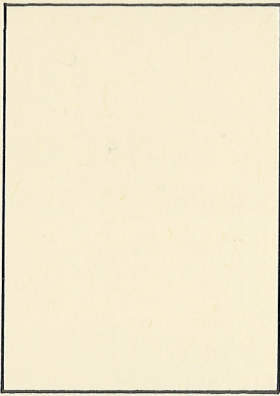




In illo tēpore. Miss⁹
est angelus gabriel
a deo. ī ciuitatē galilee cui
nomen nazareth ad virgi
nē despōsatā viro cui no
mē erat ioseph de domo
dauid: & nom⁹ n virginis
maria. Et ingressus ange
lus ad eam dixit. Ave gra
tia plena dñs tecum: bene
dicta tu ī mulierib⁹. Que
cū audisset turbata est in
sermone 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 dauid
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: & vir⁹ 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.



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 VERMONT MONK 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
Burlington, Vermont

CATALOGUE and ANNOUNCEMENTS
1971-1972

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January, April and May; three times in February and September; and four times in
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Correspondence:

All correspondence concerning applications and admission to the Graduate College should be addressed to the Graduate College Admissions Office, The University of Vermont, Burlington, Vermont 05401.

Requests for transcripts of work done at The University of Vermont should be addressed to the Registrar, The University of Vermont, Burlington, Vermont 05401.

Requests for the Summer Session and Evening Division information should be addressed to the Office of Continuing Education, The University of Vermont, Burlington, Vermont 05401.

Please note the following deadlines:

March 1—for application requesting financial aid.

April 1— for application to all departments.

The University of Vermont fully supports and complies with Title VI of the Civil Rights Act of 1964 and does not discriminate in any way in any of its policies on the basis of race, color, or national origin.

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Academic Calendar

- FALL SEMESTER 1971

August 31-	
September 1	Registration
September 2	Classes begin
September 6	Labor Day (no classes)
October 9-11	Columbus Day recess
October 25-	
November 12	Pre-enrollment for spring semester
November 24-27	Thanksgiving recess
December 15-21	Course examinations

- SPRING SEMESTER 1972

January 17-18	Registration
January 19	Classes begin
February 18-19	Winter Festival recess
March 1	Deadline for applications requesting financial aid
March 20-24	
April 3-14	Pre-enrollment for fall semester
March 27-April 2	Spring recess
April 3	Classes resume
May 10-May 16	Course examinations
May 21	Commencement: Academic year terminates

- SUMMER SEMESTER 1972

June 26-August 18	Eight-week session
July 10-August 18	Six-week session

- FALL SEMESTER 1972

September 5-6	Registration
September 7	Classes begin
October 7-9	Columbus Day recess
November 9-17	Pre-enrollment for spring semester
November 22-25	Thanksgiving recess
December 18-23	Course examinations

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 1971, 200 master's degrees and 24 Doctor of Philosophy degrees were awarded. The Graduate College currently enrolls over 750 students pursuing advanced degrees with about 250 pursuing the Doctorate. Scholarships, fellowships, assistantships, and special loan programs are available in limited numbers for students who have achieved a good academic record in their undergraduate and graduate programs. With the excellent 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

THE UNIVERSITY OF VERMONT

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, the College of Medicine, the Graduate College, and the Division of Health Sciences.

The present physical plant is valued at more than \$55,000,000, 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 539,000 volumes.

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 4,520 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.

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. In addition two galleries are devoted to special exhibitions which change monthly. 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.

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 34 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 addition to three major series of concerts, the Red, Blue, and White, the Lane Series also sponsors a Chamber Arts Series in the spring semester, a Summer Series, youth concerts and special events, and concerts in several towns outside of Burlington, notably in St. Johnsbury.

The Placement Service To assist graduates in exploring and selecting among various career employment possibilities, the University operates

THE UNIVERSITY OF VERMONT

an extensive Placement Program. Under the sponsorship 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 for employers and education 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 50,000, Burlington is Vermont's largest city. The greater Burlington area of approximately 100,000 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 Airlines, Executive Airlines, Vermont Transit and Greyhound Bus Lines. The expanded Vermont interstate highway system has correspondingly shortened automotive travel time.

Degree Programs Offered

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

• *MASTER OF ARTS*

Programs are offered in the following fields:

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

• *MASTER OF SCIENCE*

Programs are offered in the following fields:

Agricultural Economics	Forestry
Anatomy	Geology
Animal Sciences	Home Economics
Animal Pathology	Mechanical Engineering
Biochemistry	Medical Microbiology
Biomedical Engineering	Medical Technology
Biostatistics	Microbiology
Botany	Pathology
Cell Biology	Pharmacology
Chemistry	Physics
Civil Engineering	Physiology and Biophysics
Economics of Natural Resource Planning	Plant and Soil Science
Electrical Biophysics	Speech Pathology
Electrical Engineering	Zoology

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	History
Botany	Home Economics
Chemistry	Latin
English	Mathematics
French	Music
Geography	Physics
Geology	Spanish
German	Vocational and Technical
Greek	Education
	Zoology

• *MASTER OF SCIENCE FOR TEACHERS*

This degree is designed primarily for secondary school teachers who wish to strengthen their backgrounds in their subject matter field, and who desire flexibility in choosing courses at levels best suited to their needs. Programs are planned on an individual basis.

- Mathematics
- Biology
(*Botany & Zoology*)
- Physical Sciences
(*Chemistry & Physics*)
- Geology

Please contact the department concerned for prerequisites and minimum degree requirements.

DEGREE PROGRAMS OFFERED

• *MASTER OF EDUCATION*

The master of education degree is intended to give those who work in education the kind of background and professional preparation needed for leadership in teaching and functions related to it. Programs are planned on an individual basis with special attention to such fields as:

Administration and Planning	Special Education
Foundations of Education	Student Personnel Services in
Reading and Language	Higher Education
(Elementary and Secondary)	Teacher Education
School Counseling	Vocational and Technical Education
(Elementary and Secondary)	

• *MASTER OF BUSINESS ADMINISTRATION*

Study leading to this degree 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 provide opportunity for those who work in non-school educational and counseling programs to develop knowledge and understanding in activities related to program management and educational methodology.

Programs are planned on an individual basis with special attention to fields such as:

Agriculture	Family Centered Services
Home Economics	Business and Industry
Youth Organizations	

DEGREE PROGRAMS OFFERED

• *DOCTOR OF PHILOSOPHY*

Programs are offered in the following fields:

Anatomy	Mechanical Engineering
Animal Sciences	Microbiology
Biochemistry	Pharmacology
Botany	Physics
Cell Biology	Physiology and Biophysics
Chemistry	Plant and Soil Science
Electrical Engineering	Psychology
Mathematics	Zoology

• *FIFTH YEAR CERTIFICATE IN EDUCATION*

A special program culminating in a fifth year certificate is offered by the College 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.

• *CERTIFICATE OF ADVANCED STUDY*

A Certificate of Advanced Study (sixth year certificate), a 30-36 graduate credit hour program beyond the Master's Degree, is offered by the College of Education in the field of Administration and Planning. The C. A. S. has become a professional requirement in the hiring and advancement of administrative, supervisory, and other personnel in many school districts throughout the United States and since 1965 has been a prerequisite for membership in the American Association of School Administrators (AASA). The program requires a nine credit hour on-campus residency unit which must include a three credit hour laboratory experience. Residency may be fulfilled during any academic semester or summer and is part of the total 30-36 program credits. Further information may be obtained from the College of Education.

• *CONCURRENT DEGREES*

Post-sophomore fellows in medicine are permitted to use credit from appropriate medical courses toward an M.S. or a Ph.D. They are enrolled in the Graduate College for one or more years to pursue research and enroll in such courses as would normally not be included within a medical program. Such persons, therefore, are working toward an M.D. and M.S. or Ph.D., but completion of each degree may occur at a different time.

All courses for which graduate credit is received at UVM in a master's degree program, whether a master's degree is received or not, may be applied toward a Ph.D. at UVM provided they are appropriate for the Ph.D. program.

No provision is made for a person to employ the same credit to satisfy two master's degrees at the University of Vermont.

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.

Admission is limited to students who intend to become candidates for advanced degrees, other than Doctor of Medicine, and 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-degree 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.

The Graduate College does make provisions for students with a baccalaureate to take graduate level courses on a non-degree basis. These are generally individuals who do not desire to pursue a degree program but merely wish to expand their knowledge in certain areas. It is not necessary to make formal application for admission to the Graduate College in order to take these courses however the student must obtain approval of the Dean of the Graduate College before registering for such courses. Registration for non-degree students occurs after registration of all degree students. Non degree students are limited to a total of six hours per semester and permission to exceed this amount must be obtained from the Dean. A non-degree student who has accumulated nine hours of graduate study at the university must seek the approval for further enrollment from the Graduate College.

REGULATIONS OF THE GRADUATE COLLEGE

Students seeking formal admission to the Graduate College to pursue an advanced degree must make application on an official form which can be obtained from the Graduate College Admissions Office. All applications must be supported by two 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, and Departmental Requirements, p. 16. *All applications for admission must be accompanied by a \$15.00 application fee.* Applications and associated correspondence should be sent directly to the Graduate College Admissions Office.

The deadline for applications for admission in the fall semester is April 1 for all departments. It is not always possible to admit additional students at midyear, however, such applications should be initiated at least three months in advance of the date study is to begin. Students who wish to be considered for fellowships or other financial assistance as well as admission should complete the appropriate section on the application form. No special forms for requesting financial aid are necessary. Such applications, with all supporting materials, including GRE scores, must be on file by *March 1* of the academic year preceding that for which the application is made. Applications for financial assistance *must* include GRE scores.

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

Foreign Students In general, only those students who are citizens of the United Kingdom, Australia, New Zealand and Canada should apply directly. Students from other countries studying in the U. S. must submit evidence of proficiency in English and record of academic achievement from a U. S. institution. Generally preference is given to candidates sponsored by established organizations such as the Institute of International Education (IIE), the African-American Institute, the American Friends of the Middle East and the American-Korean Foundation.

For information concerning eligibility criteria and application procedures for programs administered by IIE, a student may contact the U.S. Embassy, Consulate, or Information Service in his country.

Students from Africa, the Middle East, Korea and other areas may also request information about scholarships from:

REGULATIONS OF THE GRADUATE COLLEGE

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

Application through these organizations or the U. S. Consulate is required for adequate evaluation of transcripts and academic rating of institution attended.

Foreign applicants must be highly qualified, and present evidence of independent financial support (approximately \$4,500 U.S.) per year. 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 889, Princeton, New Jersey 08540. This information should be submitted to the Graduate College by Dec. 1 of the year prior to enrollment to insure adequate time to process the application.

Scholarships for foreign students are limited in number and awarded on academic competition, however, funding is not usually available for the first year of study.

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

Information on the Miller Analogies Test may be obtained from the Counseling and Testing Office, University of Vermont, or from any college testing office. Information on the Graduate Record Examination may be obtained from the Counseling and Testing Office or directly

REGULATIONS OF THE GRADUATE COLLEGE

from the Educational Testing Service, Box 889, Princeton, New Jersey 08540.

All applicants requesting fellowship support must submit scores on the Graduate Record Examination prior to March 1. Arrangements should be made to take the GRE test no later than January 1972 so that test results will be available by March 1.

Deposit A deposit of \$35 is required for each applicant upon notification of admission into the Graduate College. The deposit will cover the advanced degree fee of \$35. This deposit should be received no later than thirty days prior to enrollment.

Health Record A satisfactory health record must be submitted to the Student Health Service (Wasson Infirmary) 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. (See Academic Calendar.)

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 five weeks of classes; the exact dates to add or drop courses may be found in schedule of courses, available at the Graduate College office. Forms may be obtained from the department or Graduate College.

Completion of Thesis A student who has completed all credits required in his degree program, but has not completed or defended his thesis, must enroll for "Completion of Thesis" (cf. p. 32 Fees). Enrollment may be accomplished by mail or in person through the Graduate College.

Considered full time enrollment

REGULATIONS OF THE GRADUATE COLLEGE

Withdrawal If it is necessary for a student to withdraw from his enrollment he must request permission in writing at that time from the Dean of the Graduate College, 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 additional 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 and enrollment 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 academic progress 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. The following requirements define the parameters within which the Graduate College functions. Specific instructions for each department should be referred to in addition to these general requirements.

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 The residency requirement is ful-

REGULATIONS OF THE GRADUATE COLLEGE

filled with courses that (1) are taken for graduate credit through the University of Vermont, either in the academic year or in summers on the main campus or off-campus locations, and (2) are taken after the student has been admitted to the Graduate College. Each candidate for the master's degree must satisfactorily complete twenty-one hours in residence. Each candidate for the doctoral degree must satisfactorily complete a minimum of fifty hours in residence.

Departments may require more than the minimum hours in residence.

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 may be completed in two ways: (1) Satisfactory performance on the Educational Testing Service's Foreign Language Examination which is offered three times a year on campus. (All candidates will submit their registration forms and fees directly to the Graduate Schools Foreign Language Tests, Educational Testing Service, Princeton, New Jersey 08540. Further information may be obtained from the Counseling and Testing Service, University of Vermont.), or (2) An examination may be requested by the student's department and administered by them or in conjunction with the appropriate language department.

If the department wishes to substitute competence in Computation Science, it may be achieved by satisfactory completion of Math 31 and Math 216 or by satisfactory completion of an examination (on a pass-fail basis) set and graded by the staff of the Computation Center.

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

REGULATIONS OF THE GRADUATE COLLEGE

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*, 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 time specified by the department and the Dean.

Graduate students may elect to take an undergraduate course on a pass-fail basis provided permission is obtained, prior to enrollment, from the department chairman and the dean of the Graduate College and that a letter grade is not required by the Studies Committee for any type of evaluation.

Maximum Time Limits for Degree Completion

MASTERS DEGREE

Full Time Student	3 Years
Fellow or Trainee (Non-Federal)	3 Years
Salaried University Employee	5 Years
Day—Part Time	5 Years
Evenings Only	5 Years
Summers Only	7 Years

normal full-time enroll. 12 yrs max 15

DOCTORAL DEGREE

All Students	9 Years
--------------	---------

*g. Tch or Resch Fell 6-10
RA's - 6 yrs.*

These time limits apply 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 must notify the Graduate College in writing of their withdrawal from a degree program or the deposit will be forfeited.

If a student does not register at the University of Vermont for course work, thesis research, or completion of thesis 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, his deposit forfeited and his file deactivated.

Transfer of Credit Upon request of the department, transfer of credit

for appropriate courses completed at other institutions may be accepted by the Graduate College. A maximum of nine hours credit in the case of master's candidates and twenty-four hours in the case of doctoral candidates 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) correspondence courses, (4) courses which are inappropriate for inclusion in any degree program offered by the Graduate College, (5) courses which were taken more than seven years prior to the completion of a degree program, (6) thesis credits received at another university.

Credit by Examination A student may, under certain circumstances receive credit for a course by taking an examination. The total number of credits which may be earned either by examination or transfer may not exceed the total credits which may be transferred into a master's program (9) or into a doctoral program (24).

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 prior to that time, 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 should be present at the Commencement unless he has been excused in advance by the Dean.

In unusual circumstances, a student may appeal any of the Regulations of the Graduate College by written request to the Executive Committee of the Graduate Faculty.

• REQUIREMENTS FOR A 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.

REGULATIONS OF THE GRADUATE COLLEGE

MASTER OF ARTS AND MASTER OF SCIENCE

Field of Specialization At least twenty-one 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-one hours must have been earned in courses which have been approved for graduate credit.

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 studies committee of 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 methods for satisfying the language requirement are described on page

Research and Thesis If a thesis is required, 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 three copies of his thesis to the Graduate College by the date specified in *Guidelines for Thesis Writing* which is available from the Office of the Dean. However, each department may stipulate an earlier deadline.

Thesis Examining Committee Upon submission of a completed thesis, the advisor will appoint a Thesis Examining Committee for oral examination of the candidate. The committee will consist of 3 members: 2 from the department and one from another field. The representative from the outside field will generally be designated as the chairman.

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 in the field of specialization.
- b. An oral examination in defense of the thesis.

Success in the written examination is prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington. One re-examination only is permitted for any final comprehensive examination.

Three copies of the corrected 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. Each MAT program is a cooperative venture between the specialist department and the College of Education. Students with questions regarding the education component of their program should consult with the office of the Dean of the College of Education.

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-one 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 Graduate Records Examination (Verbal and Quantitative), and be acceptable to the 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 cer-

REGULATIONS OF THE GRADUATE COLLEGE

tification requirements. Students without prior teaching experience will be required to complete satisfactorily an internship or an equivalent field experience which would be in addition to the minimum MAT education course requirements.

Examinations

- a. A written comprehensive examination in the field of Education.
- b. A written comprehensive examination or a comprehensive oral examination 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. It is the responsibility of the candidate to notify the respective department and the College of Education to schedule the required examinations.

MASTER OF EDUCATION

Before acceptance to candidacy for the degree of Master of Education, the student must present a satisfactory score in the Graduate Records Examination (Verbal and Quantitative). Before the degree is awarded, the candidate must have completed one year of successful teaching experience or other educational service. This requirement may be fulfilled by satisfactory completion of student teaching, an internship, or a practicum.

The graduate program of each student admitted to candidacy for the degree of Master of Education is planned and supervised by an advisor in the respective program area. 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. Contingent on a candidate's background and interests and on program specification, additional credit hours may be required. 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. Each Master of Education degree program must include a minimum of six semester hours of graduate work in the

humanistic foundations of Education, unless this requirement or its equivalent has been previously met. Graduate courses which currently fulfill this requirement include: Education 202, 204, 205, 206, 252, 254 and 255.

In order to insure effective planning of a graduate program for the degree of Master of Education, not more than nine hours credit 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 the Summer Session, prior to his second summer in residence. Candidates must satisfactorily complete twenty-one hours in residence. Full or part-time study arrangements are made with the respective program area faculty.

Examinations

A comprehensive examination is required. However, it may be written or oral. The choice between a written or an oral examination, or the decision to require both, will be made by faculty members in the area of specialization after consultation with the advisor and the candidate.

- a. The written comprehensive examination will cover the field of Education, with emphasis on the area of specialization,
- b. The oral comprehensive examination will emphasize the area of specialization.

All examinations are taken on the university campus in Burlington. Only one re-examination is permitted for any final comprehensive examination. It is the responsibility of the candidate to schedule the required examination with the College of Education. Since each program has different options for meeting the oral and written comprehensive requirements, candidates should contact the respective program chairman or advisor regarding that program policy.

If the thesis option is elected, there will be an oral examination in defense of the thesis.

MASTER OF SCIENCE FOR TEACHERS

Refer to specific departments for requirements for this degree program.

REGULATIONS OF THE GRADUATE COLLEGE

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 have the option of pursuing a thesis research topic consistent with his area of concentration and overall educational objective, at the conclusion of which the student must present a thesis which embodies the results of his work and demonstrates his capability. If the student desires and the department concurs, he may substitute nine additional hours of course work in lieu of the thesis.

Examinations

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

Normally the comprehensive examination is administered upon completion of all course work for the degree. Success in the written comprehensive is a prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington. One re-examination only is permitted for any final comprehensive examination.

Information on the M.B.A. evening courses may also be found in the University of Vermont Continuing Education Bulletin.

Not more than six credit hours of graduate work completed prior to residence as defined on page 18 will be applied toward the degree requirements.

MASTER OF EXTENSION EDUCATION

A minimum of 30 semester hours is required in courses numbered above 200. Each candidate is expected to complete 12 semester hours of course credit in Agriculture and/or Home Economics or related basic courses; including a minimum of 6 semester hours in Vocational, Technical, Extension and/or Home Economics Education. The minimum of

18 semester hours of approved electives provides the candidate with the opportunity of concentrating his study in an appropriate field.

The application of each student seeking admission to candidacy for the Master of Extension Education is reviewed by the chairman of the departments of Home Economics and Vocational, Technical, and Extension Education. An advisor will be assigned from the appropriate department.

A student must present a satisfactory score in the Miller Analogies Test. 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 will complete the requirements for the degree either through Summer Sessions, Evening Division and/or full time residency.

Examinations

- a. A written comprehensive examination in field of specialization.
- b. A comprehensive oral examination in the field of specialization.

Success in the written examination is prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington. 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 department chairman. 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 A minimum of fifteen hours in courses used for compilation of the grade point average must be taken in residence at The University

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of Vermont. 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 The determination of language requirements is established by each individual department. Please refer to specific departmental entries. If a knowledge of a foreign language is required, the method of satisfying this requirement will be determined by each individual department, as well as the evaluation of the results.

The language requirement must be fulfilled before the written comprehensive examination is taken and before admission to candidacy.

Completion of an appropriate foreign language at the intermediate college level with a grade of B or better in the final semester may be accepted in fulfillment of a reading knowledge of a foreign language.

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 four copies of his thesis to the Graduate College by the date specified in *Guidelines for Thesis Writing* which is available from the office of the Dean; 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 approve a Thesis Committee, appointed by the department, for the oral examination of the candidate. The Committee shall consist of the Dean, as chairman, the members of the Studies Committee, and at least two faculty members from outside of the department who will be nominated by the chairman of the department concerned for a total membership of six. 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.

Success in the written examination is prerequisite to taking the oral examination. All examinations are taken on the University campus in Burlington.

Four copies of the corrected thesis must be forwarded to the Dean of the Graduate College after the successful defense of thesis.

Definition of Vermont Resident

The following rules of residence, adopted by the Board of Trustees on October 18, 1952, used in determining a student's eligibility to benefit from the reduced tuition rate for residents of Vermont, be and hereby are amended, effective with the beginning of the fall semester in 1971, to read as follows:

Definition of "Vermont Resident"

1. A student who is of age at the beginning of a semester of the University shall be deemed to be a Vermont resident during such semester if, and only if, he had his domicile in Vermont for a period of one year next preceding the beginning of such semester, except as otherwise provided by these rules.

2. A student who is a minor at the beginning of a semester of the University shall be deemed to be a resident of Vermont during such semester if, and only if, his parents had their domicile in Vermont for one year preceding the beginning of such semester, except as otherwise provided in these rules.

3. A student who at the beginning of a semester of the University has his domicile fixed by a special rule of law (as a student under guardianship, a married woman, etc.) shall be deemed to be a Vermont resident during such semester if, and only if, the circumstances claimed to have made the student a resident shall have taken place at least one year prior to the beginning of such semester; provided, however, that a guardianship of a minor student shall not be deemed a basis for residence if the primary purpose of the guardianship is to qualify the minor for resident tuition.

4. Whenever a resident student shall lose his Vermont domicile (as in the case of a minor whose parent or guardian moves from Vermont but excepting women who lose such domicile by marrying non-residents) the student shall be reclassified as a non-resident effective at the beginning of the next semester for which the student enrolls; and it shall be incumbent upon any student whose status so changes from resident to non-resident to inform the Dean of his college, or the Registrar, promptly, of the facts relating to his residence.

5. The burden of proof shall in all cases rest upon the student claiming to be a resident of the State of Vermont.

6. The Board of Trustees may whenever justice requires make exceptions to these rules.

DEFINITION OF VERMONT RESIDENT

The Committee on Residence has been authorized by the Board of Trustees to consider exceptions as stated in rule 6 above. Appeals from the decision of the committee may be made to the Board of Trustees.

Application for change of residence classification should be made to the Director of Admissions who is chairman of the Committee on Residence.

Student Expenses

Application Fee All applications for admission must be accompanied by a \$15 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 prior to enrollment (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.

Tuition Rates for the academic year 1971-72 will be as follows: For Vermont residents, \$40 per credit hour, with a semester maximum of \$475.

For nonresidents of Vermont, \$100 per credit hour, with a semester maximum of \$1200.

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 has not completed or defended his thesis.

Library Bond 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. This fee is assessed by legislative act and turned over to the State of Vermont each year to the extent necessary to fund the debt retirement on the bond issue that was used to fund the construction of Bailey Library.

Student Health Fee A fee of \$22 per semester is charged all full time degree students enrolled at the university.

Athletic Bond 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. This fee is assessed by legislative act and turned over to the State of Vermont each year to the extent necessary to fund the debt retirement

on the bond issue that was used to fund the construction of Patrick Gymnasium.

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 cost of thesis binding and, in the case of doctoral candidates, the academic hood, and is normally covered by the initial deposit of \$35.

Living Expenses At present there is no university housing for single graduate students. A limited amount of married student housing is available. All inquiries should be referred to the Housing Office. The Housing Office, 633 Main Street, Burlington, also 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 \$20.00 per week for a single furnished room to \$135.00 per month for a furnished, two-bedroom apartment. A single student should expect overall living expenses of \$225 to \$250 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.

Tuition Refunds

In the event of voluntary withdrawal from college, during the first week of any semester the full tuition is refunded; thereafter, 20 percent is retained by the University for each week that has elapsed.

Any student who has paid in full the tuition for a semester and who withdraws for reasons of health or other causes beyond his control before the end of the semester, may, with the permission of the dean and in lieu of any refund, elect to enroll for a final semester without charge for tuition.

If a student is suspended, no cash refund is made; the student and his parents are informed that a credit balance for the amount actually paid for tuition by the student or his parents will be retained on the University's books and applied to his tuition charges, if he re-enrolls within three years of his suspension; no scholarship grants will be included in such credit.

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If a student is dismissed for cause, a refund of tuition is made proportionate to the number of weeks remaining in the semester at the time of dismissal.

In case of death of a student, tuition paid is refunded in full.

A student who changes his status from full-time to part-time (fewer than twelve hours) by an approved change of enrollment during the first three weeks of a semester may be entitled to partial refund of tuition, gymnasium, and library fees, since the charges will be adjusted to fit his new status.

Deposit Refunds

A student who is admitted to register in July or September and cancels prior to May 1 will receive a refund of \$15.00 from the original \$35.00 deposit. If a student has been admitted for January, the College must be notified by December 1 in order to receive the partial refund.

