and the historical documentation of Adlerian psychology.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Undergraduate courses in Statistics, Systematic Psychology and Experimental Psychology; satisfactory scores on the Graduate Record Examination and the Miller Analogies Test.

PSYCHOLOGY

MINIMUM DEGREE REQUIREMENTS FOR MASTER OF ARTS DEGREE

Twenty-four hours of Psychology courses and seminars, including Psychology 303, 304, 305, 306; thesis research for 6 credits. The requirement of the specific courses (303, 304, 305, 306) may be exempted by examination. Satisfactory performance on the departmental comprehensive examination (examination #1).

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of minimum degree requirements for Master of Arts degree, except for thesis; satisfactory performance on the departmental doctoral examination (examination #2); completion of one of the languages of the language requirement.

MINIMUM DEGREE REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE

In addition to the 30 credit hours required for the master's degree, 45 credit hours mainly in courses numbered in the 300 or 400 sequences of the psychology curriculum including thesis, or acceptable courses at the 200 or 300 level from other curricula. Completion of the language requirement. Satisfactory performance on the departmental final oral examination (examination #3).

COURSES OFFERED

210 COMPARATIVE PSYCHOLOGY Behavior of animals under controlled experimental conditions and in their natural environments. Of primary interest is consideration of behavior similarities and differences at various levels of the phyletic scale from lower forms to man. *Prerequisite:* 110, 123. Three hours. Mr. Leitenberg.

221 PHYSIOLOGICAL PSYCHOLOGY I The study of the structure and function of the mammalian nervous system, with emphasis upon neurological correlates of behavior and receptor mechanisms. Individual laboratory experience in electrophysiological techniques and the recording of receptor potentials. *Prerequisites:* 110, 123. Three hours. Mr. Patterson.

222 PHYSIOLOGICAL PSYCHOLOGY II The study of the role of central nervous system mechanisms in the determination of innate behavior, arousal, internal inhibition and learning. Individual laboratory experience in assessing the effects of brain stimulation, hormones and psychoactive drugs upon behavior. *Prerequisites:* 110, 123, 221. Three hours. Mr. Musty.

225-226 PSYCHOLOGICAL TESTS A survey of important clinical tests of ability and personality; training in the administration of individual intelligence tests. *Prerequisite:* 110, 123. Three hours. Mr. Ansbacher.

230 LEARNING Study of the basic laws of the learning process as revealed by controlled experiments; emphasis will be placed upon specific phenomena and the variables which govern them. Students may undertake original experiments. *Prerequisite:* 110, 123. Three hours. Mr. Mayhew.

231 PERCEPTION An experimental and theoretical study of the perceptual processes. The traditional problems of space, form and movement perception

will be included, followed by consideration of the role of social and motivational factors. *Prerequisite:* 110, 123. Three hours. Messrs. Perrine and Lawson.

232 EXPERIMENTAL SOCIAL PSYCHOLOGY A laboratory course in experimental methods and techniques typically used in social psychological research. Experiments will be designed, conducted, and evaluated in such areas as attitude formation and change, conformity, motivation, prejudice, rumor, social perception, and suggestion. Techniques used in attitude measurement and public opinion surveys will also be examined and applied. *Prerequisite:* 110, 123. Three hours. Mr. Perrine.

234 MOTIVATION AND EMOTION The nature and development of motives, emotions and their relation to other psychological processes. *Prerequisite:* 110, 123. Three hours. Mr. Chaplin.

236 THINKING A critical review of the experimental investigation of thought processes. Such topics as concept formation, rule learning, plans and strategies, language and thought, and creative thinking will be discussed. *Prerequisite:* 110, 123. Three hours. Mr. Mayhew.

The prerequisite for all of the courses listed below is acceptance to the graduate psychology program which involves the satisfactory completion of undergraduate courses in experimental psychology, systematic psychology, and statistics. In special cases, these prerequisites may be waived by permission of the instructor. Additionally, acceptance to Master's degree candidacy is a prerequisite to Psychology 391 through 393 and acceptance to Doctor's degree candidacy is a prerequisite to Psychology 491 through 493.