Financial Aid

Students who wish to be considered for fellowships as well as admission must submit completed 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. No separate form is required.

- **GRADUATE COLLEGE FELLOWSHIPS**

The Graduate College offers Graduate College 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. These Fellowships are not renewable.

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

Graduate Teaching and Research Fellowships are awarded in departments offering graduate work. Graduate Teaching Fellows may be appointed for nine or twelve months with stipends ranging from \$2,000 to \$3,400, Graduate Research Fellows are appointed for eleven months with stipend of \$3,100. Teaching and Research Fellows may enroll for a maximum of twelve hours per semester; they are eligible for reappointment. Fellowship award includes tuition scholarship for the period of the fellowship.

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

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their fields of concentration in the departments in which they are appointed.

Appointments will be announced on or about April 1.

• *GRADUATE RESIDENT ADVISORSHIPS*

Graduate students, men and women, are eligible to apply for Graduate Resident Advisorships. 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 Graduate Resident Advisors receive a stipend of \$2600 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. Appointments will be announced on or about May 1.

• *NATIONAL DEFENSE EDUCATION ACT FELLOWSHIPS*

The U.S. Department of Education supports fellows in ten 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, Microbiology, Pharmacology, Physics, 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 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, Biostatistics, Education, Medical Technology, 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*

The Graduate College provides support for 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 comparatively small plants and farms. Applications should be addressed to the Chairman of the Department of Animal Sciences.

• *HOOD INTERDISCIPLINARY FELLOWSHIP*

This fellowship is awarded for study leading to a degree in a field where the principles of physics or physical chemistry are applied to biological or medical science. Applicant must be recommended by the department chairman. Stipend \$3,400 plus tuition, fees, and travel allowance. In order

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to be eligible, applicant must have equivalent of an M.S. in physics or physical chemistry.

- *THE HUMPHREY CHEMICAL COMPANY FELLOWSHIP
IN HYDROCARBON SYNTHESIS*

This fellowship is awarded annually to a qualified student in the chemistry department working toward a Ph.D. in organic chemistry. The amount of the stipend is consistent with that paid by other departments. The fellowship also provides tuition and non-refundable fees.

- *THE WEBB FELLOWSHIPS*

These fellowships are awarded to students in the department of history who are involved in such areas as the history of art and architecture, U.S. and Vermont history including social history, the history of technology and museum work. The program is operated through the Shelburne Museum and the University's departments of history and art. Fellowships carry a stipend of \$1,000 per year plus tuition.

- *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.

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.

• ANATOMY

Professors Dunihue, Newhall (Emeritus), and W. J. Young (Chairman); Associate Professors Freedman, Ring and Wells; Assistant Professors Weidman, E. Wennberg; Demonstrator Boushey.

Research activities include: electron microscope study of the structure of the renal glomerulus and juxtaglomerular apparatus under various experimental conditions; neural control of reproduction; electron microscope study of hemopoietic tissues; biochemical genetics and cytogenetics in the *Drosophila*

ANATOMY

X-chromosome; experimental neuronanatomy and autoradiography of the central nervous system; kinetics of erythropoiesis; functional development and fine structure of retina; fine structure of sperm tail filament organization.

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

Year courses in Physics, Organic Chemistry; year course or equivalent in Advanced Biology; satisfactory standing on Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS

Anatomy 301, 302, 311, Physiology 301, Medical Biochemistry 301-302 or equivalent; dissertation and comprehensive examination.

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

Bachelor's degree; one year of Biology and Organic Chemistry; Physics; Mathematics through Analytical Geometry and Calculus. GRE required.

MINIMUM DEGREE REQUIREMENTS

Anatomy 301, 302, 311, 341, 351; Biochemistry; Physiology and Biophysics 301; additional elective courses and teaching assignments as arranged with the Department; thesis research; credits as required by the Graduate College.

COURSES OFFERED

201 ELECTRON MICROSCOPY A methodology course designed to provide basic knowledge of and experience with the techniques of electron microscopy and interpretation of electron micrographs. *Prerequisite:* an acceptable course in histology or cell structure (e.g. Zoology 112; Botany 256; Anatomy 311). 3 credits. Schedule of time to be arranged, 6 hours of lecture-discussion-laboratory. Fall semester. Messrs. Black and Jagels.

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, special dissection, and demonstration. Six hours. Messrs. Ring, Weidman, and Boushey.

302 NEUROSCIENCE A correlated presentation of the neuroanatomy and neurophysiology of the mammalian central nervous system. The course will consist of lectures, demonstrations and laboratory. The laboratory consists of

both microscopic examination of the nervous system and gross dissection of the human brain. Clinical presentation of patients with neurological deficits when appropriate. Same course as Physiology 302. *Prerequisites:* Permission of the instructor. Four hours. Anatomy and Physiology Staff.

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

323 NEUROENDOCRINOLOGY A consideration of the diencephalic regulation of hormonal activity. Initial lectures will cover morphological features of the hypothalamus and hypothalamo-hypophysial pathways. The major portion of the course will be devoted to hypothalamic mechanisms controlling each principal pituitary hormone. These topics will be covered in a brief lecture followed by a discussion based upon text and journal assignments. *Prerequisites:* Anatomy 302. 2 credits. Alternate years. Mr. Freedman.

324 ADVANCED NEUROANATOMY A detailed analysis of the morphology of the nervous system is presented through lectures and laboratory. A regional approach to the anatomy is supplemented by units on development, blood supply, and the autonomic nervous system. Laboratory exercises will consist of brain dissection and microscopic examination of brain stem sections. *Prerequisites:* Anatomy 302. 3 credits. Messrs. Freedman, Wells and Weidman.

325 CEREBRAL CORTEX Selected aspects of the morphology and physiology of the cerebral cortex will be presented by lectures and discussions of assigned reading. Thalamo-cortical systems, cytology, cytoarchitecture, development, functional localization, and neurochemical observations are some of the topics to be examined. *Prerequisites:* Anatomy 302. 2 credits. Alternate years. Mr. Wells.

341, 342 SPECIAL DISSECTIONS IN GROSS ANATOMY Special dissections of particular regions of the human body, utilizing either adult or fetal material. *Prerequisite:* consent of instructors. Credit as arranged. Staff.

351, 352 SPECIAL TECHNIQUES IN HISTOLOGY A study of selected cells, tissues or organs by means of special techniques. Specific work as agreed upon. *Prerequisite:* 311; consent of instructors. Credit as arranged. Staff.

374 CYTOGENETICS The structure and function of chromosomes and associated organelles (centriole, spindle, nucleolus) will be analyzed by critical review of the current literature. The seminar will include the pertinent observations in human somatic and meiotic cells, as well as in selected plant and animal species. *Prerequisites:* Zoology 115 or equivalent, with permission of the instructors (same course as Botany 374). 2 credits. Mr. Young, Mr. Hyde (Botany). Alternate years.

ANIMAL PATHOLOGY

381 SEMINARS IN ANATOMY Critical review of the literature in various areas of the anatomical sciences. *Prerequisite:* graduate standing. Credit as arranged.

382 HISTOPHYSIOLOGY OF THE HEMATOPOIETIC TISSUES Seminar discussions of pertinent literature on the functional morphology of the hemopoietic tissues under normal and certain abnormal conditions. The latter are selected to illustrate altered or heightened normal activities. Where available, relevant histological and electron microscopic materials will be demonstrated. *Prerequisites:* Anatomy 311 or other histology course (e.g.: Zoology 112) 2 credits. Spring semester. Alternate years, 1971. Mrs. Wennberg.

384 SEMINAR IN CELLULAR FINE STRUCTURE Seminar discussions of current concepts of the fine structure of cell organelles and of their functions and modifications as revealed by electron microscopy. *Prerequisite:* An acceptable course in histology (e.g. Anatomy 311; Zoology 112; Botany 256) and in cell physiology or biochemistry (e.g. General Biochemistry 201; Zoology credits. Spring semester. Alternate years, 1971. Mrs. Wennberg.

391 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.

491 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.

• ANIMAL PATHOLOGY

Professor Bolton (Chairman); Associate Professors Doremus and Murray.

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.

MINIMUM DEGREE REQUIREMENTS

Candidates will elect a major concentration in Anatomy, Animal Sciences, Biochemistry, Microbiology, Pathology or Physiology and Biophysics; additional courses in related fields; thesis research (12-15 hours).

COURSES OFFERED

217-218 LABORATORY ANIMALS (2-2) Life cycles, feeding, housing, breeding requirements, nutrition, disease prevention, maintenance of germ-free colonies, preoperative and postoperative care, and humane methods of handling. *Prerequisite:* microbiology and biochemistry 55 or medical microbiology 201, chemistry 131, 132. Three hours. Dr. Henry Doremus.

220 LABORATORY ASSIGNMENTS (1-6) Rotating assignments in the Animal Pathology Laboratory and Division of Animal Services in the College of Medicine. Students work with groups of experimental animals under the guidance of the professional staff. *Prerequisite:* 107, 217. Three hours. Staff.

391 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	110 Wildlife Diseases
106 Animal Diseases	197, 198 Senior Research
107-108 Laboratory Animal Techniques	217-218 Laboratory Animals
	220 Laboratory Assignments

• ANIMAL SCIENCES

Professors Atherton, Balch, Smith, (Chairman) and Welch; Associate Professors Carew, Duthie, Nilson and Simmons; Assistant Professor Foss; Lecturers Gibson, Mercia, and Woelfel.

Research activities in basic and applied science encompass a broad range of interests. The areas of study and research include nutrition; physiology; dairy and food plant management; chemistry, or bacteriology; and quality control aspects of the food industry.

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

An acceptable undergraduate major in the Animal Sciences; Chemistry; Biology; or a related field. Satisfactory scores on the aptitude and advanced section of the Graduate Records Examination must be presented.

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

Satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination must be presented. The applicant must satisfy the prerequisites of the Graduate College and pass the general qualifying examination administered by the Department of Animal Sciences.

MINIMUM DEGREE REQUIREMENTS

The Department of Animal Science believes each graduate program has its individual needs and must be arranged accordingly. The candidate must meet all requirements as prescribed by the graduate college for the degree of the Doctor of Philosophy. In addition, all courses and seminars as established by the Studies Committee must be satisfactorily met, doctoral research must be completed, and an acceptable thesis written and defended. In accord with the policy of the Animal Sciences Department, all doctoral students will be provided the opportunity to participate in the department's undergraduate teaching program. Proficiency in a modern foreign language or computer language and programming is optional at the discretion of the studies committee.

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. Welch.

211 ICE CREAM AND FROZEN DAIRY PRODUCTS Fundamentals of ice cream manufacturing, the physico-chemical and biological factors involved; calculation of formulas; sherberts and specialties; merchandising, soda fountain management and sanitary control. *Prerequisite:* 104; credit or concurrent enrollment in 109. Three hours. Mr. Nilson. Alternate years, 1971-72.

251 ADVANCED DAIRY CATTLE MANAGEMENT The organization and operation of dairy cattle enterprises. Theories and methods of application of feeding, breeding, and management programs and principles will be emphasized. *Prerequisite:* 55. Three hours. Mr. Woelfel. Alternate years, 1971-72.

256 DAIRY PLANT MANAGEMENT Organization and operation of milk

processing and manufactured milk products plants. *Prerequisite:* 153, Ag.Ec. 62: Three hours. Mr. Nilson. Alternate years, 1972-73.

257 DAIRY CHEMISTRY An advanced study of the chemical and physical properties of milk constituents with emphasis on training and experience in dairy research methodology. Students will select, design and perform several research experiments. *Prerequisite:* 33, 104, and a course in organic chemistry. Three hours. Mr. Duthie. Alternate years, 1971-72.

260 ANIMAL BREEDING Theory and application of genetic principles to breeding of livestock. *Prerequisite:* 2, Zoology 115. Three hours. Mr. Balch. Alternate years, 1972-73.

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, 1972-73.

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

291 SPECIAL PROBLEMS IN ANIMAL SCIENCES Reading, discussion, and special laboratory investigation in the field of animal sciences. *Prerequisite:* Departmental permission. Three hours. Staff.

294 HISTORY OF NUTRITION (See Home Economics 294). One hour. Staff.

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. *Prerequisite:* one of the following: Animal Sciences 206, Home Economics 243, or a 200 level course in biochemistry. Three hours. Staff. Alternate years, 1971-72.

308 EXPERIMENTAL TECHNIQUES IN NUTRITION Methods of conducting research in nutrition with the 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. Staff.

BIOCHEMISTRY

391 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 DOCTORAL THESIS RESEARCH Original research under the direction of an assigned staff member, culminating in an acceptable doctoral thesis. Credit as arranged.

Undergraduate courses:

- | | |
|---------------------------------------|--|
| 2 Introductory Animal Science | 114 Manufactured Dairy Products |
| 33 Introductory Dairy Technology | 121 Sensory Evaluation of Milk and Milk Products |
| 44 Dairy Cattle Judging | 153 Milk Processing |
| 55 Fundamentals of Livestock Feeding | 177 Advanced Livestock Production |
| 58 Introductory Avian Biology | 187, 188 Light House Production and Management |
| 104 Dairy Testing and Quality Control | 190 Poultry Technology |
| 109 Food Microbiology | 197, 198 Senior Research |

• BIOCHEMISTRY

Professor Melville (Chairman); Associate Professors Lamden, Meyer and Woodworth; Assistant Professors Hart, Schofield, Thanassi, Willard and Wuthier; Instructor Ishikawa.

Current research programs include studies of the physiology and ecology of procaryotic photosynthetic organisms, with emphasis on carbon dioxide fixation and its regulation (B. A. Hart); the effects of ascorbic acid on the metabolism of bone and other tissues (M. P. Lamden); the biosynthesis and function of ergothioneine and related compounds (D. B. Melville and Y. Ishikawa); hormonal and enzymatic control mechanisms in muscle (W. L. Meyer); the relationship between structure and function of nucleic acids with particular reference to transfer-RNA and ribosomal-RNA (P. Schofield); catalytic mechanisms involved in transamination and decarboxylation reactions (J. W. Thanassi); the enzymatic mechanisms of carbon dioxide fixation (J. M. Willard); the nature of the binding of metals to proteins, particularly the iron-binding proteins of blood plasma (R. C. Woodworth); and the relationship of lipid metabolism to bone formation (R. E. Wuthier).

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

Fifteen hours from graduate courses offered by the Department of Biochemistry exclusive of seminars, and including Biochemistry 301-302 and 303, and participation throughout residence in Biochemistry Seminars; fifteen hours of Master's Thesis Research.

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.

MINIMUM DEGREE REQUIREMENTS

Twenty hours from graduate courses offered by the Department of Biochemistry including Biochemistry 301-302, 303, and participation throughout residence in Biochemistry Seminar; nine 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 or other appropriate foreign language.

COURSES OFFERED

301-302 BIOCHEMISTRY The General Biochemistry Section is designed for science majors and covers two semesters. The Medical Biochemistry Section is primarily for medical students and is given during the first two trimesters of the medical college calendar. The two sections are equivalent in all respects except for emphasis on basic science in one and medical relevance in the other. *Prerequisite:* Chemistry 131-132 and permission of the department. Three hours per semester or trimester. Staff.

General Biochemistry Section: Comprehensive survey of biochemistry for

BIOCHEMISTRY

students majoring in the sciences. Topics include the chemistry, structure, metabolism, and function of proteins, amino acids, carbohydrates, lipids, and nucleic acids; enzymes; bioenergetics; respiratory processes; cellular and physiological control mechanisms.

Medical Biochemistry Section: A survey of physiological and molecular biochemistry with special reference to man. Topics include the metabolism and function of proteins, amino acids, carbohydrates, lipids, and nucleic acids; vitamins and nutrition; enzymes and bioenergetics; respiration, hemoglobin, plasma proteins, and iron metabolism; acid-base balance, water balance, and mineral metabolism; hormones and control mechanisms.

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

311, 312 BIOCHEMICAL PREPARATIONS Laboratory procedures and techniques for the synthesis, isolation, and characterization of compounds of biochemical interest. *Prerequisite:* 301-302. Two hours per semester. Messrs. Ishikawa and 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:* 301-302; 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:* 301-302; Chemistry 141-142. Two hours. Mr. Willard.

331 NUCLEIC ACIDS The structure and function of ribonucleic acids and deoxyribonucleic acids. *Prerequisite:* 301-302. Two hours. Mr. Schofield.

340 ORGANIC BIOCHEMISTRY Organic reaction mechanisms as related to substances of biochemical interest, with emphasis on catalytic mechanisms. *Prerequisite:* 301-302. Two hours. Mr. Thanassi.

350 RADIOISOTOPE LABORATORY The practical aspects of the use of radioisotopes as tracers in biochemical research. *Prerequisites:* 301-302, 303 and permission of the department. Three hours. Mr. Ishikawa.

371 PHYSICAL BIOCHEMISTRY Protein interaction, solubility and fractionation, electrophoresis, sedimentation, phase rule study, diffusion, viscosity,

spectrophotometry, and related topics. *Prerequisites:* 301-302; Chemistry 141-142. Two hours. Mr. Woodworth.

381 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 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 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*).

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 prerequisites. 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.

• BIOSTATISTICS

This is an interdisciplinary program administered through the Biometry Facility in the Department of Community Medicine. Dr. Whorton is the program director.

BIOMEDICAL ENGINEERING

The department offers a concentrated program in Biostatistics leading to the M. S. degree. The program takes full advantage of statistics courses taught in the Department of Mathematics, biostatistics and community medicine courses taught in the Department of Community Medicine, and a wide variety of health and related research projects at the University of Vermont. The program will aim to give trainees maximal opportunity to use their academic training to assist in defining problems, formulating rational methods of inquiry, and gathering, analyzing and interpreting data related to the specific problem under study and its proposed solutions.

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

An undergraduate major which includes an indication of mathematical ability and an interest in applying statistical tools to health and medical problems. Students without a background in linear algebra and the topics included in Mathematics 271 will be required to make up these deficiencies as part of their graduate degree program.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Thirty-six semester hours consisting of nine hours of probability and mathematical statistics, nine hours of statistical methodology and sample survey methods, six hours of approved electives, six hours of course work in community medicine and biometry, and six hours of thesis research. In addition, the student is expected to participate in the biostatistics workshop each semester.

COURSES REQUIRED

BIOSTATISTICS 200, 201 STATISTICAL METHODOLOGY I, II For description see Mathematics 200, 201.

BIOSTATISTICS 202 SAMPLING METHODS For description see Mathematics 202.

BIOSTATISTICS 203 ELEMENTS OF PROBABILITY For description see Mathematics 203.

BIOSTATISTICS 204, 205 MATHEMATICAL STATISTICS I, II For description see Mathematics 204, 205.

BIOSTATISTICS 206 EXPERIMENTAL DESIGN For description see Mathematics 206.

BIostatistics 209 NONPARAMETRIC METHODS For description see Mathematics 209.

BIostatistics 201 POPULATION ANALYSIS For description see Sociology 210.

BIostatistics 281 COMMUNITY MEDICINE Consideration of social science in medicine, environmental health problems, community health services, and the application of epidemiologic principles and techniques to selected infectious and noninfectious diseases. Lectures, demonstrations and seminars. Two hours.

BIostatistics 300 MEDICAL SOCIOLOGY For description see Sociology 300.

BIostatistics 371 BIostatistics WORKSHOP Study of specialized methods and procedures of statistics which are especially important in health and related studies. Participation by students in current research problems. Two hours. Staff.

BIostatistics 391 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.

• BOTANY

Professors Dodge (Visiting), Gershoy (Emeritus), Hyde (Chairman), Klein, Marvin, Sproston, Taylor and Vogelmann; Associate Professors Cook and Etherton; Assistant Professors Wilson and Worley.

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; bio-systematics 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; cellular electrophysiology, biogeography of the Bryophytes. Interdisciplinary research programs may be developed in many areas of biology.

BOTANY

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. Satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination.

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. 23.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS (BIOLOGY)

A bachelor's degree from an accredited institution and certification as a teacher of biology or an associated field. Three years teaching experience at junior high or high school level. Satisfactory scores on the aptitude section of the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS

Thirty hours of course work to include a selection of courses in the Department of Botany and Zoology which will broaden and balance the undergraduate work in biology. At least two 200 level courses in each department. Courses in four of the five following areas: anatomy; morphology and systematics; genetics; developmental biology; and environmental biology. Up to 12 hours of 100 level courses may be used for the above requirement. Students will be encouraged to select courses in related science departments, mathematics, and in education to complete the required thirty hours. No thesis is required, however, each degree recipient must complete a written and oral examination.

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 121 or its equivalent; one year in Physics, *i.e.*, Physics 5-6 or its equivalent. Satisfactory scores in the Graduate Record Examination. 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. The specific language requirement for the candidate is to demonstrate ability to comprehend the contents of articles in the biological sciences in a modern language appropriate to the student specialty and approved by the studies committee.

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.

COURSES OFFERED

202 Electron Microscopy for Life and Physical Scientists, Biologists and Engineers (see Mechanical Engineering 340)

205 MINERAL NUTRITION OF PLANTS (see Plant and Soil Science 205)

207 WATER RELATIONS OF PLANTS (see Forestry 207)

210 PLANT RESPONSE TO ABIOTIC TOXICANTS Study of the relationship between plants and phytotoxic abiotic factors. Representative examples of the damage caused by selected agents and current hypotheses relating to the mechanisms of abnormal response are discussed. Interactions of biotic and abiotic factors; air and water pollutants; nutritional disorders; pesticides. *Prerequisites:* 104 or Zoology 103 or equivalent. Three hours. Mr. Wilson. Alternate years, 1972-73.

212 PHYSIOLOGY OF PLANT PATHOGENESIS A study of the physiological interactions in selected plant disease situations. Topics include hydrolytic enzyme systems involved in tissue disintegration, role of enzymes, polysaccharides, and toxins in wilting phenomena; mode of action of microbial toxins in altering plant metabolism; role of growth regulators in hyperplastic responses; alterations in respiration, photosynthesis, and other physiological processes in disease situations. *Prerequisites:* 117, 104 or Microbiology and Biochemistry 201. Three hours. Mr. Wilson. Alternate years, 1971-72.

213 PLANT COMMUNITIES Principles of plant sociology; structure and or-

BOTANY

ganization of the plant community; sampling methods and analysis of data; climatic and edaphic factors; field work. *Prerequisite:* 109 or departmental permission. Three hours. Mr. Vogelmann. Alternate years, 1972-73.

232 BOTANY FIELD TRIP A multidisciplinary course involving field trips to selected environments outside of Vermont. Led by several faculty members representing different fields of Botany. Emphasis will be on overall, integrated approach to plant ecology, plant structure and plant function. One hour. Staff. Christmas or spring vacation or end of school year.

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:* 4 or Biology 1, 2 or departmental permission. Four hours. Mr. Taylor. Alternate years, 1972-73.

253 FUNGI The reproductive processes of the common molds, yeasts, and antinomycetes and their classification. Physiological studies; antibiosis. *Prerequisite:* Chemistry 131, 132 or departmental permission. Four hours. Mr. Sproston. Alternate years, 1971-72.

254 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:* Zoology 101 and at least 8 additional hours of Botany or Zoology courses numbered above 100. Three hours. Mr. Hyde. Alternate years, 1972-73.

256 CYTOLOGY The dynamics of the protoplast; nuclear division, gamete formation, and syngamy. Ultrastructure of cell organelles; nucleocytoplasmic interaction. *Prerequisites:* 254 or Zoology 101; Chemistry 131-132 or departmental permission. Four hours. Mr. Hyde. Alternate years, 1972-73.

257 PHYSIOLOGY OF THE PLANT CELL Detailed study of photosynthesis, plant cell membrane function, and plant cell growth. *Prerequisites:* Botany 104; Chemistry 131, 132 or Chemistry 16; Physics 5-6; Microbiology and Biochemistry 201. Four hours. Mr. Etherton and staff. Alternate years, 1972-73.

259 PLANT GROWTH The nutrition of plant tissues, organs and the plant body. Cyclic variations of environmental factors, morphogenesis. *Prerequisites:* 104; Chemistry 131-132. Four hours. Mr. Marvin and Mr. Klein. Alternate years, 1971-72.

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:* 105 or 2 courses in Zoology or Botany above 100. Four hours. Mr. Cook. Alternate years, 1971-72.

270 PERSPECTIVES IN BIOLOGY Group discussion and individual participation in the examination of such topics as biological rhythms, mimicry, holism, polarity, traumatic reversion, dichotomy, the common occurrence of the helix, and others. *Prerequisite:* 12-15 credits in zoology or botany courses. Three hours. Mr. Sproston. (Pending approval for graduate credit)

281 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, Microbiology and Biochemistry, Forestry, Plant and Soil Science, etc. Attendance required of botany graduate students and seniors in botanical research programs. Without credit. Staff.

374 CYTOGENETICS (see Anatomy 374)

381 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 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 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, 2 Principles of Biology | 111 Forest Pathology |
| 4 Introductory To Plant Biology | 117 Plant Pathology |
| S10 Field Botany | 151 Plants and Man |
| 104 Physiology of the Plant Body | 160 Plant Ecology |
| 105 Developmental Plant Structure | 197, 198 Undergraduate Research |
| 109 Systematics and Phylogeny | |

OTHER DEPARTMENTS OFFERING RELEVANT COURSES

Agricultural Economics
Anatomy

CELL BIOLOGY

Biochemistry
Chemistry
Forestry
Geology
Medical Microbiology
Microbiology & Biochemistry
Pathology
Physiology and Biophysics
Plant & Soil Science
Zoology

• CELL BIOLOGY (Interdisciplinary)

Professors Glade, Hyde, Johnstone, Racusen, Rothstein and Sproston; Associate Professors Cook, Davison, Etherton, Foote, Sjogren, Stevens and Weller; Assistant Professors Brammer, Landesman and Wilson.

A graduate program in Cell Biology is offered under the direction of the Cell Biology Committee. Faculty members from the Colleges of Arts and Sciences, Agriculture and Home Economics, and Medicine will participate in the program and students enrolled in this program will be housed in a participating department. Inquiry about this program should be made to the Cell Biology Program Chairman, Dr. B. Etherton, Botany Department.

Research includes: The effects of light on sexual and asexual reproduction in fungi; 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; cellular electrophysiology; identification and metabolism of leaf proteins, the isolation and characterization of ribosomes from a variety of cell types, the synthesis and regulation of the glyoxylate bypass of fungi; biochemistry and cytology of cell division; mechanisms influencing and controlling cell division in normal and neoplastic cells; mechanism of the establishment of bilateral symmetry in fertilized amphibian eggs; inter- and intracellular mechanisms operating during early embryonic development; the relationship between structure and function in the insect visual system; the physiology of reproduction in invertebrates.

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

Biology (3 semesters, including Genetics), Chemistry through Organic, Mathematics through Calculus, Physics (2 semesters). Satisfactory scores on Graduate Records Examination. Students who do not have all of the courses listed but

who have a good academic record will be considered for admission to the program. Minor deficiencies can be made up after matriculation.

MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

30 graduate credit hours which include the following courses or their equivalents; Botany 256 Cytology, or Anatomy 374 Cytogenetics; Zoology 231 Cell Physiology, or Botany 257 Physiology of the Plant Cell; Microbiology and Biochemistry 201 General Biochemistry, and 202 Advanced Biochemistry; other courses. In addition, thesis research, advanced courses in science or mathematics as appropriate to the student's program and regular participation in Cell Biology seminar.

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

15 graduate credit hours of courses as listed under Master of Science requirements. Minimum of one semester of Physical Chemistry, equivalent to Chemistry 140. Reading knowledge of French, German or Russian. Satisfactory completion of an oral qualifying examination administered by the Studies Committee with the participation of the Cell Biology faculty not later than the third semester in residence.

MINIMUM REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Minimum of 20 additional hours of course work chosen from electives such as those listed below. Studies Committee will advise course selection. Thesis research, minimum 20 credits. Regular participation in seminar program.

ELECTIVES

Anatomy	202 Electron Microscopy
Anatomy	374 Cytogenetics
Anatomy	384 Cellular Fine Structure
Biochemistry	320 General Enzymology
Biochemistry	321 Enzyme Kinetics & Mechanisms
Biochemistry	331 Nucleic Acids
Biochemistry	340 Organic Biochemistry
Biochemistry	371 Physical Biochemistry
Botany	255 Genetics and Cytogenetics
Botany	256 Cytology
Botany	257 Physiology of the Plant Cell

CELL BIOLOGY

Chemistry	231 Principles of Physical Organic Chemistry
Chemistry	233 Mechanisms of Physical Organic Chemistry
Chemistry	251, 252, 224, 332, 334 Advanced Organic Chemistry
Electrical Engineering	238 Radiation Electronics
Geology	211 X-ray Crystallography
Medical Microbiology	203 The Mamalian Cell as a Microorganism
Medical Microbiology	211 Microbial Genetics
Medical Microbiology	302 Microbiology
Medical Microbiology	322 Immunology
Microbiology & Biochemistry	203 Molecular Biology
Microbiology & Biochemistry	254 Microbial Biochemistry
Pathology	201 Histochemistry
Pathology	301 General Pathology
Pathology	302 Systemic Pathology
Pathology	320 Fundamentals of Cell Pathology
Pharmacology	301 Medical Pharmacology
Physics	220 Biological Physics
Physics	222 Advanced Biological Physics
Physiology & Biophysics	301 Physiology & Biophysics
Physiology & Biophysics	308 Biometrics & Applied Statistics
Physiology & Biophysics	309 Synaptic & Conducting Membranes
Physiology & Biophysics	310 Molecular Basis of Biological Motility
Physiology & Biophysics	311 Special Sense Receptors
Physiology & Biophysics	313 Seminar on Endocrine Physiology
Physiology & Biophysics	315 Physiology & Pharmacology of Synapses
Physiology & Biophysics	321, 322 Cellular Physiology & Biophysics
Physiology & Biophysics	323 Principles and Elements of Biomedical Instrumentation
Zoology	216 Human Genetics
Zoology	220 Mechanisms of Cell Division
Zoology	222 Experimental Embryology
Zoology	223 Biochemical Embryology
Zoology	231 Cell Physiology
Zoology	255 Comparative Animal Physiology
Zoology	201 Control of Growth and Differentiation

• CHEMISTRY

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

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

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 coordination complexes, 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 FOR TEACHERS OF PHYSICAL SCIENCES

The requirements for admission to candidacy for the degree of Master of Science for Teachers of Physical Sciences are: (1) Completion of at least one full year of teaching, (2) Successful completion of Physics 128, Chemistry 131 and 141, and Mathematics 121, or their equivalents. (These courses may have been taken at the undergraduate level, as part of this graduate program, or credit may be obtained by transfer or examination.)

MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS OF PHYSICAL SCIENCES

The above prerequisites for admission to candidacy must be supplemented by: (1) Completion of thirty hours of credit, of which at least eighteen must be in Physical Sciences Option (A) or (B) as described below. The remaining twelve credits may be chosen, with the consent of the Joint Advisory Committee, from appropriate courses at any level in science, engineering, mathematics and education. (Credit in education courses is limited to six semester hours.) (2) Successful completion of a comprehensive examination administered by the Joint Advisory Committee. Satisfactory scores on the Graduate Record Examination.

Physical Sciences Option (A): Nine semester hours of Physics numbered 128 and above, Chemistry 212 and six semester hours of Chemistry chosen from

CHEMISTRY

Chemistry 142, 213, 224, 246 and 251. This option is primarily for teachers of chemistry.

Physical Sciences Option (B): Nine semester hours of Chemistry numbered 131 and above and nine hours of Physics in courses numbered above 200. This option is primarily for teachers of Physics.

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) one semester of residence; (3) 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 372 (only for those electing Option A) (d) Chemistry 381-382 (Seminar), and (e) Chemistry 212; and (4) 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 in either of the following two ways:

Plan A: (1) Completion of 12 hours of Masters Thesis Research (Chemistry 391) and submission of a satisfactory thesis; (2) completion of a program of at least 30 hours of graduate credit (courses and Masters Thesis Research); and (3) Chemistry 383-384 (Seminar).

Plan B: (1) Completion of 6 hours of Independent Literature Research Project (Chemistry 375); (2) completion of at least 30 hours of graduate credit (courses and Literature Research Project); and (3) Chemistry 383-384 (Seminar).

An M.S. student should decide at the beginning of his program whether he will pursue Option A or Option B and inform the department and Graduate College of his decision.

A reading knowledge of German is also expected.

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 491-493); (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) three hours of teaching; (5) one year of residence; (6) The following courses are required: Chemistry 372, and 381-384. No other courses are required, nor is any fixed number of course credits required. Each student's program will be determined by a departmental studies committee on the bases of qualifying examination performance, background, and research interests. In the normal course of events a student should expect to devote much of his first year to formal course work, and (7) 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) present a total of 75 hours of credit in course work and thesis research, and (3) make an oral and written presentation of an original research proposal (at least six months prior to the submission of the thesis). The student must also demonstrate a reading knowledge of scientific German and of either French, Russian or computer programming.

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. Brown.

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. Allen.

214 INORGANIC CHEMISTRY LABORATORY Synthesis and characterization of inorganic compounds making use of a controlled atmosphere box, vacuum line, autoclave, photochemical reactor, X-ray diffraction equipment, infrared and ultraviolet-visible spectrophotometers, etc. *Prerequisite:* 212. Two hours. Mr. Brown.

224 INSTRUMENTAL ANALYSIS Theory and practice of optical, electro-

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metric, chromatographic, and radiochemical methods of analysis. *Prerequisite:* 11, 12 or 123, 142. Four hours. Staff.

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, 1972-73. Mr. Strauss or Mr. Kice.

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, 1971-72. Mr. Krapcho or Mr. White.

246 FUNDAMENTALS OF SPECTROSCOPY A general discussion of molecular spectroscopy, rotational and vibrational states of molecules, symmetry of vibrations; introduction to electronic spectra. *Prerequisite:* 142, Mathematics 124 or permission of the instructor. Three hours. Alternate years, 1971-72. Mr. Weltin.

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. Flanagan.

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. Alternate years, 1972-73. Mr. Wulff.

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. Krapcho, Kuehne and Strauss.

311 PHYSICAL INORGANIC CHEMISTRY Ligand field theory, magnetic properties, magnetic resonance techniques (NMR, ESR, and NQR), Mossbauer spectroscopy, and optical activity. *Prerequisites:* 213 or equivalent, 246 or permission of the instructor. Three hours. Alternate years, 1971-72. Mr. Allen.

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. Mr. Kuehne.

334 NATURAL PRODUCTS—THE TERPENES The chemistry of mono-, sesqui-, 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. Mr. Kuehne.

336 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. Staff.

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. Offered as occasion warrants. Mr. Flanagan.

344 QUANTUM CHEMISTRY Applications of quantum mechanical techniques to problems of chemical interest. *Prerequisite:* 247. Three hours. Offered as occasion warrants. Mr. Weltin.

345 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 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 ad-

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vanced modern chemical methods. *Prerequisite:* permission of department chairman. Two hours. Staff.

375 INDEPENDENT LITERATURE RESEARCH PROJECT Reading and literature research culminating in the preparation of a comprehensive and critical review of a topic of current interest in chemistry. Credit as arranged. 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 SEMINAR Current problems and literature. One hour. Staff.

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

Undergraduate courses:

1, 2	Introductory Chemistry	131, 132	Organic Chemistry
3	Outline of General Chemistry	134	Organic Chemistry Laboratory
4	Outline of Organic and Biochemistry	135	Advanced Organic Chemistry Laboratory
11, 12	General Chemistry	140	Physical Chemistry for Biological Science Majors
13, 14	The Chemical Bond	141, 142	Physical Chemistry
16	Introductory Organic Chemistry	144	Physical Chemistry Laboratory
123	Elementary Quantitative Analysis		

• CIVIL ENGINEERING

Professor Oppenlander (Chairman); Associate Professors Dawson and Fay; Assistant Professors Condren, Downer, Eldred, Jewell, and Olson; Engineer Dunham; Instructor Parker; Adjunct Professor Kiley; Adjunct Assistant Professor Stearns.

The Department of Civil Engineering is presently conducting research in

environmental engineering, structures, transportation, urban planning, soil mechanics, and construction engineering.

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

A Bachelor's degree and the approval of this Department. Additional course work may be required of candidates who lack a strong science background.

MINIMUM DEGREE REQUIREMENTS

The above prerequisites for acceptance to candidacy must be supplemented in either of the two following ways.

Plan A: Completion of advanced courses in civil engineering, mathematics, other approved courses and 6 to 9 hours of thesis research for a total of thirty hours.

Plan B: Completion of thirty-six hours of advanced courses in civil engineering, mathematics, and other approved courses in lieu of the thesis.

The student should decide which option he intends to pursue at the beginning of his program.

COURSES OFFERED

200 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 and energy methods; and plastic design and buckling of plates and shells. *Prerequisite:* 172 or concurrent enrollment. Three hours. Mr. Fay.

210 AIRPHOTO INTERPRETATION The development of techniques in aerial photographic interpretation; principles of stereoscopic viewing and identification of the airphoto feature related to landform, vegetation, drainage, soil color tone, topography, and cultural features; special techniques in remote sensing; and the use of airphoto interpretation in soil identification, agricultural and forest surveys, water and air resource studies, regional and urban planning, and site and route locations. Group study projects are formulated according to areas of student interest. Three hours. Mr. Olson.

220 CONSTRUCTION ENGINEERING Development of construction processes to obtain optimum facilities with minimum outlay of resources; relationship of techniques to design details and specification requirements; sequence studies by means of CPM and PERT techniques including crashing proce-

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dures; and special problems in measurements of construction efficiency, cost estimating, specification preparation, and case studies of local projects under construction. Three hours. Mr. Dunham.

225 ENGINEERING ECONOMY Mathematical comparison of alternatives to maximize the financial return on engineering decisions and processes; project feasibility studies and design decision making; the effect of taxes on engineering decisions; and analysis of risk and uncertainty. Three hours. Messrs. Dawson and Oppenlander.

226 CIVIL ENGINEERING SYSTEMS ANALYSIS Development of operations research techniques including linear and dynamic programming, inventory theory, replacement theory, queuing models, networks, and scheduling; procedures for solving complex problems; and application of systems analysis to problems in civil engineering. Three hours. Messrs. Dawson and Oppenlander.

230 URBAN PLANNING TECHNIQUES Theories on the size, spacing, and functions of cities; economic, social, and physical determinants of various land-use elements; basic studies for urban planning; and the process of land-use planning including location and space requirements and the development of the land-use plan. Three hours. Messrs. Dawson and Oppenlander.

231 URBAN PLANNING ANALYSIS The history and development of urban planning in the United States and other countries; special approaches to planning with attention to city design and appearance, quantitative methods in planning, and social welfare planning; plan implementation through programs, zoning, land subdivision regulations, and urban renewal; organization and administration of planning agencies; and financial planning. Three hours. Mr. Oppenlander.

240 TRAFFIC ENGINEERING CHARACTERISTICS Analysis of the basic components of highway travel including driver, vehicle, roadway, environmental, and pedestrian characteristics; evaluation of traffic demands imposed by road users for travel and parking; traffic flow and intersection characteristics; highway and intersection capacities; performance of traffic systems with particular attention to accidents and travel efficiency; and techniques for measuring traffic characteristics. Three hours. Messrs. Dawson and Oppenlander.

241 TRANSPORTATION SYSTEMS ENGINEERING Introduction to the interdisciplinary aspects of transportation systems and their technological characteristics; mathematical analysis and synthesis of system problems including planning, design, and operation; economic consideration of transportation systems and economic analyses for decision making; transportation planning process; fiscal studies and financial planning; and administration of transportation systems. Three hours. Messrs. Dawson and Oppenlander.

250 DESIGN OF WATER TREATMENT FACILITIES Design of treatment systems to provide water for domestic and industrial use; source evaluation, demand projections, specific treatment processes, distribution systems, economics; and case studies. *Prerequisite:* 150. Three hours. Mr. Condren.

251 DESIGN OF WASTEWATER TREATMENT FACILITIES Design of treatment systems for processing wastewaters from municipal and industrial sources to obtain desired receiving waterway protection, and population projections, site location, collection systems, lift stations, choice and sizing of unit processes, specification writing, cost estimates, and bid document preparation. *Prerequisite:* 151. Three hours. Mr. Jewell.

252 INDUSTRIAL WASTE DISPOSAL A survey of the fundamental chemical, physical, and biological processes employed in the treatment and disposal of pollutants from the following industries: mining and metal processing, refinery and petrochemical, pulp and paper, food and meat processing, textiles, and electric generation. *Prerequisite:* 151. Three hours. Mr. Condren.

253 AIR POLLUTION ABATEMENT Identification of specific air pollutants and their effects on humans, plants, and materials; concepts, principles, and application of air pollution control processes; and electrostatic precipitation, scrubbing, cyclonic separation, filtration, absorption, catalytic oxidation, and dispersion. *Prerequisite:* Chemistry 2 and Physics 18. Three hours. Mr. Condren.

254 SOLID WASTES The significance of solid wastes generated from municipal, industrial, agricultural, and mining sources; the optimization and design of collection, disposal, and/or recycle systems; and sanitary landfills, incineration, composting, and material recovery. *Prerequisite:* Chemistry 2 and Physics 18. Three hours. Mr. Jewell.

255 UNIT OPERATIONS OF WATER AND WASTEWATER TREATMENT An examination of major physical, chemical, and biological processes used in treating water and wastewater; theory and methods of obtaining data from bench through full scale units; analysis of data to obtain process optimization; and application of data to design. *Prerequisite:* 150, 151. Three hours. Mr. Jewell.

260 HYDROLOGY The basic theory of precipitation, run-off, infiltration, and ground water; precipitation and run-off data; and application of data for use in development of water resources. *Prerequisite:* 160 or Mechanical Engineering 142. Three hours. Mr. Downer.

261 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; and non-uniform, spatially-varied flow problems. *Prerequisites:* 160, Mathematics 271. Three hours. Mr. Downer.

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263 MEASUREMENTS IN APPLIED HYDROLOGY Design of hydrologic experiments; observational methods, equipment and problems in describing precipitation, runoff, air temperature, relative humidity, wind movement, solar radiation, evaporation, soil temperature, infiltration, soil moisture, soil density, soil water pressure, sediment load, and snow density; data reduction and handling techniques; and application to the instrumentation and study of the hydrology of a small watershed. *Prerequisite:* 163 or 260. Three hours. Mr. Downer.

270 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:* 171. Three hours. Mr. Eldred.

271 PRESTRESSED CONCRETE STRUCTURES Comparison of service and ultimate strength theories for concrete structures with emphasis on prestress effects; topics considered include prestressed beam analysis, load balancing methods, column and pile design, bent analysis, yield-line theory, and circular prestressing in domes and tanks; and discussion of current design specifications. *Prerequisite:* 173. Three hours. Mr. Dunham.

280 APPLIED SOIL MECHANICS Use of soil mechanics principles in the evaluation of building foundations, braced excavations, and earth structures and bearing capacity, settlements in sands and clays, lateral earth pressures, pile foundations, pier and caisson foundations, slope stability, and construction problems. *Prerequisite:* 180. Three hours. Mr. Olson.

281 HIGHWAY AND AIRPORT PAVEMENT DESIGN Structural design of flexible and rigid pavements; types of wheel and axle configurations; 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; Watergaard analysis for rigid pavements; design of joints and reinforcing steel; and pavement evaluation. *Prerequisite:* 140, 180. Three hours. Mr. Olson.

282 ENGINEERING PROPERTIES OF SOILS The study of soil properties that influence the engineering behavior of soils as a construction and foundation material; subject areas include soil mineralogy, physicochemical concepts, plasticity properties, permeability, compaction, and soil stabilization; and laboratory work in the study of soil index properties, permeability, and compaction tests. *Prerequisite:* 180. Three hours. Mr. Olson.

290 ENGINEERING INVESTIGATION Independent investigation of a special topic under the guidance of a staff member. The course work may consist of literature investigations, unique design problems, and/or laboratory and field

studies. Preparation of an engineering report is required. Three hours. Staff.

300 ADVANCED MECHANICS OF MATERIALS The theory of elasticity with applications to curved beams, combined stresses, torsion of non-circular sections, and relaxation procedures. *Prerequisites:* 100, Mathematics 271. Three hours. Mr. Fay.

301 PHOTOELASTICITY Development of the theories of photoelastic stress analysis; model similitude; correlation with other stress analysis techniques; and laboratory work on two-dimensional applications such as stress concentrations around holes, notches, and fillets. *Prerequisites:* 100, Mathematics 271. Three hours. Mr. Fay.

330 COMMUNITY DESIGN The basic principles and methods of planning and designing the total community for its environment; site selection; elements of physical layout and design; and design of subdivisions, industrial parks, shopping centers, community service facilities, public utilities, recreational areas, urban renewal projects, and new towns. *Prerequisite:* 230. Three hours. Mr. Kiley.

340 TRAFFIC ENGINEERING OPERATIONS Techniques for making traffic engineering investigations; traffic laws and ordinances, design and application of traffic control devices including signals, signs, and markings; regulation of traffic flows, speeds, and parking; safety engineering; design of off-street parking facilities; transit operations; design of street lighting; traffic engineering administration; and evaluation of traffic engineering improvements. *Prerequisite:* 240. Three hours. Mr. Dawson.

341 HIGHWAY GEOMETRIC DESIGN Theory and practice of geometric design for rural and urban highway facilities; route location; design control criteria such as traffic volumes and characteristics, design speeds, design vehicles, capacity and level of service requirements, and design standards; design of geometric elements including sight distance, horizontal and vertical alignments, cross section, intersections, interchanges, control of access, and frontage roads; and emerging concepts of geometric design for modern highways. *Prerequisite:* 240. Three hours. Messrs. Dawson and Oppenlander.

342 URBAN TRANSPORTATION SYSTEMS Transportation planning process for urban areas including freeway and major street systems, parking, and mass transit; inventory, use, and desire studies for urban transportation; mathematical models for the evaluation of land use and traffic interaction; techniques of travel forecasting and trip generation, distribution, and assignment; circulation systems for vehicle, pedestrian, and freight traffic in the urban center; planning, design, and operation of mass transit systems; location and design of termi-

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nal facilities; and innovation of new urban transportation technology. *Prerequisites:* 230, 240. Three hours. Mr. Oppenlander.

360 ADVANCED HYDROLOGY Application of statistics to problems in engineering hydrology; the concept and use of the instantaneous unit hydrograph; study of run-off models; flow through porous media; and design techniques for water resources projects. *Prerequisites:* 260, Mathematics 271. Three hours. Offered as occasion warrants. Mr. Downer.

370 ULTIMATE STRENGTH DESIGN Development of ultimate load theory, virtual work, and statistical methods of analysis; design of structural steel and reinforced concrete structures by ultimate load methods; and consideration of shear, axial force, buckling, and rotation capacity. *Prerequisites:* 172, 173. Three hours. Mr. Eldred.

372 STRUCTURAL DYNAMICS The study of Coriolis acceleration; gyroscopic forces; dynamic measurements; and vibrations, earthquakes, and blast shocks on structures. *Prerequisites:* 172, 173, Mathematics 271. Three hours. Staff.

380 THEORETICAL SOIL MECHANICS Theories of soil mechanics, failure conditions, mechanical interaction between solids and water and problems in elasticity and plasticity pertaining to earth masses. *Prerequisite:* 180. Three hours. Mr. Olson.

382 ADVANCED ENGINEERING PROPERTIES OF SOILS A detailed study of soil properties that affect the compressibility and shear strength of natural soil deposits. Laboratory work includes extensive studies of consolidation and compressibility and use of the latest methods of shear strength determination from triaxial and plane strain testing devices. *Prerequisite:* 282. Three hours. Mr. Olson.

390 ADVANCED TOPICS IN CIVIL ENGINEERING Special topics to intensify the programs of graduate students in civil engineering. Hours and credits to be arranged. Staff.

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

• CLASSICS

Professors Gilleland, Bliss and Davison; Associate Professor Ambrose and Schlunk.
Current research interests include Early Greek Literature; the Attic orators;

Greek Drama; archaeology; philosophy; Mycenaean and Homeric Greece; Hellenistic economics; political theory; Cicero's rhetorical works; Vergil; Caesar; lyric and elegiac poetry; the Roman conquest of Greece; Roman provincial administration; Etruscology; urban topography; satire; medieval studies.

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

An undergraduate major or minor or the equivalent; a reading knowledge of French or German.

MINIMUM DEGREE REQUIREMENTS

Eighteen hours of advanced courses in Greek or Latin, six hours of which must be 381; 6 additional hours in Greek or Latin, History or Philosophy; thesis research (6 hours).

Those who hope for the department's recommendation to go on for a Ph.D. elsewhere must show competence in both German and French by the end of their first year of graduate study. All students must demonstrate an acceptable knowledge of the Greek and Latin languages and of Greek and Roman history.

A program is also offered leading to the degree of Master of Arts in Teaching; Cf. p. 23. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

COURSES OFFERED

GREEK

201 GREEK ORATORS Selected speeches of Lysias and Demosthenes. Three hours. Alternate years, 1971-72. Mr. Gilleland.

202 GREEK COMEDY Two plays of Aristophanes. Three hours. Alternate years, 1972-73. Mr. Ambrose.

203 GREEK HISTORIANS Thucydides, Books I and II; selections from Herodotus and Xenophon's *Hellenica*. Three hours. Alternate years, 1972-73. Mr. Bliss.

204 GREEK TRAGEDY Sophocles' *Antigone* and Euripides' *Medea*, or two equivalent plays. Three hours. Alternate years, 1971-72. Mr. Ambrose.

205 GREEK PHILOSOPHERS Plato, *Republic*, Books I and II; selections

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from the Pre-Socratics and from Aristotle. Three hours. Alternate years, 1972-73. Mr. Schlunk.

206 GREEK EPIC Readings in the *Iliad* and *Odyssey*. Problems of epic composition and language together with mythological and historical background. Three hours. Alternate years, 1971-72. Miss Davison.

300 PRO-SEMINAR Introduction to philology. Students will normally take this their first semester. Three hours. Staff.

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

391 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

51 Greek Drama in Translation

11, 12 Intermediate Greek

153 Greek Historians in Translation

111, 112 Greek Prose Composition

LATIN

COURSES OFFERED

203 REPUBLICAN PROSE Extensive reading in Caesar and Sallust, and in the speeches of Cicero. Three hours. Mr. Gilleland.

204 EPIC POETS Extensive reading in Lucretius, Vergil, Ovid, and others. Three hours. Mr. Ambrose.

227 ROMAN LYRIC POETS Selections from the works of Catullus, Horace, Propertius, Tibullus. Three hours. Alternate years, 1972-73. Mr. Schlunk.

251 ROMAN LETTERS Selected letters of Cicero, Pliny and Fronto. Alternate years, 1971-72. Mr. Bliss.

252 COMEDY Two plays of Plautus and Terence. Study of the precursors of this literary form. Three hours. Alternate years, 1971-72. Mr. Bliss.

253 ROMAN ORATORY Selections from Cicero's *De Oratore*, *Orator*, *Brutus*, and from his speeches. Historical development of forensic and other rhetorical canons. Three hours. Alternate years, 1971-72. Mr. Gilleland.

255 HISTORIANS OF THE EMPIRE Augustus, *Res Gestae*; Tacitus, *Annals*,

I-IV; selections from Suetonius and Ammianus Marcellinus. Three hours. Alternate years, 1972-73. Miss Davison.

256 SATIRE Selections from Horace and Persius; Juvenal, Petronius. Study of the development of this literary form. Three hours. Alternate years, 1971-72. Mr. Gilleland.

271 SILVER LATIN Extensive reading of post-Augustan authors not included in other advanced courses. Three hours. Alternate years, 1972-73. Mr. Bliss.