303-304 ADVANCED GENERAL PSYCHOLOGY This course serves as an overview of the field. It will emphasize empirical findings from the frontiers of the field and relate them to the body of psychology as it is developing today. Experiments will be undertaken by each student. Three hours. Mr. Chaplin.

305-306 ADVANCED STATISTICAL METHODS Study of statistical methods as aids for understanding and evaluating psychological data. Critical study of such topics as sampling theory, statistical estimation, simple and complex analysis of variance, non-parametric methods, simple and complex correlative techniques. Three hours. Mr. Howell.

307 ADVANCED SOCIAL PSYCHOLOGY A critical evaluation of such major concepts and methods as: attitude formation, change, and measurement; prejudice; social perception; group dynamics. Three hours. Mr. Perrine.

309 RESEARCH APPARATUS AND DESIGN A study of the methods and techniques used in executing behavioral science research, with special emphasis given to the basic principles of electricity and behavior apparatus design. Individual laboratory experience and demonstrations give the student exposure to the contemporary methodology used by the experimental Psychologist. Three hours. Mr. Patterson.

PSYCHOLOGY

311 SEMINAR IN LEARNING THEORY An examination of selected contemporary theoretical approaches to learning and a study of recent research contributions to such problem areas as social learning, emotional learning, the physiology of learning, etc. Three hours. Mr. Mayhew.

312 SEMINAR IN VERBAL LEARNING Selected problems in verbal learning and memory will be studied by means of a detailed critical examination of the relevant literature. Current topics such as the serial position effect, remote associations, short-term memory, the stimulus in serial learning, and pre-experimental associations will be examined. Three hours. Mr. Mayhew.

314 COMPARATIVE PSYCHOLOGY OF BEHAVIORAL DEVELOPMENT An examination of the general principles underlying the development of behavior from prenatal to adult responding. Focus will be on the pertinent research literature, particularly as it concerns the influence of various kinds of experience in early life upon later functioning. Three hours. Mr. Forgays.

321 SENSORY PROCESSES A study of the structure and function of the sense organs. Emphasis will be on research technique and methodology. Three hours. Mr. Patterson.

322 CENTRAL PROCESSES Basic neurophysiological psychology with emphasis on the control of behavior by the brain. Neuronal and synaptic transmission, chemical modulators of brain activity, basic organization of the nervous system. *Prerequisite:* 321. Three hours. Mr. Musty.

324 SEMINAR IN PERCEPTION A review of the history and contemporary problems of perceptual processes. Emphasis will be on perceptual mechanisms responsible for organization of sensory information. Three hours. Mr. Lawson.

326 INTRODUCTION TO CLINICAL PSYCHOLOGY Initially this course will be a study of the basic principles of interviewing, testing, assessment from life situations, and report writing. Later there will be an examination of the most common approaches to psychotherapy, such as the client-centered, habit change, cognitive change, emotional change, interpersonal relations, and group therapy approaches. Three hours. Mr. Ansbacher.

327 SEMINAR IN JUDGMENTAL PHENOMENA Survey of the basic methodological and theoretical problems involved in the process of making human judgments. Three hours. Mr. Perrine.

328 SEMINAR IN SOCIAL PERCEPTION Examination of the process through which impressions and judgments of man and other social objects are reached. Three hours. Mr. Perrine.

330 SEMINAR IN OPERANT CONDITIONING A review of current developments in this area of research. Negative and positive reinforcement; discrimination training and generalization; applications of operant techniques. Three hours. Mr. Leitenberg.

SOCIOLOGY AND ANTHROPOLOGY

331 SEMINAR IN BEHAVIOR THERAPY A review of the literature relating to theory, practice, and research. Emphasis will be placed on the applications of conditioning theory and the experimental analysis of behavior to psychotherapy. Three hours. Messrs. Leitenberg (Department of Psychology) and Agras (Department of Psychiatry).

381, 382, 383, 384 ADVANCED READINGS Readings, with conferences, to provide graduate students with background and specialized knowledge relating to an area in which an appropriate course is not offered. One to three hours. Staff.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of a staff member. Credit as arranged. Staff.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

Undergraduate courses:

1 General

123 Systematic

110 Experimental

• SOCIOLOGY AND ANTHROPOLOGY

Associate Professors Lewis (Chairman), Mabry and Pfabl; Assistant Professors Haviland, Johnson, Kennedy and Steffenhagen; Instructor Basa.

No Master's degree program offered

ANTHROPOLOGY

Research activities in anthropology include the development of early Mayan civilization; Navaho youth; and ethnic groups in Burlington, Vermont.

221 CULTURE AND PERSONALITY Relationship of socialization to the sociocultural milieu; the cross-cultural comparison of personality development; the problem of delineating model personality types; variations in child-rearing situations according to "social class" in contemporary Western Civilization. *Prerequisite:* 21, 22 and one 100 level course in sociology or anthropology. Three hours. Mr. Steffenhagen.

225 CURRENT ANTHROPOLOGICAL THEORY The data and theories of socio-cultural dynamics: innovation, diffusion, acculturation, revitalization; theories of cultural evolution, culture circles, and the American historical school. *Prerequisite:* 9 hours in Sociology. Three hours. Mr. Johnson.

228 SOCIAL ORGANIZATION Evaluation of the comparative method in anthropology; its use in the formulation of generalizations concerning the nature of society. *Prerequisite:* 9 hours in Sociology. Three hours. Mr. Haviland.

SOCIOLOGY AND ANTHROPOLOGY

283 APPLIED ANTHROPOLOGY A descriptive and analytical presentation of the place of anthropology in the modern world. Study of the human problems resulting from attempts to direct cultural change in subindustrial societies. *Prerequisite:* 21, and 161, 162, 163, or 165. Three hours. Mr. Johnson.

290 SEMINAR *Prerequisite:* twelve hours of anthropology and senior standing. Three hours.

Undergraduate courses:

- | | |
|-----------------------------|---------------------------------------|
| 21 The Cultures of Man | 162 Peoples of Africa |
| 24 World Pre-History | 163 Peoples of Southeast Asia |
| 26 Physical Anthropology | 165 Peoples of China, India and Japan |
| 161 Peoples of the Americas | |

SOCIOLOGY

Research activities include the impact of socio-cultural change on the division of labor in American society; the medical profession; the sociology of illness; correctional institutions and studies of communities and family structure.

205 SMALL GROUP DYNAMICS An analysis of the problems and the functioning of small groups and their relationship to large organizations. Attention will be given to the effect of the group on the individual, the consequences of democratic and non-democratic arrangements, factors making for group efficiency and morale, and the effects of groups on the larger organization in which they are located. Case studies include factory groups, gangs, military groups and various experimental situations. *Prerequisite:* nine hours in Sociology. Three hours. Mr. Steffenhagen.

210 POPULATION ANALYSIS Analysis of factors affecting population growth and distribution; migration patterns, and the relationship between economic activity and population trends. Particular attention will be given to the population problems of underdeveloped areas. *Prerequisite:* nine hours in Sociology. Three hours.

212 THE COMMUNITY Analysis of the structure and function of communities as social systems with special emphasis on American communities. Attention will be given to ecology, social class and power structure, and social change within the community context. Procedures for sociological study of communities will be described. *Prerequisite:* 9 hours in Sociology. Three hours. Mr. Lewis.

214 PUBLIC OPINION Analysis of opinion and attitude formation with the primary emphasis on the political sphere. Attention will be given to the relationship between opinions and religious, racial, class and partisan affiliations. The sources of democratic and non-democratic political tendencies will be examined. *Prerequisite:* nine hours in Sociology. Three hours.

221 CULTURE AND PERSONALITY (See Anthropology 221).

242 SOCIAL MOVEMENTS A study of social movements with special emphasis given to revolutions. Selected cases, to clarify the relation of social movements to social problems, social institutions, and social class structure. *Prerequisite:* 22 and 141. Three hours. Mr. Kennedy.