300 PRO-SEMINAR Introduction to philology. Students will normally take this their first semester. Three hours. Staff.

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

391 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
5 Advanced Elementary	152 Roman Epic in Translation
12 Intermediate Latin	154 Roman Satire in Translation
32 Etymology	
101, 102 Survey of Latin Literature	

• COMMUNICATION

Professors Huber, Lewis, London (Chairman), Luse; Associate Professors Feidner, Lane, Manchel, Woolf; Assistant Professors Bryan, Ellenwood, Howell, Schenk, Wilkes, Wilson, Yadav; Instructors Cronin, Dilley, Lardy, Losee, Neal, Petry, Schmider, Waite, Worden; Lecturer Houghton, Smith.

Current interests and research in the Department of Communication and Theatre include diagnostic-therapeutic programming; the effectiveness of the classroom teacher in improving articulation in skills of school-age children; studies of the dialects of the people of Vermont; studies concerning cancer of the larynx and the rehabilitation of such individuals using esophageal speech; seasonal occurrence of cleft lip-cleft palate births in Vermont; using the chewing technique in habilitating persons with cleft palate; operant procedures as applied to stuttering; conceptual language disturbance in children and adults; the role of

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selected clinician variables on client verbal productivity; content analysis of speech therapy sessions; studies concerning the development of educational radio and television programming and networks; the development of the Champlain Shakespeare Festival; group communication in the classroom; the use of mass media in British education; cross-cultural communication; persuasive speaking in Vermont during the Civil War period; the effects of environment on communication.

The department offers two master degrees: Master of Arts in Communication and Master of Science in Speech Pathology.

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

An undergraduate major in communication (speech), or in a related field of the social sciences or humanities with the equivalent of a minor in communication; satisfactory scores on the Graduate Record Examination (aptitude only).

MINIMUM DEGREE REQUIREMENTS

Thirty hours of graduate level courses including 12 hours in communication, 6 hours in thesis research, 12 hours in communication or in a related field.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN SPEECH PATHOLOGY

A minimum of 19 hours in speech pathology-audiology and selected areas to include Speech 101, 270, 271 or 272, 281 (or their equivalents); courses in Statistics and Child Psychology. These courses may be taken after a student is admitted to graduate study, but are prerequisite to degree candidacy, and will not be considered as a part of the 30 hours required for the Master's Degree. Satisfactory scores on the Graduate Record Examination (Aptitude only).

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); satisfactory completion of written comprehensive examination; oral thesis examination. Undergraduate plus graduate courses must include 6 hours of audiology.

COURSES OFFERED

201 THEORIES OF HUMAN COMMUNICATION Speech communication as a uniquely human capacity. The relationship of language, perception, think-

ing, and social context to human communication. *Prerequisite:* Nine hours of related courses, including 1. Three hours. Mr. Yadav.

210 CLASSICAL ORIGINS OF COMMUNICATION THEORY A study of selected works in order to provide understanding of the points of view of outstanding writers of the classical period who have influenced human communication theory. *Prerequisite:* Nine hours of related courses. Three hours. Mr. Wilkes.

212 PERSUASIVE COMMUNICATION An examination of selected contemporary approaches to persuasion and the study of recent research contributions to such areas as theories of persuasion, source credibility, and argument and controversy. *Prerequisite:* Nine hours of related courses including 111 or 112 or 113. Three hours. Mr. Huber.

213 THEORIES OF SPEECH ANALYSIS Principles and theories of rhetorical criticism applied to speakers and speech movements. *Prerequisite:* Nine hours of related courses. Three hours. Messrs. Wilkes and Waite.

214 ISSUES IN 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. Mr. Wilkes.

215 GROUP COMMUNICATION An examination of selected areas of study related to the problems of group communication. Each semester, one of the following three topics will be studied in depth: (1) Group Communication Theory, (2) Leadership in Groups, and (3) Communication in Organizations. *Prerequisite:* Nine hours of related courses, including 14. Three hours. May be repeated up to nine credit hours. Mr. London.

223 INTERPERSONAL COMMUNICATION A study of human communication on the interpersonal level. The subject matter is approached through an examination of the research in the area, through experimental projects and through an examination of the communication process used by the class itself. *Prerequisite:* Nine hours of related courses. Three hours. Mr. Lewis.

225 CROSS-CULTURAL COMMUNICATION A study of the conceptual perspective and the basic fund of knowledge necessary for viewing those variables which are central to the study of cross-cultural communication. *Prerequisite:* Nine hours of related courses. Three hours. Mr. Yadav.

252 LIGHTING Theory and practice in the illumination of stage productions and the creation of aesthetic effects. *Prerequisite:* 151. Three hours. Mr. Schenk.

COMMUNICATION

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:* 154. Three hours. Mr. Schenk.

263 **ISSUES IN CONTEMPORARY MASS COMMUNICATION** An analysis of current issues related to the mass media such as: the effects of mass media on society, governmental regulation of mass media, censorship of the mass media, special legal problems. *Prerequisite:* Nine hours of related courses, including 63. Three hours. Mr. Yadav.

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:* 164. Three hours. Mr. Dilley.

265 **PRINCIPLES OF CINEMATOGRAPHY** A study of the principles of the communications of meaning through moving visual images. *Prerequisite:* 165 and consent of the instructor. Three hours. Mr. Worden.

266 **SEMINAR IN FILM** A study of various topics including the influence of film on our culture, the responsibility of filmmakers to society and to themselves, the scope and limitations of film as an art, craft and business; film criticism and research. *Prerequisite:* Nine hours of related courses, including 165 or 166. Three hours. Mr. Manchel.

270 **LEARNING AND DEVELOPMENT OF SPEECH AND LANGUAGE** Speech and language acquisition in relation to current learning theory and methods of linguistic analysis. *Prerequisite:* Nine hours of related courses. Three hours. Mrs. Wilson.

271 **SPEECH PATHOLOGY I** Etiology, symptomatology, and principles of habilitation for voice disorders (including the laryngectomized) and cleft palate. Observation required. *Prerequisite:* Twelve hours of speech (including 281) and psychology. Three hours. Miss Luse.

272 **SPEECH PATHOLOGY II** The nature of articulation and the etiology, diagnosis, and treatment of disorders of articulation. *Prerequisite:* Twelve hours of speech (including 74, 101) and psychology. Three hours. Mr. Woolf.

273 **PRINCIPLES OF AUDIOLOGY** An introduction to clinical audiology including a consideration of hearing disorders, tests of the hearing function, and hearing conservation programs. Opportunities for observation and clinical practice. *Prerequisite:* Twelve hours of speech (including 74) and psychology. Three hours. Mrs. Houghton.

275, 276 **CLINICAL STUDY** Supervised practicum experiences with children

and adults presenting disorders of speech, hearing, and language. May be taken at the University of Vermont Speech and Hearing Center, and at various cooperating facilities. *Prerequisite:* Twelve hours in speech and hearing science courses, including 271 or 272; departmental permission. Credit as arranged. Staff.

281 ANATOMY-PHYSIOLOGY OF SPEECH Anatomy and physiology of speech and language processes. *Prerequisite:* nine hours of speech and psychology. Lectures and laboratory. Four hours. Miss Luse.

282 ANATOMY-PHYSIOLOGY OF AUDITION Anatomy and physiology of the normal auditory system. Basic acoustics and subjective correlates of the auditory stimulus. *Prerequisite:* nine hours of speech and psychology. Lectures and laboratory. Four hours. Mrs. Wilson.

284 SEMINAR Discussion and research in the selected areas of communication and theatre. *Prerequisite:* departmental permission. Three hours. Staff.

294 SEMINAR FOR PROSPECTIVE TEACHERS OF COMMUNICATION A study of the resources, procedures and methods utilized in teaching the different areas of communication at the various instructional levels. *Prerequisite:* 12 hours. Three hours. Mr. London.

300 RESEARCH METHOD AND DESIGN Research method and design, bibliographical resources, and professional writing in the field of communication and theatre. A recommended professional orientation for all beginning graduate students. Three hours. Mr. London.

365 ADVANCED CINEMATOGRAPHY An exploration of the limitations and possibilities of the motion picture medium through familiarization with equipment and production techniques. *Prerequisite:* 265. Three hours. Mr. Worden and staff.

367, 368 SEMINAR IN MASS MEDIA An examination of selected areas of study related to mass media. Each semester, one of the three following topics will be studied in depth: (1) Printed media, (2) Tele-communication. *Prerequisite:* Nine hours of related courses, including 63. Three hours. Mr. Yadav and staff.

377 REHABILITATIVE AUDIOLOGY I: AMPLIFICATION; SELECTION AND USE Principles and rationale underlying clinical procedures in hearing aid selection. *Prerequisite:* 273. Two hours. Mrs. Houghton.

378 REHABILITATIVE AUDIOLOGY II: SPEECH-READING AUDITORY TRAINING Theories and methods for the development of speech-reading

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skills and the effective use of residual hearing. *Prerequisite:* 273. Two hours. Mrs. Houghton.

379 REHABILITATIVE AUDIOLOGY III: PSYCHO-SOCIAL ASPECTS OF HEARING LOSS Perceptual, personal, and social problems of the hard-of-hearing; theories, research, and management. *Prerequisite:* 273. Two hours. Mrs. Houghton.

381, 382 ADVANCED READINGS Readings, with conferences, intended to contribute to the programs of graduate students in phases of communication for which formal courses are not available. Credit as arranged, up to 3 hours each semester. Staff.

383 SEMINAR IN SPEECH PATHOLOGY An intensive study of selected topics in speech pathology to include recent research in communicative disorders, new diagnostic and therapeutic approaches, and innovative program developments. *Prerequisite:* 271, 272. Three hours. Staff.

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 Etiology, pathology, diagnosis, and principles of habilitation of cerebral palsy and related conditions. Emphasis on disorders of oral communication and associated disturbances. *Prerequisite:* 271, 272. Three hours. Mr. Woolf.

387 SEMINAR IN LANGUAGE DISORDERS Identification, evaluation, and rehabilitation procedures for the preschool and school-age child with language disabilities. Some participation in diagnostic and therapeutic sessions may be arranged. *Prerequisite:* 270. Three hours. Mrs. Wilson.

388 SEMINAR IN STUTTERING Study of the research in stuttering relative to etiology and rehabilitation. *Prerequisite:* 271, 272. Three hours. Mr. Woolf.

389 SEMINAR IN APHASIA IN ADULTS Study of the symbolic and communicative disturbances in aphasic adults, principles and procedures in diagnosis, and a rationale for rehabilitation. *Prerequisites:* 271, 272. Three hours. Mrs. Wilson.

391 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 Foundations of Oral Communication

113 Advanced Public Speaking—
Stylistic Elements

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3 Parliamentary Procedure	121 General Semantics
11 Public Speaking	141 Advanced Acting
14 Group Discussion	142 Play Directing
31 Oral Interpretation of Literature	145, 146 Development of the Western Theatre
39 Introduction to Theatre	151 Stagecraft
41 Acting	154 Basic Scene Design
63 Survey of Mass Communication	164 Basic Television Production
74 Introduction to Disorders of Oral Communication	161 Audio Production
81 Voice and Articulation	162 Writing for Mass Communication
101 Phonetics	165, 166 Development of the Motion Picture
111 Advanced Public Speaking—Persuasion	193, 194 College Honors
112 Advanced Public Speaking—Logic	195, 196 Special Topics
	197, 198 Readings and Research

• ECONOMICS AND BUSINESS ADMINISTRATION

Professors Dellin, Greif, Nadworny (Chairman) and Nyquist; Associate Professors Alnasrawi, Campagna, Chase, Michael, Severance and Squire; Assistant Professors Battelle, Kuklis, Laber, Salgo, Tashman and Wicker.

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 statistics are required. Transcripts will be evaluated on an individual basis. Satisfactory scores on the Admissions Test for Graduate Study in Business. (ATGSB scores are acceptable in lieu of graduate record examination scores for financial assistance in this program.)

MINIMUM DEGREE REQUIREMENTS

The above prerequisites for acceptance to candidacy must be supplemented in either of the following two ways:

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

Plan B: Economics 207, 228, 252 and 289; twelve hours chosen in the can-

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didate's field of concentration; nine additional hours of courses approved by the department for a total of thirty-three hours.

Not more than six credit hours of graduate work completed prior to residency as defined on page 18 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. Satisfactory scores on the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours in approved courses in Economics numbered above 200, including 295, 377 and 378; thesis research (6 hours).

COURSES OFFERED

206 PRINCIPLES OF INVESTMENTS An analysis of the investment process, including an examination of types of financial assets, the markets in which such assets are traded, and factors affecting their values. *Prerequisite:* 12 and 14. Three hours. Staff.

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:* 11, 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; 190 recommended. Three hours. Mr. Alnasrawi.

217 REGIONAL ECONOMIC GROWTH An inquiry into the processes of economic growth at the regional level; theoretical models of regional growth will be developed; the relationships among growth theory, international trade theory, and location theory will be analyzed and applied to regional growth. Empirical evidence on interregional factor movements (migration and capital flows) will be examined and related to historical patterns of income growth at the state level in

the U.S. research in areas of student interest. *Prerequisite:* 186, 190. Three hours. Mr. Laber.

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. Mr. Greif.

229 MARKETING MANAGEMENT Formulation of overall policies and planning strategies for marketing programs. Product planning and development; channel selection; market and sales forecasts; advertising and sales campaigns. *Prerequisite:* 122. Three hours. Mr. Greif.

234 MONETARY THEORY Analysis of Classical, Keynesians, and modern macroeconomic models; micro and macro demand for and supply of money; portfolio choice; term structure of interest rates and the influence of financial intermediaries. *Prerequisite:* 190. Three hours. Staff.

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 preindustrial Europe see History 237. *Prerequisites:* 12 and History 12. Three hours. Staff.

240 WAGE AND EMPLOYMENT THEORY Microeconomic theory dealing with the pricing of labor as an economic resource. Analysis of theoretical economic and behavioral models that attempt to explain the role and the effects of institutions on the wages, allocations, and levels of utilization of labor resources. *Prerequisites:* 186, 190; 141 highly desirable. Three hours. Mr. Chase.

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.

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. *Pre-*

ECONOMICS AND BUSINESS ADMINISTRATION

requisites: 121, 143 and 207; 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. 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:* 12 hours in history and/or other social sciences. Three hours. Mr. Dellin.

266 ADVANCED ACCOUNTING Accounting for partnerships, ventures, consignments, installment sales, insurance, statement of affairs, receivers, realization and liquidation, estates, trusts, home offices and branches, and parent and subsidiary accounting. *Prerequisite:* 162. Three hours. Mr. Nyquist.

267 INTRODUCTION TO ECONOMETRICS Classical least squares regression model; tests of significance; problems of the linear model—collinearity, identification, auto-correlation; introduction to FORTRAN programming and computer usage in econometric research; applied econometric research in areas of student interest, matrix algebra introduced as needed. *Prerequisites:* 188, 193, 186. Three hours. Mr. Laber.

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, es-

tates, 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 forecasting methods, linear programming, inventory and queuing theory. *Prerequisite:* 188. Three hours. Staff.

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.

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:* 188; Mathematics 8 or 11. Three hours. Staff.

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:* 12. Three hours. Mr. Alnasrawi.

295 DEVELOPMENT OF ECONOMIC THOUGHT Development of economic ideas. The pre-Classical, Classical, Socialist, Neo-classical, Keynesian Schools and individual theoreticians. *Prerequisite:* 186 and 190 or concurrent enrollment. 190 recommended. Three hours. Staff.

297, 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, INDEPENDENT READING AND RESEARCH A course designed

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to meet the special research problems of graduate students. *Prerequisite:* twelve graduate credits. Credit as arranged. Staff.

303 ADVANCED PUBLIC FINANCE Economic analysis of the public sector. Emphasis is on the application of economic theory to the problems of public finance; incidence theory, optimal allocation of resources, debt management, the effect of various tax considerations upon investment theory, and fiscal policy as a component of full-employment theory. *Prerequisites:* 190 and 186, or the equivalent. Three hours. 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 186 and 289. Three hours. Staff.

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 11-12 and Economics 267. Three hours. Staff.

377 ADVANCED MICROECONOMIC THEORY Advanced microeconomic models presented and analyzed. Advanced market structure theories, theory of games, general equilibrium, and dynamic methods. *Prerequisite:* 186. Three hours. Mr. Laber.

378 ADVANCED MACROECONOMIC THEORY Advanced macro models presented and analyzed. Models of economic growth, general equilibrium and economic dynamics; theory and empirical results. *Prerequisites:* 186, 190. Three hours. Mr. Campagna.

391 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
9, 10 Business Law I
101 Money and Banking

132 Fundamentals of Advertising
141 Labor Economics
142 Collective Bargaining
143 Industrial Management
160 Introduction to Integrated Data
Processing and Computers

103 Economics of Taxation	161-2 Intermediate Accounting
104 State and Local Finance	164 Basic Federal Taxes
105 International Trade and Finance	181 Transportation and Public Utilities
121 Principles of Marketing	183 Government and Business
122 Problems in Marketing	186 Microeconomic Theory
123 Personal Selling in the Economy	188 Elementary Statistics
127 Research Methods in Marketing	190 Macroeconomic Theory
130 Sales Management and Promotion	

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 Boller, Corrigan, Fishell, Hunt and Rippa; Associate Professors Case, Fox, Gobin, Leggett, McKenzie, Peterson, Petrusich, Wheeler; Assistant Professors Abruscato, Agne, Bright, Burrell, Cheney, Christensen, Clements, Conrad, Dunkley, Erb, Greig, Hanley, Lang, Larson, Marchant, McEntee, Moore, Nash, Ponzo, Rathbone, Shiman; Instructors Bloomenthal, Egner, Greenberg, Ho, Knight, Perelman, Royce, Schneider, Smith, Szabo, and Watson.

The College of Education offers numerous opportunities for graduate study in preparation for special competencies in a variety of fields which include practicums, research problems, and in-service relationships with cooperating school systems. The programs in various areas of specialization are described below.

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

Eighteen hours of Education and related areas and satisfactory score on the Graduate Record Examination. These prerequisites do not apply to the Student Personnel Services in Higher Education program.

EDUCATION

MINIMUM DEGREE REQUIREMENTS

Eighteen hours in courses in Education numbered above 200, including a minimum of six graduate hours in the humanistic foundations of education, 12 additional hours in approved courses or 6 additional hours and thesis research; a year of successful experience in teaching or in a related educational activity.

AREAS OF SPECIALIZATION

Administration and Planning

This program area is designed to prepare educational administrators and planners for public schools, educational agencies, and middle management positions in higher education. The program emphasis is on administrative competencies and leadership capabilities required in most administrative positions. This program requires 30-36 credit hours of course work, laboratory experience, and research. There are six components in the program: (1) humanistic foundations of education, (2) Inquiry Seminar in Educational Administration, (3) professional educational administration, (4) research and practicum experiences, (5) social-behavioral sciences and humanities, and (6) professional education electives.

Students should contact their advisor regarding general program objectives and the related portfolio system of evaluation.

Courses in administration include: 330, 331, 332, 335, 337, 352, 353, and 354.

Inquiries regarding this program should be addressed to Associate Professor Charles Case.

Foundations of Education

This degree program area is designed to meet the personal-professional needs of the following students: (1) research scholars who wish to undertake protracted and intensive study of education as a disciplined, systematic field of inquiry; (2) in-service teachers and community college educators who are interested in the broad theoretical foundations of education, beyond specific specialization; (3) administrators, school-board members, and community leaders who wish a broad background in the theoretical-practical underpinnings of education; (4) laymen who wish to study broadly the field of education in order to make reasoned and critical judgments about the many educational proposals to which they are constantly exposed; (5) professionals outside the field of education (for example, journalists, writers, clergymen, businessmen) who want a general, multi-disciplinary understanding of education in all of its components; and (6) innovators who are interested in critical, in-depth studies of alternative educational structures (for example, inner-city and rural community schools),

and (7) individuals concerned with international education and service to developing countries.

Courses in foundations of education include 202, 204, 205, 206, 252, 254, 255, 310, and 377.

Inquiries regarding this program should be addressed to Professor S. Alexander Rippa.

Reading and Language Arts

The purpose of this program area is to prepare teachers and specialists in the field of reading. Classroom teachers, reading specialists or consultants, supervisors and administrators are responsible for developing programs which will enable every student to attain his maximum proficiency in the use of reading and language. To meet this end several courses have been devised with focus on both classroom reading instruction and reading difficulties. Through the Reading Center program students also have opportunities for laboratory experiences as well as for research and study in reading, literature, and language arts.

Courses in reading and language arts include: 222, 223, 234, 275, 276, 378, and 379.

Inquiries regarding this program should be addressed to Professor Lyman Hunt.

School Counseling

This program area is aimed at preparing individuals to work as counselors at either the elementary or secondary levels within the public schools or as Directors of Pupil Personnel Services. The program is focused on three areas: 1) understanding the foundations and dynamics of human behavior within a culture; 2) understanding the structures and processes of educational systems, and 3) professional studies which equip the counselor to function as a "helping person" in the facilitation of growth and learning in individuals. This latter category includes supervised experience in school settings or other appropriate agencies.

Courses in the Counseling program include: 220, 295, 350, 351, 374, 381, 383, 384 and 386.

In addition to the general admissions procedures, a personal interview is required for this program.

Inquiries regarding this program should be addressed to Associate Professor James Peterson.

Student Personnel Services in Higher Education

This program area is aimed at providing a general background for the individual who is preparing himself to work within the broad area of student personnel ser-

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vices. The focus of the program covers three broad areas; 1) the foundations and dynamics of human behavior and of the individual in his culture; 2) the humanistic foundations of education, and 3) professional studies in student personnel work and higher education. The program allows flexibility for the student to choose courses which would strengthen his major area of interest, i.e., admissions, housing, student activities, financial aid, counseling, placement and others. Prerequisites for this program are individualized dependent upon the student's goal.

Courses in the student personnel services program include: 220, 295, 319, 360, 374, 383, 385, 387 and 397.

In addition to the general admissions procedures, a personal interview is required for this program.

Inquiries regarding this program should be addressed to Associate Professor James A. Peterson.

Special Education

This program area is designed to prepare consulting teachers in special education. Only those applicants who intend to be full-time graduate students will be accepted. Although the minimum requirements for this degree are 30 credit hours, including six hours of humanistic foundations of education, candidates will generally complete 60 credit hours of course work, laboratory experience, and internship. Thus, each candidate should expect to spend one summer and two additional academic years in full-time study.

Courses in special education include: 295-298, 310, 312, 316, and 319.

Inquiries regarding this program should be addressed to Associate Professor Hugh McKenzie.

Teacher Education

This program area is designed to develop leadership in such educational fields as teaching, curriculum and research for elementary and secondary school teachers.

Programs are developed to provide a comprehensive background in the fields basic to teaching, as well as an application of that knowledge to a special field. They include courses aimed at the improvement of instruction in subjects taught in the elementary and secondary schools, an understanding of the principles and problems involved in curriculum development, and opportunities for independent research in the fields represented by the course offerings of the College of Education.

As in the education of teachers enrolled for pre-service degrees, work at the graduate level also draws upon other divisions of the University, thus enabling the College of Education to develop strong programs of professional education

which include academic offerings in the various teaching fields in elementary and secondary education.

Courses in teacher education include: 211, 217, 218, 225, 227, 228, 241, 242, 244, 248, 256, 257, 259, 270, and 271.

Inquiries regarding these programs should be addressed to Professor Betty Boller.

COURSES OFFERED

201 ADMINISTRATION OF ATHLETIC PROGRAMS Designed to provide the athletic director, school administrator, and teacher-coach with a background for effective administration of the athletic program of schools. Areas considered include scheduling, budgeting, management, equipment, policy, public relations, and educational justification. *Prerequisite:* 12 hours education and related areas. Three hours. Mr. Leggett.

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 related areas. Three hours. Miss Boller, Mr. Nash, or Mr. Rippa.

203 PRINCIPLES OF PHYSICAL EDUCATION Principles basic to sound philosophy of physical education for the space age; appraisal of historical development; relationship to health education, recreation and other areas; foundation and functions of physical education in contemporary society. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Gobin or Mr. Greig.

204 SEMINAR IN EDUCATIONAL HISTORY A study of selected topics in the history of education from the "Golden Age" of Greece to the present. Stresses the relationships of education to current social and political trends. Special attention to the nature of education in democratic and authoritarian social orders. *Prerequisite:* 12 hours in education and related areas, or a major in history. Three hours. Mr. Rippa.

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 related areas, or a major in history. Three hours. Mr. Rippa.

206 COMPARATIVE EDUCATION Underlying principles, general organization, and typical practices of education in leading countries of the world. Special emphasis on modern education and on areas of particular interest to class members. Constant reference will be made to American education. *Pre-*

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requisite: 12 hours in education and related areas. Three hours. Miss Boller, Mr. Rippa, Mr. Shiman, or Mr. Wheeler.

208 SCHOOL HEALTH PROGRAMS Organization of the total school health program. Problems and administration in the areas of school environment, health services, health education, and school-community relationships. Special emphasis on health appraisal of children in grades 1 through 12. *Prerequisite:* P.E. 116 or equivalent. Three hours. Mr. Gobin.

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 related areas. Three hours. Staff.

212 CHILD AND ADOLESCENT DEVELOPMENT A study of the growth and development of the individual from infancy to adulthood with special emphasis upon implications for teaching and learning. *Prerequisite:* 12 hours in education and related areas. 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 related areas. Three hours. Mr. Abruscato.

220 PERSONALITY DEVELOPMENT Study of personality and behavior theory as related to problems of individual adjustment and growth. The personality and problems of the teacher, problems of the pupil, and experiences in the family, school, and community are considered in planning ways of dealing with individual adjustment and in formulating programs of mental hygiene. *Prerequisite:* 12 hours in education, psychology and/or related areas. Three hours. Mr. Marchant or Mr. Peterson.