251 SOCIAL RESEARCH METHODS The logic and techniques of sociological inquiry. *Prerequisite:* 12 hours in Sociology; permission of the department. Three hours. Mr. Pfuhl.

255 THE DEVELOPMENT OF SOCIOLOGICAL THEORY A critical analysis of the development of sociological thought with special attention to the works of such 19th and 20th century writers as Durkheim, Marx, Weber, Simmel, Park, Sorokin, and C. Wright Mills. *Prerequisite:* 22 and History 11 or 13. Three hours. Mr. Kennedy.

258 CRIME AND DELINQUENCY Definitions of crime and delinquency; the sociological bases of criminal and delinquent behavior; analyses of delinquent subcultures such as the gang, the underworld, and white-collar crimes. *Prerequisite:* 22 plus six additional hours in sociology. Three hours. Mr. Pfuhl.

259 PENOLOGY A sociological approach to the history, current conditions and trends regarding the apprehension, adjudication and disposition of juvenile and adult offenders. *Prerequisite:* 258. Three hours. Mr. Pfuhl.

270 HEALTH AND MEDICINE The social and cultural environment of illness and its influence on definition and treatment. Role definitions and behavior of patients, physicians, and others. The use of community resources. The methods and status of research in medical sociology. *Prerequisite:* nine hours in Sociology. Three hours. Mr. Steffenhagen and Mr. Mabry.

271 SOCIOLOGY OF MENTAL HEALTH The influence of a socio-cultural environment upon the perception and definition of mental health and illness. Social responses to inappropriate behavior, including the roles of the patient, physician and family. Relationships between socialization processes and mental health. Etiology and epidemiology of mental illness. *Prerequisite:* Sociology 22, and 6 additional hours in sociology. Three hours. Mr. Steffenhagen.

281, 282 SEMINAR Topical seminar centering on some problem of central concern to the field; stresses reading in current sociological literature and professional journals. *Prerequisites:* 12 hours in Sociology; permission of the department. Three hours. Staff.

Undergraduate courses:

21 Cultures of Man
22 Principles of Sociology
141 Social Problems

151 The Family
154 Minority Groups

• SPANISH

Associate Professors Julow (Chairman) and Weiger; Assistant Professors Chinchón, Strong, Ugalde and Wesseling; Instructors Beade and Scheible.

Thesis research opportunities exist in Spanish literature of the 16th, 17th, 19th and 20th centuries and in Spanish-American literature of the 20th century.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major or its equivalent in Spanish.

MINIMUM DEGREE REQUIREMENTS

18 hours in Spanish, including at least one seminar; 6 hours in the literature of another language (may be English); 6 hours of thesis research.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 20.

COURSES OFFERED

205, 206 SPANISH-AMERICAN LITERATURE OF SOCIAL PROTEST The literature of the Spanish-American peoples as a reflection of and contribution to the social problems of the area. The second half of the course will stress the contemporary scene. *Prerequisite:* 106 or Political Science 76 or History 203 or 204. For those who do not present Spanish 106, a knowledge of Spanish is presumed. Three hours. Mr. Chinchón. Alternate years, 1968-69.

213, 214 SPANISH LITERATURE: GOLDEN AGE The picaresque novel, the drama and poetry of the 16th and 17th centuries, with emphasis on Lope de Vega, Calderón, Quevedo, Tirso de Molina. *Prerequisites:* any Spanish literature course numbered 100 or above, 213 for 214. Alternate years, 1968-69. Three hours. Mr. Weiger.

215-216 SPANISH LITERATURE: CERVANTES Don Quijote, the *Novelas Ejemplares*, and the theater of Cervantes. *Prerequisite:* any Spanish literature course numbered 100 or above. Alternate years, 1969-70. Three hours. Mr. Weiger.

223-224 ADVANCED COMPOSITION AND CONVERSATION Translation into Spanish of difficult English prose, free composition and discussion of questions of style. Practice in advanced conversation. Required of those who wish to be recommended to teach Spanish. *Prerequisite:* 121-122. Three hours. Mr. Ugalde.

301-302 GENERATION OF 1898 The essays, novels, poetry and drama of Unamuno, Azorín, Valle-Inclán, Baroja, Benavente *et al.* Study of such thinkers as Ortega y Gasset, Américo Castro and Julián Marías and critics such as Menéndez Pelavo and Menéndez Pidal. Three hours. Mr. Ugalde.

305 REGIONAL NOVEL OF SPANISH AMERICA The *criollista* and *indigenista* trends in the fictional literature of Spanish America. Study of works by Alegria, Gallegos, Güiraldes, Latorre, López y Fuentes, Rivera and others. *Prerequisite:* 206. Three hours. Mr. Chinchón.

306 **PSYCHOLOGICAL NOVEL OF SPANISH AMERICA** The more sophisticated trends of the novel dealing with the development of urban and suburban society in Spanish America. Study of works by Barrios, Borges, Carlos Fuentes, Godoy, Mallea, Yáñez and others. *Prerequisite:* 206. Three hours. Mr. Chinchón.

313 **THE SPANISH COMEDIA** Extensive readings in the baroque theater. Investigation of the genre in the light of research published in the twentieth century. *Prerequisite:* 213. Three hours. Mr. Weiger.

314 **SPANISH THEATER** Evolution of the Spanish drama from the twelfth-century *Auto de los Reyes Magos* to the contemporary theater of García Lorca, Casona and Buero Vallejo. Three hours. Mr. Weiger.

381, 382 **SEMINAR** Offered for resident candidates for the Master of Arts degree; opportunities for independent work are provided. Three hours. Staff.

391 THROUGH 393 **MASTER'S THESIS RESEARCH** Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

Undergraduate courses:

1-2 Elementary Spanish	106 Readings in Spanish American Literature: Contemporary Period
11-12 Intermediate Spanish	121-122 Conversation and Composition
101 Spanish Literature: 19th Century	
102 Spanish Literature: 20th Century	
105 Readings in Spanish American Literature: Colonial Period	

• SPEECH

Professors Huber, Lewis, Luse; Associate Professors V. Falck, Jordan, London (Chairman); Assistant Professors Ellenwood, Feidner, Thomsen; Instructors Bensman, Dilley, Macdonald, Myers, Schenk, Wilkes.

Current interests and research in the Department of Speech include the development of the Champlain Shakespeare Festival and the Institute on Elizabethan Arts and Literature; studies of the dialects of the people of Vermont; studies concerning cancer of the larynx and the rehabilitation of such individuals using esophageal speech; a study using x-rays to determine the effectiveness of rehabilitating cleft palate speech; and studies concerning the development of educational television and networks along with the development of educational FM radio and networks.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN SPEECH PATHOLOGY

An undergraduate major in Speech with eighteen hours in speech pathology and psychology, or a major in Psychology with a minor in Speech, or a major in Education with twenty-four hours in Speech and Psychology; nine hours in speech pathology to be included within the above major.

SPEECH

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours of graduate level courses including 18 hours in speech pathology and audiology, 6 hours in speech pathology or a related field; thesis research (6 hours); demonstration of proficiency in oral communication; written examination; oral examination. Undergraduate plus graduate courses must include six hours of audiology.

COURSES OFFERED

201 PHONETICS Analysis of English speech sounds used in the International Phonetic Alphabet. Application to standards of English pronunciation in the United States and to foreign dialects. *Prerequisites:* Junior standing and 9 hours of Speech; or English 25, 26 or 27, 28; or a foreign language through the intermediate level. Three hours. Miss Luse.

214 HISTORY AND CRITICISM OF AMERICAN PUBLIC ADDRESS Selected American speakers and speeches studied against the background of their lives and the issues of their times. *Prerequisite:* nine hours of related speech courses, including 11. Three hours. Staff.

217 CLASSICAL RHETORIC A study of selected works in order to provide understanding of the points of view of outstanding classical writers who have influenced rhetorical thought, criticism, speaking and writing. *Prerequisite:* nine hours of related speech courses, including 11. Three hours. Staff.