222 IMPROVEMENT OF READING INSTRUCTION IN THE ELEMENTARY SCHOOL Comparative analysis of current and emerging philosophies, programs and instructional practices for teaching reading in the elementary school. Examination and evaluation of basal textbook, individual and specialized reading programs. *Prerequisite:* twelve hours in education and/or related areas including an introductory course in reading or consent of instructor. Three hours. Staff.

223 READING PROGRAMS IN SECONDARY SCHOOLS AND COLLEGES Relationship of reading to learning; study of organization, instructional procedures, and materials for developing reading improvement programs for secondary

and college students; reading in content areas. *Prerequisite:* twelve hours in education and/or related areas or consent of instructor. Three hours. Staff.

225 TEACHING SOCIAL STUDIES IN SECONDARY SCHOOLS Designed to examine selected recent curriculum projects in the social studies. Emphasizes teaching modes of inquiry through such concepts as discovery, selecting key relationships, using original source material, and setting up independent study. *Prerequisite:* 12 hours of education and related areas. Three hours. Mr. Ho.

227 TEACHING SCIENCE IN SECONDARY SCHOOLS Consideration of modern science curricula for grades 7-12. Opportunity will be provided for laboratory work in science programs in the student's teaching area. Course will deal with articulation and implementation of science programs, course development, and science teaching techniques. *Prerequisite:* 12 hours in education and related areas and permission of instructor. Three hours. Mr. Agne.

234 LITERATURE AND LANGUAGE FOR CHILDREN AND YOUTH Study of characteristics, interests, and reading habits of children and young people; criteria for selection and evaluation of literature; organizing book units for teaching literature and for use in content areas; wide acquaintance with selected books for children and youth. *Prerequisite:* twelve hours in education and related areas or consent of instructor. Three hours. Staff.

240 MUSICAL CREATIVITY IN THE GENERAL MUSIC CLASS Designing a course of study for the general music class. Developing musical concepts and perception through individual differences. Aural approach through class performance on recorders, guitars, and mallet instruments. *Prerequisites:* An undergraduate major in Music Education or consent of instructor. Three hours. Mr. Wigness.

241 SCIENCE FOR THE ELEMENTARY SCHOOL Emphasis in this course will be on the methods and materials relating to the construction of science units for the elementary pupil, grades 1-6. Proper scope and sequence leading to an integrated curriculum suited to different age levels will be studied, as well as developments and research in the field. Opportunity will be provided for teachers to build units applicable to their teaching needs. *Prerequisite:* 12 hours in education and related areas and permission of instructor. Three hours. Mr. Agne.

242 MODERN TRENDS IN ELEMENTARY EDUCATION Study of modern educational principles and practices in today's elementary school. Emphasis on school program, materials, experiences in all areas of the school curriculum, both

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separately and as they relate in an integrated program. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Wheeler.

243 RECENT TRENDS IN MUSIC EDUCATION Study of recent thought and practices in music education. Examination of current trends in the Contemporary Music Project, Comprehensive Musicianship, The Tanglewood Symposium, recreational music, music in the inner city, and other topics of concern. *Prerequisite:* an undergraduate major in music education or consent of instructor. Credit variable, one to four hours. Mr. Lidral.

244 SOCIAL STUDIES IN THE ELEMENTARY SCHOOL Study of literature, research, and problems in teaching social studies in the elementary school. Course will be concerned with the selection and organization of content, materials, and methods. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Ho or Miss Petrusich.

248 EDUCATIONAL MEDIA Modern instructional aids, theory and practice; educational media related to psychology of teaching and learning. *Prerequisite:* twelve hours in education and related areas. Three hours. Staff.

252 SEMINAR IN AESTHETIC EDUCATION A critical examination of aesthetic values transmitted in contemporary schools and a normative critique of aesthetic values which ought to be encouraged now and in the future. Consideration of ways to expand aesthetic awareness among children, youth and adults. The aesthetic quality of natural and man-created environments with implications for educational practice will be given special attention. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Conrad.

253 PRACTICUM IN MUSIC EDUCATION Current methodology in music education for music specialist and classroom teacher. Students will study and learn to present courses in music in the public schools including Orff and Kedaly approaches general music, comprehensive musicianship, and other recently introduced and promising methods. Each year the emphasis will be in a different area of concentration. *Prerequisite:* an undergraduate major in music education or elementary education and teaching experience or consent of instructor. Credit variable. Course may be taken for 1-4 hours each semester and may be repeated for a maximum of 8 hours of credit. Staff.

254 ANTHROPOLOGY OF EDUCATION Introductory examination of theories and research of cultural anthropology and education. An anthropological perspective on education grounded in the cultural realities of life in the American school. Study of the interrelationship of culture and man—his educational values, beliefs, and practices. Topics for study include the meaning of culture, culture change, personality-in-culture, value orientations, compara-

tive enculturative patterns, and cultural dynamics. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Nash.

255 THE SCHOOL AS A SOCIAL INSTITUTION Analysis of major social forces that affect elementary and secondary schools. Professional role of the modern educator and the values underlying educational policy will focus on such contemporary issues as political pressures on public schools, problems of integration, place of religion in education, and impact of the culturally different child on school and community. *Prerequisite:* 12 hours in education and related areas. Three hours. Miss Boller, Mr. Conrad, Mr. Nash, or Mr. Rippa.

256 METHODS AND MATERIALS IN ELEMENTARY SCHOOL MATHEMATICS Materials, methods, and basic understandings in mathematics for the elementary school. Topics include the evolution of mathematical concepts and notations, the meaning of numbers and number systems, the theory underlying fundamental operations, and an analysis of the modern approach to mathematics in the elementary school. *Prerequisite:* 12 hours in education and related areas. Three hours. Miss Boller.

270 KINDERGARTEN METHODS AND ORGANIZATION Objectives, organization, curriculum, methods and materials, and relationships of kindergarten to Head Start and other pre-school experiences. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Rathbone.

271 KINDERGARTEN EDUCATION WITH LABORATORY EXPERIENCES A course designed to acquaint the prospective kindergarten teacher with educational research conducted by Piaget, Bruner, Montessori, and others with experiences provided for working with children of kindergarten age. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Rathbone.

275 ANALYSIS OF READING AND RELATED LANGUAGE DIFFICULTIES The analysis and evaluation of learning difficulties with emphasis on reading and writing. Study of the nature of difficulties; procedures and materials used for the assessment of reading performance. Involvement with children is required. *Prerequisite:* twelve hours in education and related areas, including an introductory course in reading or consent of instructor. Three hours. Staff.

276 LABORATORY EXPERIENCES IN READING AND RELATED LANGUAGE INSTRUCTION Various approaches to be used for the prevention and correction of reading and written language difficulties. Supervised teaching of individuals and/or small groups experiencing severe difficulties in reading and related language skills. Apprenticeships in a variety of reading instructional

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programs. *Prerequisite:* Ed. 275 *Analysis of Reading and Related Language Difficulties* or consent of instructor. Three-six 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.

292 ISSUES IN CONTEMPORARY EDUCATION Designed so that its content and structure may accommodate special issues in education not especially appropriate within the boundaries of an existing course. Credit according to the particular offering. *Prerequisite:* 12 hours in Education and related areas. Two to six hours. Staff.

295, 296, 297, 298 LABORATORY EXPERIENCE IN EDUCATION Supervised field work designed to give student experience in specialized areas for their professional development. *Prerequisite:* permission of instructor. Credit as arranged. Staff.

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

310 METHODS FOR DERIVING AND ACHIEVING SPECIAL EDUCATION OBJECTIVES Development and application of procedures for deriving educational objectives, selecting and sequencing instructional materials, managing classroom behaviors, and achieving individualized instruction. Each student will be required to conduct a supervised classroom project. *Prerequisite:* 12 hours in education and related areas, and permission of the instructor. Three hours. Mr. Fox and staff.

312 ANALYSIS OF CLASSROOM BEHAVIOR: THE HANDICAPPED LEARNER This course is a survey of basic behavioral principles and procedures involved in the analysis of behavior as they apply to the problem of the handicapped learners in the classroom setting. *Prerequisite:* Education 310. Three hours. Mr. Hanley and staff.

313 STATISTICAL METHODS IN EDUCATION Application of descriptive and inferential statistics to educational and psychological data. Emphasis will be on inferential statistics. Correlation, regression, the *t* distribution, analysis

of variance, and nonparametric tests of significance are among the areas that will be covered. Three hours. Staff.

316 SEMINAR IN RESEARCH IN THE EDUCATION OF HANDICAPPED LEARNERS A broad survey of research undertaken to evaluate teaching/learning procedures, methodology, and materials employed in the education of the handicapped learner. *Prerequisite:* Education 312. Three hours. Mr. McKenzie.

319 INTERNSHIP FOR SPECIALIZED PERSONNEL IN EDUCATION Students will undertake an approved internship in an institution which reflects the particular area of interest and needs of the student. *Prerequisite:* permission of the instructor. Credit as arranged. Staff.

330 THE COURTS AND THE PUBLIC SCHOOLS Examination of educational problems and cases affected by court decisions. A study of legal principles and selected cases with reference to decision-making and social policy. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

331 THE PRINCIPALSHIP Examination of the principalship in elementary and secondary schools. Particular topics to be analyzed are: role of the principal, methods of organization and administration, pupil personnel services, improvement of instruction and curriculum, school community relations; group and interpersonal behavior. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

332 SCHOOL ADMINISTRATION A general course in school administration designed for both teachers and administrators. Organization, administration, control, and financing of American public education. *Prerequisite:* 12 hours in education and related areas. Three hours. Staff.

335 INSTRUCTIONAL ASSESSMENT AND STAFF DEVELOPMENT Utilizing feedback to change behavior, learning to work in groups, gaining knowledge, skills, and understandings about practices and processes of instructional assessment and staff development, and applying these learnings to organizational problem solving. Attention will be given to planning inservice education programs. (335 includes the content normally contained in a supervision course.) *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Larson.

337 POLITICAL PROCESSES IN EDUCATION Political and operational relationships of educational organizations to multiple publics and governmental bodies at the local, state, and national levels. Intensive examination of the dynamics of normative structures, power, decision-making processes, conflict, and

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change as related to educational institutions within the total political environment. Three hours. Mr. Case.

350 GUIDANCE IN EDUCATION Introduction to guidance as an organized function of education with special emphasis upon the foundations of guidance. Content will be treated both descriptively and prescriptively including such areas as counseling role and function, testing, information, organization and administration, vocational development, referrals, ethics. *Prerequisite:* 12 semester hours in education and psychology. Three hours. Mr. Peterson.

351 UNDERSTANDING THE INDIVIDUAL Designed to develop understanding and skills in collecting and interpreting data to help the individual acquire self-understanding. Attention devoted to the interpretation of group and individual tests and inventories commonly used by guidance counselors and other pupil personnel workers. *Prerequisite:* 12 hours in education and psychology. Three hours. Staff.

352 ANALYSIS OF EDUCATIONAL ORGANIZATIONS Analyzing organizational variables, conceptualizing variable relationships, diagnosing causes of organizational problems, and developing strategies for planning change. Attention given to the examination of organizational social systems, role relationships within the organizational context, and environmental forces affecting organizational development. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Larson.

353 INQUIRY SEMINAR IN EDUCATIONAL ADMINISTRATION Primary purpose of this seminar is to provide an integrative function to assist students in educational administration and related programs to synthesize and integrate their course work, independent study, practicum modules and experiences, and research to date. The seminar provides a systematic group approach and a simulated setting to test problem-solving, future forecasting, decision making, and policy formation techniques and strategies. *Prerequisite:* Permission of instructor required. Three hours each semester. Mr. Case and Mr. Larson.

354 APPLICATIONS OF SYSTEMS THEORY AND TECHNIQUES TO EDUCATIONAL ADMINISTRATION Systems theory analyzed in terms of its utility for research theory development, interdisciplinary dialogue, and administrative practice. Particular emphasis given to the integrative power of systems analysis techniques for the administrative processes of planning, programming, and evaluation. *Prerequisite:* 12 hours in education and related areas. Three hours. Mr. Case.

360 HIGHER EDUCATION IN AMERICA An introductory study of institutions of higher education in the United States with emphasis upon contemporary

nature and function. Analysis from the sociological, philosophical, historical, economic and political perspectives. Three credits. Staff.

374 COUNSELING THEORY AND PRACTICE A theoretical and practical approach to understanding the dynamics of the counseling process. Emphasis will be placed upon the refinement of a personal philosophy and theory of counseling and the implementation of it in practice. *Prerequisite:* graduate standing, 12 hours in education and/or psychology, and permission of instructor. Three hours. Mr. Peterson or Mr. Ponzio.

377 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 related areas. Three hours. Staff.

378 ADVANCED STUDY AND RESEARCH IN READING AND RELATED LANGUAGE ARTS Survey of past and current research, comparison 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. Staff.

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. Staff.

381 PERSONALIZING INFORMATION PROCESSES IN GUIDANCE The role of information in the growth and development of the individual within the current cultural context. Interpretation of socio-economic and technological change. Psychology of vocational development and theories of vocational choice. Practical application of the uses of information in individual and group counseling as well as in group guidance. *Prerequisite:* 12 hours in education and/or psychology. Three hours. Mr. Peterson.

382 TEACHING INTERNSHIP Supervised teaching experiences on a full-time basis, with related seminars in teaching subject. *Prerequisite:* Permission of the coordinator of Professional Laboratory Experiences, College of Education. Three to eight hours. Staff.

383 GROUP DYNAMICS: THEORY AND EXPERIENCE Encounter group experience for prospective counselors geared to provide them with increased awareness of self and of their modes of relating to others. Study of theory and

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practice of group dynamics. *Prerequisites:* Twelve hours in education and psychology and permission of the instructor. Three credits. Mr. Ponzo.

384 PRACTICUM IN COUNSELING Supervised experiences in individual and small-group counseling situations. 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:* 374 and permission of the instructor. Three hours. Mr. Marchant, Mr. Peterson or Mr. Ponzo.

385 STUDENT PERSONNEL SERVICES IN HIGHER EDUCATION Purposes, organization, and administration of student personnel services in higher education. Functional areas within student personnel work are examined in terms of the student culture, current research, and basic principles of administration. *Prerequisite:* Permission of instructor. Three hours. Mr. Moore.

386 ORGANIZATION AND COORDINATION OF GUIDANCE PROGRAMS Attention is given to factors to be considered in planning, initiating, organizing, coordinating, and evaluating guidance services most effectively. Emphasis on roles and relationships in a K through 12 developmental guidance program in which total staff participation is encouraged. *Prerequisite:* introductory courses in guidance and 12 hours in education and psychology. Three hours. Mr. Ponzo.

387 SEMINAR IN HIGHER EDUCATION Designed for graduate students concentrating in Student Personnel Services in Higher Education. Analysis and discussion of current issues and problems in higher education. *Prerequisite:* Candidacy in graduate program in Student Personnel Services in Higher Education. One to three credits. Mr. Burrell and Staff.

390 ORGANIZATION AND ADMINISTRATION OF MUSIC EDUCATION 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 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.

397 PROBLEMS IN EDUCATION Individual work on a research problem selected by the student in consultation with a staff member. *Prerequisite:* 12

ADDITIONAL GRADUATE COURSES

hours in education and related areas; endorsement by a sponsoring faculty member. Credit as arranged. Staff.

399 RESEARCH METHODS IN EDUCATION Format of this course will include seminars on particular research problems and concepts. Each student will conduct a small research project based upon his or her individual interest. Seminars and research projects will introduce the students to the methods of historical, descriptive, experimental, quasi-experimental, field studies, and survey research. Three hours. Mr. Case.

• ADDITIONAL GRADUATE COURSES

The following courses are also offered by the College of Education, usually in the Summer Session and in the Evening Division.

214 THE SLOW LEARNER (EXCEPTIONAL CHILD WITH LEARNING DISABILITY)	3
215 THE GIFTED CHILD	3
218 WORKSHOP IN CURRICULUM	credit variable 1-4
219 WORKSHOP IN ECONOMIC EDUCATION	4
228 LITERATURE IN THE JUNIOR-SENIOR HIGH SCHOOL CURRICULUM (Literary Criticism for Teachers)	3
229 COMMUNICATIVE ARTS IN SECONDARY SCHOOLS (Teaching English in Secondary Schools)	3
257 TEACHING MATHEMATICS IN SECONDARY SCHOOLS	3
259 TEACHING FOREIGN LANGUAGE IN THE ELEMENTARY (Secondary) SCHOOL	3
260 IMPROVEMENT IN TEACHING BOOKKEEPING AND BUSINESS SUBJECTS	3
261 SEMINAR IN BUSINESS EDUCATION	3
262 PRINCIPLES, PROBLEMS, AND TRENDS IN BUSINESS EDUCATION	3
263 IMPROVEMENT IN TEACHING SECRETARIAL SUBJECTS	3
264 BUSINESS EDUCATION CURRICULUM	3

ELECTRICAL BIOPHYSICS

373 INDIVIDUAL TESTING

3

380 PROFESSIONAL PROBLEMS 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*).

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 Handelsman, Lai, Lambert, Roth (Chairman) and Rush; Associate Professors Evering, and Taylor; Assistant Professors Absher, Ellis, Mirchandani, and Williams.

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 are control systems, biomedical engineering, electromagnetic fields, instrumentation, solid state physical electronics, information processing and communication theory.

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.

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. A reading knowledge of two approved languages or fluency (able to read, write and converse) in one. The language requirement for the Electrical Engineering Ph.D. program comprises the following: a. Satisfactory passing of a reading proficiency examination in two foreign languages. The selection shall be made from French, German or Russian; or, b. Satisfactory completion of the reading proficiency examination in one of the languages in (a) plus a verbal proficiency examination in the same language. The requirements specified under the Regulations of the Graduate College must also be met.

COURSES OFFERED

201 LINEAR SYSTEM THEORY Introduction to linear system theory and application to the processing and control of information. Mathematical models and classification of systems. Lagrangian and Hamiltonian formulation. Time-invariant and time-varying differential systems. Characterization by impulse response and integral transforms. Methods of analysis. Adjoint system and implications. Characterization and analysis of linear discrete-time systems. *Prerequisite:* Math 124 or equivalent background. Three hours. Staff.

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202 NETWORK ANALYSIS Introduction to modern network analysis through a topological study of networks with emphasis on electrical networks. Graph theory. Fundamental principles and theorems. State variable characterization of linear, nonlinear and time-varying networks. Other methods of characterization. Analysis using linear algebra concepts. Computational problems. *Prerequisite:* EE 171 and Math 124 or equivalent background. Three hours. Mr. Mirchandani.

205, 206 NETWORK SYNTHESIS Design of linear and nonlinear networks using the digital computer. Review of classical realizability theory of passive networks. Computer oriented topics including: Linear algebraic computational and numerical integration problems. Concepts of modelling. Optimization methods. Worst case design. Use of analysis programs. Discussion of recent methods and developments. *Prerequisite:* 202. Knowledge of programming helpful but not necessary. Three hours. Mr. Mirchandani.

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.

235 ELECTRONIC INSTRUMENTATION FOR SCIENTISTS Introduction to electrical components and circuit theory, electrical measurements, oscilloscopes, power supplies, amplification by vacuum tubes and transistors, oscillators, comparison measurements, servo systems, operational amplifiers for measurement and control, electronic switching circuits, timing and digital counting systems. This course may not be taken for credit by students in Electrical Engineering. *Prerequisite:* College Physics and Calculus or permission of the instructor. Four hours. Mr. Evering.

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 and boundary conditions for time varying systems. Propagation and reflection of electromagnetic waves, guided electromagnetic waves, resonant cavities, and microwave networks. *Prerequisite:* 240 or departmental permission. Three hours. Mr. Evering.

244 RADAR SYSTEMS ENGINEERING Radar theory including antennas, propagation, signal detection and parameter estimation. Applications including search and track radars, aircraft control and landing, radio/radar astronomy, and modern phased array radars. *Prerequisite:* EE 174. Three hours. Mr. Handelsman.

251 APPLICATIONS OF LINEAR ALGEBRA Introduction of basic definitions and concepts of linear algebra; formulation and solution of engineering problems. Definitions of linear vector and function spaces, subspaces and manifolds, linear operators, change of basis, spectral representation of operators, the eigenvalue problem, matrices and functions of matrices. Application to problems of state variable analysis, field theory, mechanics, quantum mechanics and signal theory. *Prerequisite:* Graduate standing in E.E. or Physics, or departmental permission. Three hours. Mr. Rush.

261 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:* Mathematics 21 or 23. Three hours. Mr. Lambert.

262 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:* 261. Three hours. Staff.

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 191. Three hours. Mr. Absher.

281 SEMINAR Presentation and discussion of advanced electrical engineering

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problems and current developments. *Prerequisite:* 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. Three hours. Mr. Roth.

287 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 INTRODUCTION TO OPTIMUM CONTROL SYSTEMS Review of conventional s-plane design of linear systems. Introduction to the optimal control problem, parameter optimization, Parseval's Theorem and least-square optimization in the frequency domain. Optimization using the calculus of variations, Pontryagin's maximum principle, and Hamilton Jacobi theory. Dynamic programming and functional analysis. Computational methods for solving two-point boundary-value problems, simplex technique and linear programming, search techniques and nonlinear programming. Examples of optimum systems control. Introduction to stochastic control problems. *Prerequisites:* 111, 201, 311 for 312. Three hours. Mr. Absher or Mr. Taylor.

314, 315 NONLINEAR SYSTEM THEORY Analysis and synthesis of piecewise linear networks. Topological study of second order autonomous systems. Nonlinear conservative and Lagrangian systems. Existence of periodic solutions and associated theorems. Graphical methods of analysis. Concepts of stability. Lyapunov stability. Perturbation theory; existence and convergence of periodic solutions. Parametrically excited systems. Mathieu-Hill theory. *Prerequisite:* 201 or Mathematics 230. Three hours. Staff.

317, 318 THEORY OF OPTIMUM CONTROL SYSTEMS Optimum z-domain design of sampled-data systems. Discrete variational calculus and a discrete maximum principle. Formulation of distributed system problems and a distributed maximum principle. Optimum state estimation in linear stationary systems. Optimum filtering for nonstationary continuous systems. Least-squares curve fitting and state estimation in discrete linear systems. Sensitivity in optimal control. *Prerequisite:* 312, 370, 317 for 318. Mr. Absher or Mr. Taylor.

319, 320 SPECIAL TOPICS IN CONTROL SYSTEM THEORY Topics selected from special interests of staff with lectures and readings from current literature. *Prerequisite:* 318. Mr. Absher or Mr. Taylor.

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.

345 ELECTROMAGNETIC ANTENNAS AND PROPAGATION Fundamentals of electromagnetic radiating systems and antennas. Radiation from simple sources and from apertures. Study of antenna gain, directivity and receiving area. Linear antennas, aperture antennas and phased arrays. Study of transmission line systems and propagation through the atmosphere and ionosphere. *Prerequisite:* EE 242 or equivalent. Three hours. Mr. Handelsman.

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.

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:* Atomic or Modern Physics; 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.

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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, 371 SIGNAL THEORY Analysis and representation of nonrandom and random signals. Discrete signals. Signal-space concepts. Random processes. Correlation function and power density spectrum. Measurement techniques. Applications. *Prerequisite:* Graduate standing in Electrical Engineering or concurrent enrollment in 174, 370 for 371. 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.

378 SPECIAL TOPICS IN STATISTICAL COMMUNICATION AND RELATED FIELDS Coding for communication or computer systems, pattern recognition and learning machines, artificial intelligence, etc., selected from special interests of staff with lectures and readings from current literature. *Prerequisite:* Graduate standing in Electrical Engineering. Three hours. Mr. Lai.

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

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

Undergraduate courses:

2, 3, 4 Engineering Analysis	143, 144 Electromagnetic Field Theory
32 Engineering Computation	146 Wave & Diffusion Analogies
111 Control Systems	162, 163 Solid State Physical Electronics
113, 114 Energy Conversion	171 Signals & Systems
121, 122, 123 Electronics	174 Information Transmission Systems

• ENGLISH

Professors Bandel, Bogorad, Cochran, Jones, Long, Orth and Rothwell (Chairman); Associate Professors T. A. Broughton, Manchel, Poger and Shepherd; Assistant Professors Biddle, Clark, A. I. Dickerson, Edwards, Eschholz, Gutman, Hall, Howe, Rosa, Seid, Stanton, and Stephany; Instructors Bradley, M. T. Broughton, Campolucci, M. J. Dickerson, Huddle, Kohler, Miller, Simone, and Zeuch.

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. 23. 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.

ENGLISH

COURSES OFFERED

200 OLD ENGLISH The sounds, words, and structure of Old English; simple prose texts and selections from *Beowulf*. *Prerequisites*: three hours of English. Three hours. Alternate years, 1971-72. Mr. Dickerson.

202 MEDIEVAL LITERATURE The forms (in translation) of medieval literature, with emphasis on Arthurian materials. *Prerequisites*: three hours of English. Three hours. Mr. Stephany.

204 MIDDLE ENGLISH Literary, historical, and linguistic considerations of Middle English texts, excluding Chaucer. *Prerequisites*: three hours of English. Three hours. Alternate years, 1972-73. Mr. Dickerson.

206 ELIZABETHAN DRAMA A study of drama in England from its beginning to 1642, exclusive of Shakespeare. *Prerequisites*: three hours of English. Three hours. Alternate years, 1972-73. Mr. Rothwell, Mr. Howe.

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*: three hours of English. Three hours. Alternate years, 1971-72. Mr. Long.

212 MILTON *Paradise Lost*, *Paradise Regained*, *Samson Agonistes*, some of the minor poems, and selections from the prose works. *Prerequisites*: three hours of English. 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*: three hours of English. Three hours. Alternate years, 1972-73. Mr. Howe.

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*: three hours of English. Three hours. Alternate years, 1972-73. Mr. Jones.

227, 228 ENGLISH NOVEL English fiction from its origins through the nineteenth century. Masterpieces are stressed and read critically. *Prerequisites*: three hours of English. Three hours. Alternate years, 1972-73. Mr. Long.