221 GENERAL SEMANTICS A study of the theory of communication both verbal and non-verbal, with an emphasis upon the factors of inter- and intra-personal communication breakdowns. *Prerequisite:* 6 hours of Speech. Three hours. Mr. Lewis.

252 LIGHTING Theory and practice in the illumination of stage productions and the creation of aesthetic effects. *Prerequisite:* 151. Three hours. Mr. Schenk.

254 SCENE DESIGN Lecture and laboratory. Analysis of the drama from the standpoint of its visual creation upon the stage; audience-stage relationships, styles of production. *Prerequisite:* 252; art 1. Three hours. Mr. Schenk.

264 TELEVISION PRODUCTION An analysis of the principles involved in the production of programs for television broadcast. Emphasis on the following types of programs: educational, news, documentary, dramatic and variety. Laboratory use of the ETV studio. *Prerequisite:* 161. Three hours. Mr. Dilley.

271 SPEECH PATHOLOGY I The etiology, symptoms and principles of habilitation for voice disorders, cleft palate; historical aspects of stuttering; problems of foreign accent. *Prerequisites:* 12 hours of Speech and Psychology including Speech 74. Three hours. Miss Luse.

272 SPEECH PATHOLOGY II The etiology, symptoms and treatment of retardation of speech, including congenital aphasia, aphasia in adults, and cere-

bral palsy. *Prerequisites:* 12 hours of Speech and Psychology including Speech 74. Three hours. Mr. Jordan.

273 PRINCIPLES OF AUDIOLOGY Anatomy and physiology of the ear; history of audiometry; diagnostic hearing tests. *Prerequisites:* 12 hours of Speech and Psychology, including Speech 74. Three hours. Mrs. Falck.

274 SPEECH READING AND AUDITORY TRAINING Principles of teaching speech reading and auditory training to the hard of hearing. *Prerequisite:* 273. Three hours. Mrs. Falck.

275, 276 CLINICAL STUDY IN SPEECH DIAGNOSIS AND THERAPY Observation and practice in diagnosis and therapy of speech disorders. *Prerequisites:* 12 hours of Speech and Psychology, including Speech 271 or 272. Credit as arranged. Mr. Ellenwood.

281 VOICE SCIENCE The anatomical, physiological and physical factors of speech. *Prerequisite:* 12 hours of Speech and Psychology. Three hours. Miss Luse.

283 CLINICAL AUDIOLOGY Advanced audiological testing and clinical procedures. *Prerequisite:* 273. Three hours. Mrs. Falck.

294 SEMINAR FOR PROSPECTIVE TEACHERS OF SPEECH A study of the resources, procedures and methods utilized in teaching the different areas of speech at the various instructional levels. *Prerequisite:* 12 hours including Speech 1 and 11. Three hours. Mr. London.

381, 382 ADVANCED READINGS Readings, with conferences, intended to contribute to the programs of graduate students in phases of speech for which formal courses are not available. *Prerequisites:* 271, 272. Credit as arranged, up to 3 hours each semester. Miss Luse and Mr. Jordan.

385 SEMINAR IN VOICE Study of the research in voice production and speech. Application to pathological and non-pathological problems. *Prerequisite:* 271, 272. Three hours. Miss Luse.

386 SEMINAR IN CEREBRAL PALSY Study of the pathology, etiology, methods in diagnosis, and the rehabilitative procedures used with the various types of cerebral palsy. *Prerequisite:* 271, 272. Three hours. Miss Luse.

387 SEMINAR IN LANGUAGE DISORDERS Study of the different types of language disorders, examination procedures, and methods of rehabilitation. *Prerequisite:* 271, 272. Three hours. Mr. Jordan.