231, 232 VICTORIAN LITERATURE A study of the lives and the works, except the novels, of the significant writers from 1832 to 1900. *Prerequisites*: three hours of English. Three hours. Alternate years, 1972-73. Mr. Long.

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

236 MODERN AMERICAN DRAMA American plays representing the principal trends culminating in contemporary drama. *Prerequisites:* three hours of English. Three hours. Mr. Orth.

239 MODERN BRITISH POETRY A study of selected British poets since World War I. *Prerequisites:* three hours of English. Three hours. Mr. Poger.

242 LITERATURE OF THE SOUTHERN RENAISSANCE Study of selected short stories, novels, and poetry by Glasgow, Faulkner, Warren, Tate, Styron, and others. *Prerequisites:* three hours of English. Three hours. Alternate years, 1971-72. Mr. Shepherd.

244 MODERN IRISH LITERATURE A study of Irish literature from 1890 to the present, with emphasis on Yeats and Joyce. *Prerequisites:* three hours of English. Three hours. Alternate years, 1971-72. Mr. Bradley.

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:* three hours of English. Three hours. Mr. Shepherd.

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:* three hours of English. Three hours. Alternate years, 1971-72. Mr. Orth.

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:* three hours of English. Three hours. Alternate years, 1971-72. 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:* three hours of English. Three hours. Mr. Cochran.

258 MODERN AMERICAN POETRY Major American poets since World War I. *Prerequisites:* three hours of English. Three hours. Mr. Poger.

261 STRUCTURE OF THE ENGLISH LANGUAGE Descriptive study of the

ENGLISH

structure of modern American English. *Prerequisites:* three hours of English. Three hours. Mrs. Clark.

262 HISTORY OF THE ENGLISH LANGUAGE The principles of historical linguistics and their application to English. *Prerequisites:* three hours of English. Three hours. Alternate years, 1972-73. Mrs. Clark.

264 ENGLISH STYLISTICS Introduction to English stylistics through consideration of changing conceptions of style, evaluation of selected methods of stylistic analysis, and comparison of various literary styles. *Prerequisites:* three hours of English. Three hours. Alternate years, 1971-72. Mrs. Clark.

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, figurative language, and meter. *Prerequisites:* three hours of English. Three hours. Mr. Bogorad.

275 HISTORY OF CRITICISM Principles and theories of criticism from Aristotle to the twentieth century. *Prerequisites:* three hours of English. Three hours. Alternate years, 1971-72. Mr. Stanton.

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:* three hours of English. Three hours. Mr. Poger.

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

302 GRADUATE SEMINAR A seminar for graduate students only. The topic varies from semester to semester, 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 PRINCIPLES OF LITERARY RESEARCH Methods of literary study, research, and scholarship. Required of all first-year graduate students in English. Three hours. Mr. Orth.

EXTRA-DEPARTMENTAL COURSES

391 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 Written Expression	135, 136 Canadian Literature
2 Introduction to Literature	138 Modern British Novel
3, 4, 5, 6, 7, 8 Genre Courses	140 Modern Short Fiction
9, 10, 11, 12 Thematic Courses	141 Modern American Novel
13 Introduction to the English Language	142 Contemporary American Novel
16 Expository Writing	143 Literature of Black America
17, 18 Creative Writing	151 Philosophy and Literature
21, 22 British Literature	177, 178 Advanced Creative Writing
23, 24 American Literature	182 Seminar for Prospective Teachers of English
25, 26 World Literature	192 Major Developments in English Literature
101 Chaucer	193, 194 College Honors
107-108 Shakespeare	195, 196 Special Topics
121, 122 The Romantic Period	197, 198 Reading and Research
133, 134 Development of American Literature	

• EXTRA-DEPARTMENTAL COURSES

AREA STUDIES 297, 298. Seminar for area studies majors and other qualified students conducted by a team of area specialists and covering selected topics through interdisciplinary and comparative approaches. *Prerequisite:* Permission by the executive committee and Dr. Dellin of Area Studies. Three hours. Staff.

GENERAL LITERATURE 251, 252. STUDY OF MOVEMENT, GENRE, OR TOPIC. Precise content of the course to be announced before the registration period, chosen from the following (or similar) topics: 1. *Medieval Epic* (French, Germanic, Spanish); 2. *Comedy* (Classics, English, French); 3. *Enlightenment* (French, English, German); 4. *European Romanticism* (English, French, German); 5. *Political Literature in the Nineteenth Century* (English, French, German); 6. *Existentialism in Literature* (French, German, Spanish); 7. *Avant-Garde Theater* (French, German, American); 8. *Tragedy* (Classics, French, German). *Prerequisite:* Any 100 level literature course in any of the cooperating departments. Three hours. Staff.

FORESTRY

• FORESTRY

Professor W. W. Christensen (Chairman); Associate Professors Hannah, McCormack and Whitmore; Assistant Professors Armstrong, Donnelly, Fuller, Hoekstra, Lindsay and Myers; Lecturer Harold.

Research in the Department of Forestry includes investigations on the effects of site and cultural practices upon the growth of quality spruce and balsam fir Christmas trees; development of tree volume equations basic to volume table construction for native tree species; habitat management and population dynamics of wood ducks; the effect of physical soil properties on the growth and wood quality of yellow birch; and internal moisture content and light density influences on photosynthesis and transpiration of beech seedlings.

Other investigations include research on forest products marketing; parametric linear programming in forest management planning; and cooperative input to a Northeastern Regional Research project on genetic and environmental adaptability of forest trees.

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

Advanced Forestry and related courses (15-24 hours); Thesis research (6-15 hours).

COURSES OFFERED

205 MINERAL NUTRITION OF PLANTS This course is identical with Plant and Soil Science 205.

207 WATER RELATIONS OF PLANTS Absorption, translocation, and transpiration of water. Soil-water relations. Effects of excesses and deficits of water. Mineral absorption. *Prerequisite:* Botany 103. Mr. Donnelly and botany and plant and soil science staff. Alternate years, 1972-73.

221 SITE RELATIONS AND PRODUCTION DYNAMICS IN FORESTS Theory of site relations, methods of study, discussion of current research and its application; total site concepts; dynamics of dry matter production. *Prerequisite:* Permission. Three hours. Mr. Hannah. Alternate years, 1971-72.

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

242 ADVANCED FOREST BIOMETRY Advanced principles of electronic data processing and biometry for forest land management. Current developments in the science of forest biometry. *Prerequisite:* 144 or permission. Three hours. Mr. Myers.

252 FOREST VALUATION Principles of valuation of forest land, growing stock, and other forest resources. *Prerequisites:* 136 and 151 or concurrent enrollment. Two hours. Mr. Armstrong.

271 WILDLIFE MANAGEMENT Integration of principles and techniques of wildlife management with contemporary land use; emphasis on development and maintenance of habitat requirements; population regulation. Field trips. *Prerequisites:* Forestry 123, 170. Four hours. Mr. Fuller and Mr. Hoekstra.

282 SEMINAR Review and discussion of current forestry problems. Required of Forestry seniors and graduate students. One hour. Mr. Christensen.

381 SELECTED PROBLEMS IN FORESTRY OR WILDLIFE SCIENCES Advanced readings, or a special investigation dealing with a topic beyond the scope of existing formal courses. *Prerequisite:* Undergraduate major in forestry or wildlife. Credit arranged. Staff.

391 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	140 Forest Biometry II
2 Seminar	142 Forest Photogrammetry
5 Dendrology	144 Forest Biometry I
100 Forest Bioecology	151 Forest Economics
105 Man and the Forest Environment	152 Forest Policy and Administration
107 Forest Entomology	162 Wood Technology
112 Forest Pathology	163 Timber Harvesting
122 Silvics	165 Forest Products
123 Silviculture	170 Wildlife Biometrics
132 Forest Fire Control	174 Principles of Wildlife Management
133 Forest Recreation Management	175 Game Mammals
136 Forest Management	197, 198 Senior Research

FRENCH

• FRENCH

Professors Daggett and Johnston; Associate Professors Julow (Chairman), Kohler and Parker; Assistant Professors T. Geno, Rivard, Whitebook and Willis; Instructors Crichfield, Lascoumes, Lehovich and Wiley.

Opportunities for thesis research in French literature are offered in all areas from the medieval through the 20th century, 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 or equivalent, including a year course in literature and a year course in advanced composition and conversation.

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours in French which may include six hours in a related field; thesis research, six hours.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. Satisfactory scores on the Graduate Record Examinations are prerequisite for acceptance to candidacy for this degree.

COURSES OFFERED

223, 224 ADVANCED COMPOSITION AND CONVERSATION Translation into French of difficult English prose, free composition, and discussion of questions of style. Advanced conversation. Required of those who wish to be recommended to teach French. *Prerequisite:* 122 or equivalent. Three hours. Mr. Lascoumes and Staff.

227, 228 LINGUISTIC STRUCTURE OF FRENCH An analysis of present-day French, with emphasis on phonetics, phonemics, morphology and syntax of the language. Required of those who wish to be recommended to teach French. *Prerequisite:* 122. Three hours. Mr. Willis.

233 EXPLICATION DE TEXTES Written and oral analyses in French by the instructor and by the student of a variety of literary passages. Constructive criticism or students' *explications*. *prerequisite:* 224 or equivalent. Three hours. Mr. Lascoumes.

234 STYLISTICS Study and comparison of various literary styles. Imitative

compositions based on passages studied, development of individual styles. *Prerequisite:* 223. Three hours. Mr. Lascoumes.

251 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 theater. Works studied in original text and in modern French versions. *Prerequisite:* Any French literature course numbered 100 or above, or permission of department. Three hours. Mrs. Whitebook. Alternate years, 1972-73.

256 FRENCH LITERATURE: 16th CENTURY Selected works of the period with emphasis on Rabelais, Montaigne, and the Pléiade. *Prerequisite:* Any French literature course numbered 100 or above, or permission of department. Three hours. Mr. Daggett. Alternate years, 1972-73.

261 FRENCH LITERATURE OF THE BAROQUE AGE Selected works of the period from Montaigne to Pascal with emphasis on d'Aubigné, Jean de Sponde, Malherbe, Hardy, Mairet, Rotrou, Corneille, Tristan, Saint-Amant, d'Urfé, Scudéry and Scarron. *Prerequisite:* Any French literature course numbered 100 or above, or permission of department. Three hours. Mr. Parker. Alternate years, 1972-73.

262 FRENCH LITERATURE: 17th CENTURY Selected works of the century with emphasis on Corneille, Racine, and Molière. *Prerequisite:* Any French literature course numbered 100 or above, or permission of department. Three hours. Mr. Julow. Alternate years, 1972-73.

267, 268 FRENCH LITERATURE: 18th CENTURY 267: Study of the principal *philosophes* and *encyclopédistes*, Montesquieu, Voltaire, Rousseau, Diderot. 268: Evolution of the novel, theater and *belles-lettres*. *prerequisite:* Any French literature course numbered 100 or above, or permission of department. Three hours (each course). Mr. Johnston and Staff. Alternate years, 1971-72.

271, 272 19th CENTURY POETRY 271: Study of the Romantic movement and its antecedents. 272: Parnassian and pre-symbolist movements of second half of century, including Baudelaire, Leconte de Lisle, Verlaine, Rimbaud. *Prerequisite:* Any French literature course numbered 100 or above, or permission of department. Three hours (each course). Mr. Crichfield and Staff. Alternate years 1971-72.

273, 274 19th CENTURY NOVEL: 273: 1800 to 1850, development of novel in Constant, Senancour, Madame de Staël, the Romantic novelists, Stendhal and Balzac. 274: 1850 to 1900: Theory and practice of realistic-naturalistic

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novel, emphasis on Flaubert, Zola. *Prerequisite:* Any French literature course numbered 100 or above, or permission of department. Three hours (each course). Mr. Julow and Staff. Alternate years, 1971-72.

275 19th CENTURY THEATER Romantic drama of first half of century, transition at mid-century and the realistic-naturalistic theater of second-half of century, including *Théâtre Libre*. *Prerequisite:* Any French literature course numbered 100 or above, or permission of instructor. Three hours. Mr. Daggett. Alternate years, 1971-72.

281 20th CENTURY POETRY Study in depth of principal poetic movements. Symbolism, the New Spirit, Surrealism, the Modern Epic, and the Poetry of Everyday Life. *Prerequisite:* Any French literature course numbered 100 or above or permission of instructor. Three hours. Mr. Parker. Alternate years, 1972-73.

283, 284 20th CENTURY NOVEL 283: Gide, Proust, *et. al.* 284: Malraux, Sartre, Camus, the New Novelists. *Prerequisite:* Any French literature course numbered 100 or above or permission of instructor. Three hours (each course). Mr. Johnston.

285, 286 20th CENTURY THEATER 285: 1900 to 1939. Synthesis of the preoccupations of 20th century man as seen in Jarry, Surréalisme, the Cartel, *théâtre psychologique, théâtre du boulevard*. 286: Artaud, *le théâtre engagé, théâtre de l'absurde, théâtre poétique, théâtre expérimental*. *Prerequisite:* Any French literature course numbered 100 or above or by permission of instructor. Three hours (each course). Mr. Geno and Staff. Alternate years, 1972-73.

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. Mr. Parker. Alternate years, 1971-72.

302 EMILE ZOLA's *ROUGON-MACQUART* A through study of Emile Zola's *Rougon-Macquart* series, his theories of naturalism and critical estimate of his work. Lectures, discussions, reports. Three hours. Mr. Julow. Alternate years, 1972-73.

381 Offered for resident candidates for the Master of Arts degree; opportunities for independent work are provided. Three hours. Staff.

391 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
19 Intermediate Grammar	Conversation
51, 52 Intermediate Reading	151, 151 Masterworks
119 Advanced Grammar	291 Senior Seminar

• GEOGRAPHY

Professor Miles (Chairman); Associate Professors Barnum, Gade and Meeks; Assistant Professors Leinbach, Lind and Wilvert; Instructor Grant.

Faculty research interests include most systematic aspects of geography, especially from an historical perspective. Technique interests are in cartography, remote sensing, and quantitative methods. The regional interests and field experience are almost world-wide in scope, but normally a Master's thesis would be a project on Vermont or adjacent areas.

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

Twelve semester hours or its equivalent in geography and supporting courses in related fields or demonstrated proficiency in geography which would be assurance of success in graduate study.

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours of approved courses in geography including six in thesis research, and six additional hours in geography or a related field.

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

COURSES OFFERED

Admission to the following courses for graduate study requires the approval of the department.

201 HISTORICAL GEOGRAPHY OF THE UNITED STATES (Same as History 201) The physical setting of the American historical development, emphasizing the sequence of peoples and cultures which have occupied the land and their varied appreciation of its resource base. *Prerequisites:* History 23 plus 6

GEOGRAPHY

additional hours in geography, history, or other social sciences. Three hours. Mr. Miles.

202, 203 HISTORICAL GEOGRAPHY OF EUROPE (Geography 202 same as History 202) European geography within a framework of past times, the historical development and distribution of settlement, economic and political patterns. *Prerequisite:* History 12 plus six additional hours in geography or history. Three hours. Mr. Barnum.

211 GEOGRAPHIC ANALYSIS OF VERMONT A course emphasizing field studies, using the state and local area as an outdoor laboratory to indicate lines of geographic inquiry and to demonstrate methods and techniques of investigation into the human use of the earth. *Prerequisites:* 6 hours in geography. Three hours. Staff.

216 BIOGEOGRAPHY Processes and patterns of distribution, domestication and human utility of plant and animal species and communities in varying environmental and historical contexts. *Prerequisites:* nine hours in geography or biology. Three hours. Mr. Gade.

221 SPECIAL TOPICS IN REGIONAL GEOGRAPHY Specialized study of a particular region or parts thereof. *Prerequisite:* 12 hours in the social sciences including three in geography and departmental permission. Three hours. Staff.

231 PHYSICAL AND RESOURCE GEOGRAPHY OF THE UNITED STATES The physical environmental patterns of the United States. Identification and analysis of natural regions as they reflect the elements of the physical environment. Emphasis on distributional patterns and resources significance. *Prerequisite:* 6 hours in geography including Geography 12. Three hours. Mr. Meeks.

241 ADVANCED PHYSICAL GEOGRAPHY Analysis of the patterns of distribution and the characteristics of the earth's physical landscapes within the context of climatic zonality. Survey of changing climatic and physical patterns during prehistoric times. *Prerequisite:* Geography 12 or 51. Three hours. Mr. Lind.

244 ADVANCED ECONOMIC GEOGRAPHY The geographical aspects of the localization of economic activity, patterns of circulation, regional specialization and development. *Prerequisite:* Geography 14 and 6 additional hours in geography, economics, or the social sciences. Three hours. Mr. Leinbach.

246 URBAN GEOGRAPHY An analysis of the morphology and function of cities. Consideration of urban growth and development, methods of classifica-

tion, distribution, and theories of location. *Prerequisite:* Geography 11 and 6 additional hours in the social sciences. Three hours. Mr. Barnum.

251 ADVANCED CLIMATOLOGY Analysis of regional and local climatic data with special reference to climatic controls: special laboratory projects. *Prerequisite:* Geography 51 or Meteorology 61 and permission. Three hours. Mr. Lind.

257 POLITICAL GEOGRAPHY (Same as Political Science 257) Characteristics of the political unit as a geographic area. Consideration of 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. Three hours. Mr. Miles.

258 SELECTED TOPICS IN POLITICAL GEOGRAPHY Advanced studies in political geography focusing primarily on contemporary world politics from a geographical and geopolitical viewpoint. *Prerequisite:* Geography/Political Science 257 and permission. Three hours. Mr. Miles.

262 CULTURAL GEOGRAPHY (same as Anthropology 262). Concepts and theories of cultural ecology, culture area, culture history and the cultural landscape. *Prerequisites:* Geography 11 and six additional hours in geography, anthropology or other social sciences. Three hours. Mr. Gade.

263 MAN IN NATURE An inquiry into the changing conceptions of the earth as the home of man, and the conservative and destructive uses of the physical environment that have resulted from these attitudes. *Prerequisite:* 3 hours of geography. Three hours. Mr. Gade.

271 ADVANCED CARTOGRAPHY The history and importance of cartography; contemporary developments; special laboratory projects. *Prerequisite:* Geography 71 and permission. Three hours. Mr. Barnum.

281 THE NATURE OF GEOGRAPHY The history, philosophy and structure of modern geography. *Prerequisite:* 12 hours in geography. Three hours. Staff.

285 SEMINAR IN HISTORICAL GEOGRAPHY Advanced studies and research in historical geography. *Prerequisite:* Geography/History 201 or 202, or Geography 203, and permission. Three hours. Staff.

381 ADVANCED READINGS AND RESEARCH Readings on research topics, with conferences and reports, to provide graduate students with background

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and specialized knowledge in an area not appropriately covered by an existing course. Credit as arranged. Staff.

391 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:

- | | |
|--|------------------------------------|
| 11 Introduction to Human Geography | 102 Geography of Canada |
| 12 Introduction to Physical Geography | 103 Geography of the Soviet Union |
| 14 Introduction to Economic Geography | 105 Geography of Europe |
| 33 World Geography | 106 Geography of Latin America |
| 51 Climate | 107 Geography of the United States |
| 61 Introduction to Remote Sensing and Air Photo Interpretation | 108 Geography of East Asia |
| 71 Cartography | 109 Geography of South Asia |
| 101 Geography of Africa | 110 Geography of Southwest Pacific |
| | 193, 194 College Honors |
| | 195, 196 Special Topics |
| | 197, 198 Readings and Research |

• GEOLOGY

Associate Professors Hunt, Stanley (Chairman) and Wagner; Assistant Professors Bucke, Drake and Doolan; Adjunct Professor Johnson.

Research programs are oriented in the following areas: Selected problems in minerology; selected problems in igneous and metamorphic petrology; 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; problems in environmental geology; field and laboratory cold room ice studies. Interdisciplinary studies are available.

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 12 semester hours in geology.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN TEACHING (GEOLOGY).

1. A bachelor's degree from an accredited institution;
2. Certification as a teacher of a physical or natural science;
3. Satisfactory scores on the Graduate Record Examination (Aptitude portion).

MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN TEACHING (GEOLOGY).

Thirty hours of course work that will strengthen the students background in earth science. Up to 12 hours of 100-level courses may be chosen if applicable. Course work may be chosen from supporting subject areas as well as from geology. Each student, in conference with his adviser, will develop a program suited to his needs and background. No thesis is required, however, each degree recipient must complete a general written and oral examination.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 23.

COURSES OFFERED

212 ADVANCED MINERALOGY Selected topics in mineralogy including crystal chemistry experimental mineralogy, and current problems in mineralogy.

Prerequisite: permission of the instructor. Three hours. Alternate years, 1972-73. Mr. Drake.

216 GLACIAL GEOLOGY The Quaternary history of the world with emphasis on North America; relating the origin, mechanics and effects of past and present glaciations. *Prerequisite:* 101 or permission of the instructor. Three hours. Alternate years, 1972-73. Mr. Wagner.

218 HYDROGEOLOGY The origin, occurrence, movement, and character of ground water in various geologic environments, principles and practices of de-

GEOLOGY

velopment, utilization, and management of ground water supplies. *Prerequisite:* Geology 101 or 216, or permission of the instructor. Three credit hours. Alternate years. Mr. Johnson, Mr. Wagner.

220 SEMINAR IN ENVIRONMENTAL GEOLOGY Consideration of environmental problems in Vermont, New England, and elsewhere with emphasis on the geological role in the solution of these problems. Discussion will be complemented by field trips and guest speakers. *Prerequisite:* 101, or by permission of the instructor. Three hours. Mr. Wagner.

222 INVERTEBRATE PALEONTOLOGY Classification, geological distribution, evolution, and morphology of major invertebrate fossil groups. Consideration given to correlation and environmental interpretation. Laboratory includes methods of collecting, preparing, and identifying fossils. *Prerequisite:* 121, or equivalent. Three hours. Mr. Hunt.

224 STRATIGRAPHY The sequential development and distribution of the sedimentary rocks. *Prerequisites:* 156 or permission of instructor. Three hours. Alternate years, 1971-72 or as the demand arises. Mr. Bucke.

238 FIELD GEOLOGY Geologic mapping of nearby areas. Methods of analysis of field data, structural features in sedimentary, metamorphic, and igneous rocks, and stratigraphic principles. Held in late May and early June. *Prerequisite:* 166 or departmental permission. Four hours. Mr. Stanley.

242 REGIONAL GEOLOGY An examination and comparison of the geology of selected portions of the world. *Prerequisites:* 155 or 156, 166. Three hours. Mr. Stanley, Mr. Doolan.

245 GEOLOGY OF NEW ENGLAND Comprehensive study of the geology of New England with emphasis on the spatial and temporal relationships to the eastern part of the North American continent. *Prerequisite:* 166, or 156, or 224. Three hours. Mr. Stanley.

253 PHASE EQUILIBRIUM The application of thermodynamics and graphical methods to the analysis of multicomponent, polyphase systems of mineralogical interest. *Prerequisite:* 11 or permission of instructor. Three hours. Mr. Drake.

254 GEOCHEMISTRY The application of basic concepts in chemistry to geological problems, including solution geochemistry, weathering, mineral paragenesis, and the effects of pressure and temperature. *Prerequisites:* 155 or 156 or permission of instructor. Three hours. Mr. Drake.

271 TOPICS IN GEOLOGY Selected topics of current interest. One hour. Staff.

310 CLAY MINERALOGY The structure, composition, properties, occurrence, origin, distribution, and environmental significance of the various clay minerals. Laboratory techniques in identification of clay minerals and measurement of their physical and chemical parameters. *Prerequisite:* Permission of the instructor. Three hours. Mr. Bucke.

321 IGNEOUS GEOLOGY Paragenesis of igneous rocks; laboratory work on selected suites of specimens. *Prerequisite:* 145, 156. Three hours. Alternate years, 1971-72. Mr. Doolan.

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:* 145, 156. Three hours. Alternate years, 1971-72. Mr. Doolan, Mr. Drake.

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:* 155. 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:* 101 or permission of the instructor. 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 results, 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.

337 STRUCTURAL PETROLOGY Origin of strain features in common rock forming minerals with emphasis on their dynamic and kinematic interpretation as based on laboratory and field studies since World War II. Laboratory will be problem oriented with emphasis on techniques of analysis including orientation and universal stage procedures, use of computers in the rotation of data, and methods of interpretation. *Prerequisite:* Geology 116 or 145. Will alternate with Advanced Structural Geology 335. Mr. Stanley.

GERMAN

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:* 222. Three hours. Mr. Hunt.

371 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 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 Introductory Geology	156 Igneous and Metamorphic Petrology
11 Introductory Mineralogy	161 Meteorology
42 Geological Oceanography	166 Structural Geology
101 Environmental Geology	193, 194 College Honors
121 Geologic History of Life	197, 198 Research in Geology
145 Optical Mineralogy	
155 Sedimentary Petrology	

• GERMAN

Professors Webster (Chairman) and White; Associate Professors Kahn and Paucker; Assistant Professors Richel and Wurthmann.

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, satisfactory scores on the Graduate Record Examinations.

MINIMUM DEGREE REQUIREMENTS

German 381; 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. 23. Satisfactory scores on the Graduate Record Examination are prerequisite to acceptance to candidacy for this degree.

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, 1971-72. 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. Staff.

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. Staff.

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, 1971-72. Miss Richel.

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. Staff.

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. Staff.

HISTORY

281 SEMINAR Special readings and research. One hour. Staff.

305 SCHILLER Life and major works of the poet, including drama, poetry, aesthetic and philosophical writings. Three hours. Mr. Paucker.

322 BRECHT AND THE MODERN DRAMA Brecht's major dramas, as well as selected theoretical writings. Analysis of his concept of modern theater and its influence on contemporary German playwrights. Readings to include Dürrenmatt, Weiss and others. Three hours. Miss Richel.