388 SEMINAR IN STUTTERING Study of the research in stuttering relative to etiology and rehabilitation. *Prerequisite:* 271, 272. Three hours. Mr. Jordan.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

ZOOLOGY

Undergraduate courses:

1 Foundations of Oral Communication	111 Persuasion
3 Parliamentary Procedure	116 Speech Composition
11 Public Speaking	141 Advanced Acting
12 Argumentation	142 Play Directing
14 Group Discussion	145, 146 Development of the Western Theatre
31 Oral Interpretation of Literature	151 Stagecraft
39 Introduction to Theatre	161 Radio Production
41 Acting	162 Writing for Radio and Television
61 Introduction to Broadcasting	163 Broadcast Materials
74 Introduction to Speech Correction	197, 198 Honors or Special Readings
81 Voice and Articulation	

• ZOOLOGY

Professors Glade (Chairman), Lochhead, Moody and Potash; Associate Professors Bell, Chipman, Davison, Henson, and Rothstein; Assistant Professors Bromley and Stevens.

Faculty research interests fall within the general areas of environmental biology, developmental biology, and physiology. Current on-going projects include research in insect taxonomy and ecology, especially of the Carabidae; aquatic ecology with emphasis on Lake Champlain; reproductive physiology and physiological ecology of mammals; experimental embryology of amphibians and crustaceans; control of morphogenesis in amphibian limb regeneration; crustacean anatomy and physiology; mechanisms of cell division; the synthesis of macromolecules during mitosis. When applying, students are requested to indicate their general area of interest for research to the extent it is known.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in zoology or its equivalent.

MINIMUM DEGREE REQUIREMENTS

Zoology Seminar each semester; 15-22 additional hours in zoology and related fields; thesis research (8-15 hours).

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 20.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of: an academic year of graduate study in the University of Vermont; a year of Mathematics and one of Physics (college courses of appropriate level for students majoring in science); Organic Chemistry; at least one year of Zoology. Students whose programs are to include Physical Chemistry should have had, or should take, mathematics through Mathematics 21 or its equivalent. Satisfactory showing in an oral qualifying examination administered by the Studies Committee with the participation of the Depart-

ment. Acceptability to the faculty member with whom the candidate wishes to do his thesis research.

MINIMUM DEGREE REQUIREMENTS

Of the 75 credit hours required for the degree, at least 40 hours must be earned in courses suitable for graduate credit, the selection of courses to be designated for each student by his Studies Committee. Of these courses a minimum of 13 credits must be in courses other than Zoology. At least 20, but not more than 40, credits must be earned in thesis research. Attendance at seminar required. Language requirement: reading knowledge of two appropriate foreign languages. Each candidate must participate in the teaching of at least one undergraduate course.

COURSES OFFERED

203 POPULATION ECOLOGY Dynamics, composition, and density regulation of animal population. *Prerequisite*: 104. Four hours. Mr. Potash. Alternate years, 1968-69.

207 VERTEBRATES Classification, ecology, behavior, evolution, and distribution of vertebrates other than birds. *Prerequisite*: 42, either 2 or 21, and a course in zoology numbered above 100. Four hours. Mr. Bell.

216 HUMAN GENETICS Principles of human inheritance; population genetics; interaction of heredity and environment; application of principles of heredity to human problems. *Prerequisite*: 115 or Botany 255. Three hours. Mr. Moody.

222 EXPERIMENTAL EMBRYOLOGY Theoretical approach to major problems of development based on research in embryology, genetics, physiology, bacteriology, and related fields. *Prerequisite*: 111 and consent of the instructor. Four hours. Mr. Glade. Alternate years, 1967-68.

225 ENVIRONMENTAL PHYSIOLOGY The physiological processes by which animals cope with moderate, changing, and extreme environments. *Prerequisite*: a course in physiology and a course in ecology. Four hours. Mr. Chipman. 1968-69.

231 CELL PHYSIOLOGY Study of cell function, with emphasis upon experimental techniques used to elucidate chemical and physical mechanisms within living cells. *Prerequisite*: a course in zoology numbered above 100; Chemistry 131, 132 and consent of the instructor. Four hours. Mr. Rothstein.

236 FRESH-WATER BIOLOGY Organisms of lakes, ponds and streams; their aquatic environment and their adaptations to varying physical, chemical and biotic conditions. *Prerequisite*: A course in zoology numbered above 100 and inorganic chemistry. Four hours. Mr. Henson.

255 COMPARATIVE ANIMAL PHYSIOLOGY General principles of function in invertebrates and vertebrates. *Prerequisite*: 104 or 150 or 236; Chemistry 131, 132; and consent of the instructor. Four hours. Mr. Rothstein.