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

391 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, Literature and Discussion

13, 14 Intermediate German, Composition and Conversation

15, 16 Intermediate German, Introduction to Technical Reading

81, 82 Scientific German

101, 102 Introduction to German Literature

121, 122 Composition and Conversation

195, 196 Special Topics

• HISTORY

Professors Bliss, Daniels, Davison, Evans (Emeritus), Felt (Chairman), Hand, Rollins, Schmokel (Director of Graduate Studies) and Schultz; Associate Professors Metcalfe, Muller, Spinner, and Stout; Assistant Professors Andrea, Fackler, Hutton, Overfield, Seybolt, Steffens, and True; Adjunct Professor Morrissey; Instructors Carlson, Stoler, and Young.

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; history of the American black; American military history; Medieval Europe; the Renaissance and the Reformation; French history; English History (Tudor-Stuart and recent); twentieth-century German, Russian and Chinese history; the Communist movement and

Soviet foreign policy; Canadian history (including French Canada); Latin American history; African history; music history; history of science. For ancient history, see Latin and Greek.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS AND MASTER OF ARTS IN TEACHING

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 FOR THE DEGREE OF MASTER OF ARTS

Twenty-four hours in History, including thesis research (six hours), and History 301; 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. 23). Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

COURSES OFFERED

201 HISTORICAL GEOGRAPHY OF THE UNITED STATES This course is identical with Geography 201.

202 HISTORICAL GEOGRAPHY OF EUROPE This course is identical with Geography 202.

203 LATIN AMERICAN HISTORY The Spanish Empire in America including the Indian heritage, the conquest, economic, social and political trends within the empire, and the struggles for independence. Reading knowledge of Spanish strongly recommended. Three hours. Mr. True. (To be given in alternate years, spring semester.)

204 LATIN AMERICAN HISTORY An introduction to the history of modern Latin America. The political, social and economic development of selected countries since 1826. Three hours. Mr. True.

205 HISTORY OF MEXICO Concentrates on the political, social, and economic development of Mexico since 1810. Reading knowledge of Spanish strongly recommended. Three hours. Mr. True. (To be given in alternate years, spring semester.)

HISTORY

207 **THE EARLY MIDDLE AGES** Western Europe from the late Roman Empire to the death of Otto III (A.D. 1002). Emphasis on political, social, and ecclesiastical developments. Three hours. Mr. Andrea.

208 **THE HIGH MIDDLE AGES** Western Europe, 1000-1300. Emphasis on religious, intellectual, and artistic developments. Three hours. Mr. Andrea.

211 **THE RENAISSANCE** Historical change in Italy and northern Europe from the 14th century to the early 16th century, emphasizing the transition from medieval to early modern society. Three hours. Mr. Overfield.

212 **THE REFORMATION** Political, economic, and cultural developments in Europe in the sixteenth century. Particular attention will be devoted to the religious movements. Three hours. Mr. Overfield.

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. Three hours. Mr. Muller, Mr. Metcalfe, Mr. Young.

215, 216 **FRENCH CANADA** A history of the French experience in North America from 1608-1867, and 1867 to the present, with special emphasis on the problems of a minority group in North America, and the roots of French-Canadian nationalism and separatism. Ability to read in French a decided asset. *Prerequisite:* 213, 214, or concurrent enrollment in same. Three hours. Mr. Young.

221 **THE AMERICAN COLONIES** The colonial period of American history from the earliest explorations to 1763. Three hours. Mr. Carlson, Mr. Stout.

222 **THE AMERICAN REVOLUTION** History of the War for Independence, the Confederation, and the making of the U. S. Constitution, 1763-1789. Three hours. Mr. Carlson, Mr. Stout.

226 **THE MIDDLE PERIOD OF U. S. HISTORY** History of the U. S., 1815-1856, with emphasis on political and social development. Three hours. Mr. Fackler.

231, 232 **FRENCH HISTORY** France in modern times. Emphasis on the French Revolution and the French Revolutionary Tradition. First semester: sixteenth century to 1815; second semester: 1815 to the present. Three hours. Mr. Hutton.

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

235, 236 **INTELLECTUAL HISTORY OF MODERN EUROPE** Emphasis upon ideas in their relation to major political and social movements. First semester: Humanism, the Scientific Revolution, and the Enlightenment (1500-1800); second semester: the Nineteenth century (1800-1914). Three hours. Mr. Hutton, Mr. Overfield.

240 **AMERICAN BIOGRAPHY** Investigation and portrayal of personalities; the uses of biography in the study of American history. Subjects selected to represent a variety of vocations and aspects of history. Three hours. Mr. Schultz.

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. Three hours. Mr. Daniels, Mr. Gard.

244 **TSARIST RUSSIA** History of Russia from the Middle Ages to the Revolution of 1917, with emphasis on the period since Peter the Great. Three hours. Mr. Gard.

253 **TUDOR-STUART ENGLAND** England from 1485 to 1660, with particular emphasis on the central period from the 1530's to the 1640's (the Henrician Reformation to the Revolution). *Prerequisite:* 11 and 12. Three hours. Mr. Metcalfe. (Offered 1972-73 and alternate years)

254 **VICTORIAN ENGLAND** Selected topics in 19th century English history with emphasis on "industry and empire," changing class relationships, and the growth and development of political parties. *Prerequisite:* 11 and 12. Three hours. Mr. Spinner. (Offered 1972-73 and alternate years)

257, 258 **AMERICAN STATESMEN** Thought and practical politics of American statesmen. 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. Three hours. Mr. Schultz.

261 **VERMONT HISTORY** A survey of Vermont history from early times to the present, with special emphasis on local history as a mean to examine national trends and as a vehicle for research. *Prerequisite:* 23 and 24. Three hours. Mr. Muller.

263, 264 **SOCIAL HISTORY OF THE U. S.** Selected topics in the history of

HISTORY

American society, including social movements, rural history, or urban history. Three hours. Mr. Fackler.

265, 266 AMERICAN INTELLECTUAL HISTORY Topics in the intellectual history of the United States. 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. Three hours. Mr. Stoler.

271, 272 HISTORY OF MODERN CHINA History of China in modern times, including the Empire, the Western impact, the Revolutions of the 20th century, and the Communist regime. Three hours. Mr. Seybolt.

277 SOVIET POLITICS An intensive historical and institutional study of the Soviet government and Communist Party, mainly treating the period since 1953. Application of sociological and biographical analysis and data-processing techniques. Comparative treatment of other communist systems. *Prerequisite:* 243 or six hours of Political Science including 172. 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.

280 SCIENCE AND CULTURE Investigates the relationship between scientific thought and general culture in the 20th century. *Prerequisite:* History 61, 62. Three hours. Mr. Steffens.

281 SCIENTIFIC REVOLUTIONS AND SOCIETY Emphasizing a biographical approach, the course deals with the interrelationship between scientific activity and social change during selected periods of rapid scientific advance. *Prerequisite:* History 61, 62. Three hours. Mr. Steffens.

289 QUANTITATIVE METHODS IN HISTORICAL RESEARCH Applications of quantitative methods to the selection and analysis of historical source materials; emphasis on political and social data. Use of the University's Computation Center facilities and other data-processing equipment. *Prerequisite:* Math 110 or permission of the instructor. Three hours. Mr. Fackler.

291 GENERATION OF HISTORICAL EVIDENCE Readings, research and field work on the problem of assessing how events generate evidence and how

historians judge and correlate such evidence. Discussion of archival practices and of the approaches to evidence used by the social sciences. Emphasis on first-hand experience in the processes which generate primary source material. Three hours.
II. Mr. Morrissey.

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 M.A. candidates. Three hours. Staff.

Seminar Courses: Ordinarily each seminar will be given for one semester in alternate years. All seminars will count for three credit hours per semester. The prerequisites for each seminar are appropriate work in the given field, foreign language where necessary, and permission of the instructor. Exceptionally qualified senior undergraduates will be admitted to seminars when space permits.

303 LATIN AMERICAN HISTORY Mr. True.

305 ANCIENT HISTORY Miss Davison.

307 MEDIEVAL HISTORY Mr. Andrea.

311 THE HISTORY OF EARLY MODERN EUROPE Mr. Overfield.

313 THE HISTORY OF CANADA Mr. Metcalfe, Mr. Muller.

321 AMERICAN COLONIAL HISTORY Mr. Stout.

326 MIDDLE PERIOD OF U. S. HISTORY Mr. Fackler.

331 THE HISTORY OF FRANCE Mr. Hutton

333 THE HISTORY OF GERMANY Mr. Schmokel.

343 THE HISTORY OF RUSSIA Mr. Daniels, Mr. Gard.

353 THE HISTORY OF ENGLAND Mr. Metcalfe, Mr. Spinner.

355 RECENT EUROPEAN HISTORY Mr. Schmokel and staff.

357 U. S. POLITICAL HISTORY Mr. Hand, Mr. Schultz.

361 STATE AND LOCAL HISTORY Mr. Morrissey, Mr. Muller.

363 SOCIAL HISTORY OF THE U. S. Mr. Fackler.

365 U.S. SOCIAL AND INTELLECTUAL HISTORY Mr. Felt.

367 THE HISTORY OF U. S. FOREIGN RELATIONS Staff.

377 SPECIAL TOPICS Mr. Daniels and staff.

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

397 SPECIAL READINGS AND RESEARCH Directed individual study of areas not appropriately covered by existing courses.

Undergraduate courses:

11, 12 European Civilization

17 Ancient Mediterranean Civilization

HOME ECONOMICS

- 18 Medieval European Civilization
- 23, 24 History of the United States
- 40 Biography
- 51, 52 Contemporary History
- 61, 62 History of Science
- 73 Traditional East Asian Civilization
- 74 East Asia in Transition
- 81 American Military History
- 91 Historiography
- 105 The Ancient Near East
- 106 History of Greece
- 107 History of Rome
- 115, 116 Introduction to African History
- 123 American History since 1945
- 125 History of the Negro in America
- 153, 154 English History

• HOME ECONOMICS

Professors Betsinger (Chairman), Brown, Grams, Morse and Williams; Associate Professors Caldwell, Knowles, Powell, and Webster; Assistant Professors Atwood, Emanuel, J., Howard, Jameson, Lepeschkin, Livak, Prior and Whittlesey; Instructors Emanuel, F., McKay, Osborn, Pooley and Soule; Lecturers Keyser and Spaven.

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. 23 and p. 26. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for the MAT degree.

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

S217 AMERICAN TEXTILES AND FASHION: TWO CENTURIES—18th CENTURY TO 1910 The collections of textiles and needle art in the Shelburne Museum will provide source material for lectures, demonstrations and laboratory experience in the study of home production, design and use of early fabrics. The Museum's extensive collection of Couturier gowns will be used for the study of late Victorian and Edwardian fashion. *Prerequisite:* six hours in design and/or textiles, or permission of instructors. Three hours. Misses Atwood and Caldwell.

219 INTERIOR DESIGN II Studies in interior design with special emphasis given to period furnishing, its present use and influence upon modern furnishing. *Prerequisite:* 119. 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. Mrs. Webster.

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, 219, 221 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. *Prerequisite:* 40, 135, 137 or equivalent; Chemistry 4 or 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. *Prerequisite:* 135. 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 ORGANIZATION & MANAGEMENT Personnel

HOME ECONOMICS

policies; laws and regulations; promotion and advertising. *Prerequisites:* 138, 139. Three hours. Mr. Emanuel.

240 **METHODS IN NUTRITION EDUCATION** Problems common to nutrition educators in schools, hospitals, and the community. Individual investigation of a problem selected to meet the special needs of students. *Prerequisite:* college course in nutrition or departmental permission. Three hours. Staff.

243 **ADVANCED NUTRITION** Review of relevant biochemical and physiological material as applied to human nutrition and metabolism. Individual projects. *Prerequisites:* biochemistry 201, zoology 6. Three hours. Miss Morse and Mr. Keyser.

244 **DIET THERAPY** Adaptations of the normal diet in conditions affected by or affecting the utilization of food. *Prerequisite:* 243. Four Hours. Miss Powell.

248 **READINGS IN NUTRITION** Critical survey of the literature on recent developments in nutrition. *Prerequisite:* 243 or departmental permission. 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. Staff.

258 **FAMILY ECONOMICS** The American Family as a socio-economic unit: acquiring resources, managing current consumption, planning for future consumption. *Prerequisite:* 56, Economics 3 or 12. Three hours. Staff.

263 **SEMINAR IN FAMILY RELATIONS AND HUMAN DEVELOPMENT** Theory and research on the family. *Prerequisites:* 163, and/or Sociology 151, or equivalent. Three hours. Mr. Grams.

264 **CHANGING ROLES OF MEN AND WOMEN** Recent literature regarding the changing roles of men and women and the unique tasks they face in a dynamic twentieth century world. *Prerequisites:* 163, and/or Soc. 151, or equivalent. Three hours. Staff.

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. *Prerequisite:* 63, 163, or equivalent. Three hours. Mr. Grams.

266 SEMINAR IN HUMAN DEVELOPMENT

An intensive study of issues in human development and their application in a wide variety of professional areas. *Prerequisites:* 63 and 163, or equivalent. Three hours. Mr. Grams.

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. *Prerequisite:* 171, or permission of instructor. 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. Miss Osborn.

274 HOME ECONOMICS IN ELEMENTARY AND MIDDLE SCHOOLS

Home Economics as an integral part of the school curriculum through the 8th grade. Observations and study of the child through age 12. Participation in local schools. *Prerequisites:* 63, 71. Three hours. Miss Osborn.

290 INTRODUCTION TO RESEARCH

Research procedures with lectures and discussions of problem selections, objectives, bibliographical techniques, and analysis of data. Each student will prepare a project outline for a simple experiment or study in a chosen field. A suggested prerequisite for special problems or theses at the senior or graduate level. One hour. Miss Morse.

294 HISTORY OF NUTRITION

Foremost investigators and methods involved in the development of present day nutritional knowledge. *Prerequisites:* three hours of nutrition. One hour. Staff.

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. Staff.

307 ADVANCED CONCEPTS IN NUTRITION (See Animal Science 307.)

Three hours. Staff.

308 EXPERIMENTAL TECHNIQUES IN NUTRITION (See Animal Science 308.)

Two hours. Staff.

HOME ECONOMICS

366 SOCIAL WELFARE AND SOCIAL WORK AS SOCIAL INSTITUTIONS

Critical survey of the philosophy and purpose of social welfare and systems of service delivery in welfare agencies. Investigation of basic concepts of social work practice. Three hours. Miss Whittlesey.

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 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 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.

397 PROBLEMS IN EDUCATION (see Education 397) Credit to be arranged. Staff.

Undergraduate Courses:

- | | |
|--|---|
| 15 Design | 140 Child Nutrition |
| 16 Sketching for Fashion and Housing Design | 144 Applied Normal Nutrition |
| 17 Costume Design | 148 Community Involvement—Problems in Foods and Nutrition |
| 20 Introduction to Textiles and Clothing | 151 House Planning |
| 22 Clothing Selection and Construction | 155 Experimental Equipment |
| 23 Clothing Concepts and Techniques II | 156 Home Management Residence |
| 37 Basic Concepts of Foods | 158 Consumer Problems |
| 40 Basic Concepts of Nutrition | 161 Human Relationships and Sexuality |
| 51 Family Housing Selection | 163 The Emerging Family |
| 52 Socio-Economic Aspects of Housing | 164 Education for Child Rearing |
| 54 Household Equipment | 165 Aging in the Family and Community |
| 56 Principles of Home Management | 171 Methods of Teaching |
| 61 Human Development in Contemporary Society | 172 Student Teaching |
| | 173 Communication Methods |
| | 175, 176 Special Problems in Home Economics Education |

- 62 Adolescent Psychology and Development
- 63 Child Development
- 64 Maturing and Aging
- 71 Introduction to Home Economics Education
- 82 Creative Curriculum Activities for Preschool and Kindergarten I
- 115 Textile Design
- 116 Weaving
- 117 History of Costume
- 119 Interior Design I
- 120 Advanced Textiles
- 122 Pattern Design and Advanced Construction
- 123 Tailoring
- 135 Advanced Food Preparation
- 137 Meal Management
- 138 Quantity Food Production and Service
- 139 Institutional Purchasing and Food Cost Control

- 182 Creative Curriculum Activities for Preschool and Kindergarten II
- 184 Early Childhood Education
- 185 Experience with Preschool Families
- 187 Field Practicum
- 189 Preschool Practicum

Social Welfare Program:

- SW - 2 Orientation to Social Work
- SW - 51 Human Needs and Social Services
- SW - 166, 167 Social Welfare as A Social Institution
- SW - 168 Social Work as A Profession
- SW - 169 Social Work in the Community
- SW - 170 Field Experience
- SW - 290, 292 Special Problem

• MATHEMATICS

Professors Brock, Izzo, Lighthall, Meserve, Moser, Riggs and Schoonmaker (Chairman); Associate Professors Bee, Chamberlain, Dwork, Hill, Prather, Sylwester, Whorton and Wright; Assistant Professors Burgmeier, Cooke and Lamborn; Instructors Brown, Cobb, Dimmock, Earnshaw, Johansson, Morrow, Puterbaugh and Williams.

Current research interests include applied mathematics; computer science; optimization; abstract algebra; real and complex analysis; probability and statistics; and differential equations.

For many mathematics courses it will be assumed that the enrolled student knows how to program the University Computer and how to use the University Computer facility. This knowledge can be acquired by attending an informal, six hour session arranged by the director of the Computer Facility.

MATHEMATICS

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

Thirty semester hours beyond intermediate calculus, including a year of advanced calculus. Satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS

Plan A: Twenty four hours in advanced Mathematics courses; six hours in thesis research.

Plan B: Thirty hours in advanced Mathematics courses; no thesis required.

The department also offers programs leading to the degrees of Master of Arts in Teaching: Cf. p. 23, and Master of Science for Teachers: Cf. p. 25. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for the MAT degree.

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

A baccalaureate degree; at least 18 semester hours of credit in collegiate mathematics, including Summer Institute courses S45, S46, S47 and S48, or the equivalent; three years of experience teaching secondary school mathematics; certification as a secondary school teacher of mathematics.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS

Required for the M.S.T. degree in Mathematics is thirty hours of course work in Mathematics. Specific courses in Mathematics which must be included in the program are 121, 124, S142, S144, 251, 260, 261 and three other 200 level courses. Although no thesis is required, each degree recipient must successfully complete a written comprehensive examination. A departmental advisory committee will plan a program for each student recognizing his previous experience. Such programs will be subject to the approval of the Dean of the Graduate College upon recommendation of the Chairman of the Mathematics Department.

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

The applicant must satisfy the prerequisites of the Graduate College. He must

have a Master's degree, or at least one year (30 semester hours) of graduate study, and satisfactory scores on the aptitude and advanced sections of the Graduate Record Examination. His prior studies must include the equivalent of a year of advanced calculus, Mathematics 241, 242, and a semester of modern algebra, Mathematics 251. If specialization in Computer Sciences is desired, the candidate must have had one year of work equivalent to our Mathematics of Computing, Mathematics 115, 116. In addition the student must qualify on Preliminary Examinations in algebra, real analysis and complex analysis and in one area of specialization chosen by the applicant. Qualification includes both understanding of the material and ability to use his knowledge for independent research.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The student must complete 40 graduate credit hours in formal course work. At least 20 of these credits must be 300 or 400 level courses in Mathematics including two seminars. Total credit hours including thesis must be at least 75. Arrangements will be made for a thesis advisor and thesis committee. All doctoral students are required to participate in the department's undergraduate teaching program.

COURSES OFFERED

200 STATISTICAL METHODOLOGY I Fundamental ideas and techniques of statistics, including randomization, confidence intervals, hypothesis testing, and estimation. Emphasis on applications to current problems of interest to the student requires acquaintance with another discipline to serve as source of data for problems (e.g., education, biology, economics, psychology, agricultural engineering). No graduate credit for mathematics majors. This course is much more demanding than 110. *Prerequisite:* 9. Three hours. Staff.

201 STATISTICAL METHODOLOGY II Techniques of regression, analysis of variance and covariance, multiple comparisons. Heavy emphasis on application requires knowledge of another discipline to serve as source of current problems and data. *Prerequisites:* 200 or 204. Three hours. Staff.

202 SAMPLING METHODS Constructing and analyzing designs for investigations involving sampling techniques. Descriptive surveys including simple random, stratified, and multistage designs. Estimation in finite populations including ratio and regression estimators. *Prerequisite:* 201. Three hours. Mr. Whorton.

203 ELEMENTS OF PROBABILITY Basic concepts, techniques and applications of probability, random variables, moment generating functions, laws of

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large numbers and central limit theorems. Techniques and applications include permutations and combinations, binomial and normal distributions, the Poisson process, reliability theory and quality control. No graduate credit for mathematics or electrical engineering majors. *Prerequisite:* 12. Three hours. Staff.

- 204 MATHEMATICAL STATISTICS I Theory and application of classical statistical methods. Sampling distributions, estimation procedures, tests of hypothesis and confidence intervals. *Prerequisite:* 102, 124, 203. Three hours. Miss Lamborn.

205 MATHEMATICAL STATISTICS II Theory and application of modern statistical procedures. Non-parametric methods, multivariate techniques, decision theory, sequential procedures. *Prerequisite:* 204. Three hours. Miss Lamborn.

206 EXPERIMENTAL DESIGNS Analysis of variance including subsamples and disproportionate subclass numbers, estimation of variance components, incomplete block designs, compounding of factorial effects, fractional replication, multiple comparison techniques, principles of split plots, and pooling of experiments. *Prerequisite:* 201. Three hours. Mr. Bee and Mr. Whorton.

207 PROBABILITY THEORY Basic non-measure-theoretic course in probability theory with some applications. Axioms of probability, random variables, moment generating functions, laws of large numbers and central limit theorems, introduction to stochastic processes. Students will need a strong working knowledge of calculus including infinite series, partial differentiation and multiple integration. *Prerequisites:* 102, 124. Three hours. Mr. Sylwester.

210 APPLIED STOCHASTIC PROCESSES Random walk models, Markov chains, Poisson process, Brownian motion, probability generating functions, discrete branching processes, homogeneous birth and death processes, and diffusion processes. *Prerequisites:* 207. Three hours. Mr. Sylwester.

211 MULTIVARIATE METHODS. Multivariate normal theory, tests of hypotheses. Multivariate analysis of variance and covariance, principle components and factor analysis. *Prerequisites:* 201 and 205, or permission of instructor. Three hours. Mr. Whorton.

216 SYSTEMS PROGRAMMING Review of assembly language coding. Batch processing systems programs. IOCS buffer pool management, supervisors, loaders, utilities. Parallel processors, Interrupt handling, spooling. Introduction to multi-programming and time sharing. *Prerequisite:* 116 or equivalent. Three hours. Staff.

217 SWITCHING THEORY Lattices and Boolean algebras, Boolean func-

tions, minimization theory, Quine's algorithm, combinational and sequential logic nets, state assignment problems, Hartmanis' theorems, closure operators, Paull-Unger problems. *Prerequisite:* 251 or permission of instructor. Three hours. Mr. Hill.

218 AUTOMATA THEORY Finite state automata, nondeterministic and two-way automata, theorems of Rabin-Scott, Myhill and Kleene. Regular expressions, homomorphisms, the lattice of automata, free automata, isomorphism theorems. *Prerequisite:* 251. Three hours. Mr. Prather.

219, 220 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. *Prerequisites:* 102 or consent of instructor; 219 for 220. Three hours. Mr. Prather.

221 DETERMINISTIC MODELS IN OPERATIONS RESEARCH Techniques of linear and dynamic programming and game theory. Graphs and tree models. Classical problems are discussed, and problem formulation stressed. *Prerequisites:* 121, 124. Three hours. Mr. Prather.

222 STOCHASTIC MODELS IN OPERATIONS RESEARCH Stochastic processes and their use in analysis of industrial problems. Markov chains, queueing theory, linear and dynamic programming under uncertainty. *Prerequisites:* 203, or 207; 221. Three hours. Mr. Sylwester.

229 COMPUTER FACILITY MANAGEMENT Non-mathematical content, problems of technical administration, budget considerations, open-closed shop, equipment proliferation, interorganizational relationships. *Prerequisites:* 116 or permission of instructor. Two hours. Mr. Brock and Mr. Hill.

230 ORDINARY DIFFERENTIAL EQUATIONS Solutions of linear ordinary differential equations, the Laplace transformation, and series solutions of differential equations. *Prerequisites:* 121, 124. Three hours. Staff.

231, 232 FUNCTION 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. *Prerequisite:* 242; 231 for 232. Three hours. Staff.

233, 234 THEORY OF FUNCTIONS OF REAL VARIABLES Functions of

MATHEMATICS

real variables, including: point sets and measure, transfinite numbers, Riemann and Lebesgue integrals, and sequences of functions. Considerable outside reading is assigned. *Prerequisite:* 242; 233 for 234. Three hours. Staff.

235 PARTIAL DIFFERENTIAL EQUATIONS First order equations, classification of second order equations, standard problems of Laplace and Cauchy. *Prerequisites:* 230, 242. Three hours. Staff.

236 CALCULUS OF VARIATIONS Necessary conditions of Euler, Legendre, Weierstrass and Jacoby for minimizing integrals. Sufficiency proofs. Variation and eigenvalue problems. Hamilton-Jacoby equations. *Prerequisite:* 230. Three hours. Staff.

237 NUMERICAL METHODS I Concept of error, polynomial approximation, summation techniques, solution of equations, linear systems, eigenvalues. *Prerequisites:* 121 and 124. Three hours. Staff.

238 NUMERICAL METHODS II Finite differences, differentiation and integration, ordinary and partial differential equations, linear programming. *Prerequisite:* 237. Three hours. Staff.

239 INTEGRAL TRANSFORMS The theory of Fourier, Laplace, Hankel and Mellin transforms with applications to fluid dynamics, elasticity, physics. *Prerequisite:* 231. Three hours. Mr. Burgmeier.

240 OPERATIONAL MATHEMATICS Orthogonal functions, transforms and boundary value problems. *Prerequisite:* 230 or 271. Three hours. Mr. Dwork.

241, 242 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 recommended; 241 for 242. Three hours. Staff.