ZOOLOGY

267 GENETICS OF DEVELOPMENT Problems of differentiation and morphogenesis approached from the viewpoint of gene action and biosynthesis; influence of hereditary material during ontogeny. *Prerequisite:* 111, 115, and consent of the instructor. Four hours. Mr. Bromley. Alternate years, 1968-69.

270 MODERN EVOLUTIONARY THEORY Contributions of modern research in genetics, systematics, distribution, experimental embryology, serology, and related fields to problems of the means and methods of evolutionary change. *Prerequisite:* a course in evolution and one in heredity or genetics. Three hours. Mr. Moody.

271 ADVANCED LIMNOLOGY Analyses of current limnological concepts and problems. *Prerequisite:* 236. Four hours. Mr. Henson.

281 THROUGH 289 SEMINAR Review and discussion of current zoological research. Required of graduate students and seniors in zoological research programs; open to others by special permission only. No course credit. Staff.

381 THROUGH 386 SPECIAL TOPICS Readings with conferences, small seminar groups, or laboratories intended to contribute to the programs of graduate students in phases of zoology for which formal courses are not available. *Prerequisite:* an undergraduate major in zoology. Credit as arranged.

391 THROUGH 393 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged.

491 THROUGH 493 DOCTORAL THESIS RESEARCH Original research under the direction of an assigned staff member, culminating in an acceptable doctoral dissertation. Credit as arranged.

Undergraduate courses:

1, 2 Introductory Biology	108 General Entomology
5-6 Mammalian Anatomy and Physiology	109 Field Zoology
21 Organic Evolution	111 Embryology
41, 42 Comparative Vertebrate Anatomy	112 Comparative Histology
52 Physiology	115 Heredity
104 Animal Ecology	150 Invertebrate Zoology
	197, 198 Undergraduate Research

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* Deceased, November 30, 1967.

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tur statim erubescences: qui dicunt michi euge
euge. **E**xultent et letentur in te oēs qui que-
runt te/ & dicāt semp magnificetur dñs qui dili-
gunt salutare tuū **E**go vero egen⁹ et pauper
sum deus adiuua me. **D**iutor meus & libe-
rator meus es tu: domine ne moreris. **I**lla pri.
⁹. Saluos fac seruos tuos et ancillas tuas. **R.** De⁹
me⁹ sperātes in te. **V.** Esto nobis dñe turris for-
titudinis. **R.** A facie inimici. **V.** Nichil pficiat in-
mic⁹ in nobis. **R.** Et filius iniquitatis non apponat
nocere nobis. **V.** Dñe nō lēdm pētā nra, facias no-
bis. **R.** Neq; secū dū iniquitates nras retribuas no-
bis. **V.** Oremus p pōtifice nro. **R.** Dñs cōseruet
eū & viuificet eū & btīm faciat eū in terra: & nō
tradat eū in aīam inimicorū ei⁹. **V.** Orem⁹ p bñ-
factorib⁹ nris. **R.** Retribuere dignare dñe oib⁹
nobis bona faciētib⁹ ppter nomē sanctū tuum
vitam eternā amē. **V.** Orem⁹ p fidelib⁹ defun-
ctis. **R.** Requiescēt eternā dona eis dñe: & lux per-
petua luceat eis. **V.** Requiescāt in pace. **R.** Amē.
⁹. Pro fratribus nris absentibus. **R.** Saluos fac
seruos tuos deus meus sperantes in te. **V.** Mitte
eis domine auxilium de sancto. **R.** Et desyō
tuere eos. **V.** Domine exaudi orationem meam
R. Et clamor meus ad te veniat. **V.** Domin⁹ vo-
biscum. **R.** Et cum spiritu tuo. **O**ratio.

Eus cui proprium est misereri semper/
et parcere: suscipe deprecationem no-
stram. vt nos & omnes famulos tuos quos deli-
ctorum cathena constringit/ miseratio tue pier-
tatis absoluat. **O**ratio.