251 MODERN HIGHER ALGEBRA Fundamental concepts of Abstract Algebra. Sets, mappings, groups, rings, integral domains, fields, homomorphisms and isomorphisms. *Prerequisite:* 12; 102 highly desirable. Three hours. Staff.

252 ADVANCED LINEAR ALGEBRA Linear transformations and vector spaces, including Jordan forms. Symmetric, Hermitian, orthogonal and unitary matrices, and quadratic forms. *Prerequisite:* 124; 251 desirable. Three hours. Staff.

253, 254 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 or 242; 253 for 254. Three hours. Staff.

255 ELEMENTARY NUMBER THEORY Divisibility, prime numbers, Diophantine equations, congruence of numbers, and methods of solving congruences. *Prerequisite:* 121. Three hours. Staff.

256 ANALYTIC NUMBER THEORY Prime numbers, prime number theorem, interchange of summations, Euler phi function, Mobius function, Riemann zeta function. *Prerequisite:* 255, 232 desirable. Three hours. Mr. Brock.

257 THEORY OF GROUPS The study of the various kinds and structures of groups. *Prerequisite:* 251. Three hours. Staff.

258 GALOIS THEORY The study of Galois theory leading to the insolubility of general quintic equations by radicals and theorems on constructions with straightedge and compass. *Prerequisite:* 257. Three hours. Staff.

260 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. Messrs. Izzo, Meserve and Riggs.

261 THE DEVELOPMENT OF MATHEMATICS Besides considering important contributions of outstanding mathematicians of the past, and classical problems of mathematics, the historical development of the concepts of modern mathematics is presented. Three hours. Staff.

262 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 and Mr. Meserve.

263 PROJECTIVE AND AFFINE GEOMETRIES The principle of duality, perspectivity, projectivity, harmonic sets, cross ratio, the theorems of Pascal and Brianchon, poles and polars. *Prerequisite:* 124. Three hours. Staff.

264 VECTOR ANALYSIS Introduction to general vector methods including the elements of vector algebra and vector calculus with applications to physics and mechanics. *Prerequisite:* 121. Three hours. Staff.

265 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:* 121. Three hours. Staff.

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266 MATHEMATICS OF DIGITAL COMPUTATION FOR TEACHERS

Mathematical theory underlying digital computing machines including assigned problems on a university computer, including programming in a computer system language. A portion of the course is devoted to elementary numerical analysis. *Prerequisites:* 121, 124 highly desirable. Three hours. Staff.

271 APPLIED MATHEMATICS FOR ENGINEERS AND SCIENTISTS I

Matrix Theory, Vector Analysis, Linear Ordinary Differential Equations. Emphasis on methods of solution, including numerical methods. For a mathematics concentration, a sequence beginning with 230 is advised. *Prerequisites:* 123 and knowledge of computer system programming. Three hours. Staff.

272 APPLIED MATHEMATICS FOR ENGINEERS AND SCIENTISTS II

Partial Differential Equations of Mathematical Physics, Calculus of Variations, Functions of a Complex Variable, Cauchy's Theorem, integral formula, conformal mapping. *Prerequisite:* 271. Three hours. Staff.

281 SPECIAL TOPICS IN APPLIED MATHEMATICS For advanced students in the field of applied mathematics. Lectures, reports and directed readings on advanced topics in applied mathematics. *Prerequisite:* 232. Credit as arranged. Offered as occasion warrants. Staff.

283 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. *Prerequisite:* 216. Credit as arranged. Offered as occasion warrants. Staff.

285 SPECIAL TOPICS IN STATISTICS For advanced students in the field of statistics. Lectures, reports and directed readings on advanced topics in statistics. *Prerequisite:* Permission of department. Credit as arranged. Offered as occasion warrants. Staff.

287 SPECIAL TOPICS IN ALGEBRA For advanced students in the field of algebra. Lectures, reports and directed readings on advanced topics in algebra. *Prerequisites:* 251 and consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

289 SPECIAL TOPICS IN TOPOLOGY For advanced students in the field of topology. Lectures, reports and directed readings on advanced topics in topology. *Prerequisites:* 254 and consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

291 SPECIAL TOPICS IN GEOMETRY For advanced students in the field of geometry. Lectures, reports and directed readings on advanced topics in

geometry. *Prerequisites:* 263 or 265 and consent of instructor. Credit as arranged. Offered as occasion warrants. Staff.

293 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.

301 THEORY OF HYPOTHESIS TESTING AND ESTIMATION Confidence intervals, point estimation, Neyman-Pearson Theory of testing hypotheses, sufficient statistics, decision theory. *Prerequisites:* 205, 208. Three hours. Mr. Sylwester.

303 ADVANCED DESIGN I Theory of factorial arrangements of treatments, general two-way classification, confounding of factorial effects, fractional replication, confounding in mixed series of factorials, randomization tests, transformations of data, split-plot techniques, and analysis of covariance. *Prerequisite:* 313. Three hours. Mr. Bee.

305 MULTIVARIATE ANALYSIS Theory of multivariate normal distribution, simple, partial, and multiple correlation, multivariate sampling distributions. Wishart distribution, T^2 distribution, estimation of parameters, and tests of hypotheses on vector means and covariance matrix. Classification problems, discriminate analysis and applications. *Prerequisites:* 211, 308. Three hours. Mr. Whorton.

306 REGRESSION ANALYSIS Linear, non-linear, and multiple regression. Statistical model building, examination of residuals, application to analysis of variance, and computing algorithms. *Prerequisite:* 201, 205. Three hours. Mr. Hill and Miss Lamborn.

308 DISTRIBUTION THEORY Continuous, discrete and mixed random variables, Beta, Gamma, and waiting-time distributions, moments, cumulants, characteristic and generating functions. Theory of runs and order statistics, quadratic forms and distribution free statistics. *Prerequisite:* 205. Three hours. Mr. Bee.

309 NON-PARAMETRIC STATISTICAL ANALYSIS Non-parametric procedures including tests based on ranks, permutation tests, asymptotic relative efficiency, and locally most powerful tests. *Prerequisite:* 205. Three hours. Mr. Sylwester.

313 THEORY OF LINEAR STATISTICAL MODELS Non-central chi-square and F distributions, Markoff theorem, general linear hypothesis of full rank and

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less than full rank, experimental design models, and variance components. *Prerequisites:* 205, 206. Three hours. Mr. Bee.

314 MEASURE THEORY Sets and classes, inner and outer measure, Lebesgue-Stieltjes measure, measurable functions, absolute continuity, Radon-Nikodym theorem, and applications in theoretical probability. *Prerequisite:* 242. Three hours. Miss Lamborn.

315 ADVANCED SYSTEMS PROGRAMMING I Multiprogramming operating systems. Addressing techniques, paging, core management, file system design and management system accounting. Design of system modules and interfaces. System updating and documentation. *Prerequisite:* 216. Three hours. Mr. Hill.

316 ADVANCED SYSTEMS PROGRAMMING II Teleprocessing based systems. Time sharing. Roll in roll out systems. Multiprogramming time sliced systems. Communications methods. Multi-computer systems vs. single machine techniques. Virtual memory concept and virtual machine operating systems. *Prerequisite:* 315. Three hours. Mr. Hill.

321 RECURSIVE FUNCTION THEORY Recursive functions and effective computability, Turing machines, Church's thesis, unsolvability, Godel numbering, recursive and recursively enumerable sets, Post's correspondence theorem; universality, enumeration, and iteration theorems. *Prerequisite:* 218 or 219. Three hours. Mr. Prather.

325 ADVANCED AUTOMATA THEORY Algebraic structure theory of automata, monoids and automata; homomorphisms, simulation and realization. The semigroup of an automata, decomposition theory of Hartmanis-Stearns, Krohn-Rhodes theorem, categories of automata, abstract automata. *Prerequisite:* 218. Three hours. Mr. Prather.

326, 327 COMBINATORIAL THEORY Permutations and combinations, Mobius inversion theorem, inclusion-exclusion principle, generating functions, Polya's counting theorem, graphs, Latin square configurations, finite geometries, block designs. *Prerequisites:* 256, 326 for 327. Three hours. Mr. Brock.

331 FOURIER ANALYSIS Trigonometric series, orthogonal polynomials, convergence properties, boundary value problems, applications. *Prerequisite:* 234. Three hours. Mr. Cooke.

332 APPROXIMATION THEORY Interpolation and approximation by interpolation, uniform approximation, approximation in normed linear spaces, spline functions, orthogonal polynomials. Least squares, Chebychev approximations, rational functions. *Prerequisites:* 124, 238. Three hours. Staff.

333, 334 INTEGRAL EQUATIONS Resolvent kernels for Volterra and Fredholm integral equations, elements of Hilbert spaces, the Fredholm alternative, symmetric kernels, eigenvalues and eigenfunctions, Hilbert-Schmidt theory, Mercer's theorem, numerical techniques. *Prerequisites:* 242, 232 and 234 desirable; 333 for 334 or consent of instructor. Three hours. Mr. Burgmeier.

335, 336 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, 335 for 336. Three hours. Mr. Dwork.

337, 338 NUMERICAL ANALYSIS Initial value and boundary value problems for systems of non-linear ordinary differential equations, convergence and stability of computational procedures. Analysis of partial differential equations, boundary value problems, iterative methods. Analysis of methods for obtaining eigenvalues and matrix inverses, pseudo inverses. *Prerequisite:* 238, 332 desirable; 337 for 338 or consent of instructor. Three hours. Mr. Brock and Mr. Riggs.

340 ADVANCED OPTIMIZATION TECHNIQUES Modern invariant imbedding techniques are explored. General linear boundary value problems are studied using Riccati transformations. Quasi-linearization and linear functional equations are among advanced modern mathematical topics discussed. Applications and problems formulation are stressed. *Prerequisites:* 230; 237 and 238 desirable. Three hours. Mr. Burgmeier.

351, 352 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. *Prerequisites:* 252, 351 for 352. Three hours. Mr. Wright.

391 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.

437, 438 ADVANCED ORDINARY DIFFERENTIAL EQUATIONS Existence theorems, uniqueness and continuation of solutions, dependence of solutions on a parameter. Linear systems, regular and irregular singular points, Sturm-Liouville systems, asymptotic behavior, Lyapunov stability, periodic solutions, multidimensional systems. *Prerequisite:* 230; 437 for 438, or consent of instructor. Three hours. Mr. Chamberlain and Mr. Wright.

MATHEMATICS

439 ASYMPTOTIC THEORY OF ANALYTIC ORDINARY DIFFERENTIAL EQUATIONS I Asymptotic order and equivalence relations, logarithmic monomials and classes of comparison functions, coefficient domains, Bank's algorithm for asymptotic solutions of quasi-logarithmic type, existence and uniqueness theorems for exact solutions of quasi-logarithmic type, approximate and exact factorizations of linear differential equations. *Prerequisites:* 230, 232. Three hours. Mr. Wright.

440 ASYMPTOTIC THEORY OF ANALYTIC ORDINARY DIFFERENTIAL EQUATIONS II Quasi-logarithmic coefficient fields, generalized asymptotic expansions, Strodt's structure theorem for asymptotically non singular solutions, quasilinearization procedures. *Prerequisite:* 439. Three hours. Mr. Wright.

445, 446 MATHEMATICAL PHYSICS Investigation of basic equations of mathematical physics, Schroedinger, Maxwell, Poisson. General orthogonal coordinate systems, dyads, mathematical structure of Quantum theory. *Prerequisites:* 232, 235. Three hours. Mr. Dwork.

447, 448 GENERALIZED FUNCTIONS Modern extensions to theory of distributions, delta functionals, countably Hilbert spaces, applications to transform theory and ordinary and partial differential equations. *Prerequisite:* 234, 336 desirable; 447 for 448, or consent of instructor. Three hours. Mr. Dwork.

491 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.

Undergraduate courses:

- | | |
|---|---|
| 2 Plane Trigonometry | 102 Fundamental Concepts of Mathematical Analysis |
| 4 Mathematics of Finance | 110 Elementary Statistics |
| 7, 8 Fundamentals of Mathematics | 115, 116 Introduction to Computing I, II |
| 9 College Algebra | 121 Sophomore Mathematics |
| 11 Plane Analytic Geometry and Calculus | 124 Linear Algebra |
| 12 Analytic Geometry and Calculus | 125, 126 Elementary School Mathematics |

Extension courses:

A360 LINEAR ANALYSIS WITH NUMERICAL METHODS An accelerated presentation of the ideas and tools of linear algebra including vector spaces, linear transformations, linear functionals, the representation theorem and spectral theory. In addition, numerical techniques which are of importance in the

application of linear algebraic methods, e.g. matrix inversion, polynomial curve fitting and numerical solutions of differential equations are introduced. *Prerequisite:* 123. Three hours. Staff.

• MECHANICAL ENGINEERING

Professors von Turkovich (Chairman), Berry, Outwater, and Tuthill; Associate Professors Carpenter, Duchacek, Hundal, Marshall, Martinek, and McLay; Assistant Professor Black; Engineer Ettlinger; Adjunct Professor Zubko.

Master of Science and Doctor of Philosophy programs are offered. Candidates holding degrees other than those in Mechanical Engineering are encouraged to apply. In such cases it may be necessary for the student to complete the 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 interest include brittle materials; fracture mechanics of composite materials; two-phase fluid flow; thermal system transients; shell structural analysis; non-linear vibrations; condensation heat transfer; biomechanics; stability of fluid jets; radiative heat transfer; matrix methods in structural mechanics; design of castings.

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

An accredited Bachelor's Degree in Mechanical Engineering or its equivalent.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Approved courses in engineering, mathematics and sciences with thesis research; thirty credit hours.

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

Successful completion of the Ph.D. comprehensive written examinations.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

At least 50 credit hours must be earned in courses and seminars and a minimum of 33 credit hours must be earned in thesis research. Each candidate must be

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able to comprehend the literature of his field in at least one foreign language provided it is required for his thesis work. The requirements specified under Regulations of the Graduate College must also be met.

COURSES OFFERED

202 DYNAMICS II Advanced topics in dynamics of particles and systems of particles. Space motion in fixed and moving frames of reference. Impulse and momentum. Central force motion. Kinematics and kinetics of rigid bodies. Euler's equations of motion. Gyroscopic effects in mechanical systems. *Prerequisite:* 133. Three hours. Mr. Hundal.

203 MECHANICAL VIBRATIONS Vibration phenomena in single and multi-degree of freedom systems. Response of systems to periodic and transient excitation. Isolation of shock and vibration. Impedance; matrix and numerical methods for vibration problems. Three hours. Mr. Hundal.

204 SYSTEMS ANALYSIS Lumped parameter and distributed-parameter systems analysis of mechanical, thermal, hydraulic, pneumatic, and electro-mechanical systems; system response to periodic, transient and random excitation. Three hours. Staff.

206 APPLICATION OF COMPUTERS IN ENGINEERING Utilization of analog, digital and hybrid computers as an engineering tool for the solution of complex engineering problems. Four hours. Mr. Hundal.

211 ADVANCED MECHANICAL STRUCTURES I Statically indeterminate problems in bending; general expression of strain energy; theorem of Castigliano and the unit load method; theory of curved beams; beams on elastic foundations; unsymmetrical bending; torsion of thin sections. Three hours. Mr. McLay.

222 ADVANCED MECHANICAL STRUCTURES II Theory and applications of the force, and displacement matrix methods of analysis; basic theory of elasticity including analysis of stress, the equilibrium equations; analysis of strain, the compatibility equations, and generalized Hook's law, introduction to plasticity; problems of plane stress and plane strain; finite differences and variational methods. Three hours. Mr. McLay.

231 MATERIALS PROCESSING II Fundamentals of forming from liquid state, plastics forming, metal joining, powder metallurgy. *Prerequisite:* 113, C. E. 100. Three hours. Mr. Berry.

233 STATISTICAL TECHNIQUES IN MANUFACTURING Quality control engineering methods including correlation, variance and time series analysis.

Principles of experimental design and operations research in manufacturing. *Prerequisites:* 53 or 131, Math 200. Three hours. Mr. Black.

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. *Prerequisite:* 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 **ENGINEERING DESIGN II** Application of the principles of kinematics, dynamics, strength of material, fluid mechanics and thermodynamics to the design of mechanical systems and their components; application of computers to design; design optimization; group projects in design; construction and evaluation. *Prerequisite:* ME 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. 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 271. 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 271. Three hours. Mr. Tuthill.

271 **INDUSTRIAL MATERIALS II** The composition, structure, mechanics and fabrication of polymeric materials. The mechanism of adhesion. De-

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formational mechanics of crystalline materials. *Prerequisite:* 171. 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. Three hours. Mr. Outwater.

281 SEMINAR Presentation and discussion of advanced mechanical engineering problems and current developments. *Prerequisite:* 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 in the design analysis and synthesis of engineering systems and their components. Four hours. Staff.

297 NUCLEAR ENGINEERING Neutron chain reactions and the criticality condition; the slowing down of neutrons in an infinite medium; one-speed diffusion of neutrons in multiplying and non-multiplying systems; combined slowing down and diffusion; bare and reflected homogeneous reactors; in the design, analysis and synthesis of engineering systems and their components. Four hours. Staff.

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. Staff.

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. Mr. McLay.

303 STRESS ANALYSIS (THEORY AND EXPERIMENT) Theory and experimental method for measuring static and dynamic stress and strain including the use of piezoelectric materials; wire resistance strain gages; mechanical, optical, inductance and capacitance displacement gages; photoelasticity; brittle coating; x-rays and associated instrumentation and recording systems; theory of plasticity; methods of elastic-plastic analysis, plastic design of structures, plates and shells. *Prerequisite:* Graduate Standing in ME. Three hours. Mr. McLay.

306 CONTINUUM MECHANICS A unified treatment of those topics which are common to solid and fluid continua; general discussion of tensors; deformation, strain, rates of deformation and strain; conservation laws; mass, momentum and energy; laws of motion; constitutive equations of mechanics for fluids, elastic and hyperelastic solids including materials with memory. *Prerequisite:* Graduate Standing in ME. Three hours. Mr. Martinek.

307 ADVANCED FLUID DYNAMICS Integrated development of equations of continuity, momentum and energy for fluid particles and control volumes; viscous flow theory; stress and rate of deformation tensors; Navier-Stokes equations and its applications; boundary layer theory; turbulence; flow about immersed bodies and in closed conduits; theory of fluid amplifiers and computers. *Prerequisite:* Graduate Standing in ME. Four hours. Mr. Martinek.

308 ADVANCED DYNAMICS Fundamental principles of kinematics and dynamics; motion of systems with several degrees of freedom; rotating and accelerating frames of reference; energy methods; variational principles; LaGrange's and Hamilton's equations; gyroscopes and their application; vibration and stability of systems; non-linear vibration and dynamics of structures; Liapunov's method. *Prerequisite:* Graduate Standing in ME. Three hours. Mr. Hundal.

309 ADVANCED ENGINEERING THERMODYNAMICS A rigorous and general treatment of the first law of thermodynamics for a system and control volume with applications to steady and transient problems involving fluid flow and heat transfer; application of the first law to chemical reactions; the second law of thermodynamics for a system and control volume and its application; entropy production and the concept of availability; irreversible thermodynamics and its application; phase equilibrium; equation of state; transfer phenomena; relation between statistical mechanics and thermodynamics; canonical equations; Liouville's Theorem, ensembles; partition function, statistical thermodynamics, the third law of thermodynamics; equilibrium in a gas with charged particles; equilibrium of multicomponent systems; metastability. *Prerequisite:* Graduate Standing in ME. Three hours. Mr. Martinek.

MECHANICAL ENGINEERING

310 ADVANCED HEAT TRANSFER Generalized equation of heat conduction including heat generation, moving boundaries; solution of the heat conduction equation for various geometries and boundary conditions; numerical methods; thermal boundary layer phenomena in forced and natural convection; dimensional analysis; application of convective heat transfer to engineering problems; aerodynamic heating; heat transfer in rarified gases; condensation; boiling; transpiration and ablative cooling; heat exchange by radiation; interchange factors in radiation. *Prerequisite:* Graduate Standing in ME. Three hours. Mr. Martinek.

311 ADVANCED GAS DYNAMICS Analysis of compressible flow in ducts with area change, friction and heat transfer; shock waves; oblique shock; two and three-dimensional compressible flow; small perturbation theory; similarity in high speed flow; transonic and supersonic flow; method of characteristics. *Prerequisite:* Graduate Standing in ME. Three hours. Mr. Martinek.

320 SPECIAL PROBLEMS IN ELASTICITY Advanced topics in the theory of elasticity in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

321 SPECIAL PROBLEMS IN FLUID MECHANICS Advanced topics in fluid mechanics in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

322 SPECIAL PROBLEMS IN DYNAMICS Advanced topics in dynamics in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

323 SPECIAL PROBLEMS IN THERMODYNAMICS Advanced topics in thermodynamics in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

324 SPECIAL PROBLEMS IN HEAT TRANSFER Advanced topics in heat transfer in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

325 SPECIAL PROBLEMS IN MATERIALS Advanced topics in behavior of materials in which there is a particular student and staff interest. *Prerequisite:* Graduate Standing in ME. Three hours. Staff.

330 MATRIX METHODS IN STRUCTURAL DYNAMICS Introduction to matrix methods of structures and Lagrange's equations; natural vibration of structures with many degrees-of-freedom; application of variational methods, differential and integral equations; study of damping; introduction to frequency

MEDICAL MICROBIOLOGY

response and random excitation; advanced computing methods. *Prerequisite:* ME 203. Three hours. Mr. McLay.

340 ELECTRON MICROSCOPY An introduction into the basics of electron microscopy designed to enable the student to understand the operations and care of electron microscopes, electron optics, the physical principles involved in the operation and care of an electron microscope, the associated techniques of specimen preparation and interpretation of electron micrographs. *Prerequisites:* Graduate standing and consent of instructor. Four hours. Mr. Black.

391 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 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, 2 Engineering Graphics	131 Materials Processing I
53 Manufacturing Processes	133 Dynamics I
73 Creative Design	135 Engineering Design I
84 Mechanical Instrumentation	137 Systems Control
92 Thermodynamics I	142 Fluid Mechanics
111 Thermodynamics II	164 Environmental Engineering
113 Thermodynamics and Heat Transfer	171 Industrial Materials I
115 Thermodynamics	174 Industrial Engineering
117 Mechanical Engineering Laboratory	175 Methods Engineering
	176 Plant Organization

• MEDICAL MICROBIOLOGY

Professor Stineberg (Chairman); Professors Merchant and Smith; Associate Professor Phillips, Schaeffer; Assistant Professors Absher, Boraker, Gallagher, Moehring, Novotny.

Research activities include: host-parasite interactions with emphasis on cellular and molecular aspects of mechanisms of pathogenesis; non-antibody resistance mechanisms especially concerning production, storage, and mode of action of interferon; studies of etiology of chronic respiratory diseases; antimicrobial effects of lysosomal components; transplantation immunity and immuno-

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genetics; mechanisms of transmission of bacterial DNA; studies of rubella, respiratory syncytial, and other viruses.

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

Two years of biological science; mathematics through elementary calculus (Mathematics 12 equivalent); one year course in physics (Physics 5 and 6 equivalent); chemistry including one year of inorganic chemistry, quantitative analysis and one year of organic chemistry (equivalent of Chemistry 1, 2, 123, 131, 132). Chemistry 140 (Physical Chemistry for Biological Science Students) would be helpful but is not required.

MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 302, 381-384, Thesis Research; approved selected course or courses from among Medical Microbiology 203, 211, 322, a course in biochemistry from among Microbiology and Biochemistry 201-250, 254, or Biochemistry 301-302, 303-304 with approval of the Department; passage of a comprehensive examination in Medical Microbiology and related subjects.

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

* This program offered jointly with Department of Microbiology and Biochemistry.

Two years of biology; chemistry through physical chemistry (equivalent to Chemistry 1, 2, 123, 131, 132, 141, and 144); mathematics through calculus; additional courses required by the Department depending on the aims of the student.

MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 302; participation in seminars offered by the Department during residency of students; Biochemistry 301-302, 303; Microbiology and Biochemistry 254; approved selected courses from programs in Medical Microbiology, Biochemistry, Physiology and Biophysics, Botany and Zoology or others at the discretion of the Department.

The student is expected to develop proficiency in the use of computer language and programming. There is no other formal language requirement. Knowledge of a particular language may be required by the candidate's Studies Committee if his research problem warrants this decision.

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

COURSES OFFERED

203 THE MAMMALIAN CELL AS A MICROORGANISM Discussion of such current ideas in cell biology as cell immortality, transformation, dedifferentiation, synchronization, cell-macromolecule interaction; laboratory will illustrate current cell culture techniques as a foundation for the lectures. Designed for biology students of varied training. Four hours. Mr. Merchant, Mr. Moehring, Mr. Schaeffer, and Mr. Stinebring.

205 PATHOGENIC BACTERIOLOGY Studies of major species of pathogenic bacteria with emphasis on mechanisms of disease production, epidemiology, control measures, and diagnosis. Designed for advanced undergraduate or graduate students interested in phenomenon of parasitism. *Prerequisite:* permission of the instructor. Three hours. Mrs. Absher and Mr. Stinebring. Alternate years, Spring 1972.

211 GENETICS OF MICROORGANISMS Studies of mutation, genetic information transfer, fine structure of the gene, cytoplasmic inheritance, and lysogeny in fungi, bacteria, and viruses. *Prerequisite:* permission of the Instructor. Three hours. Dr. Novotny.

302 MEDICAL MICROBIOLOGY Fundamentals of pathogenic microbiology with emphasis on mechanisms of disease production and mechanisms of resistance to infection. The ecologic rather than taxonomic approach is stressed. *Prerequisite:* permission of the Department. Four hours. Staff.

303 SPECIAL PROBLEMS IN MEDICAL MICROBIOLOGY Supervised investigations in pathogenic microbiology. Credit as arranged. Staff.

323 IMMUNOLOGY Analysis of the immune response with respect to structure and function of immunoglobulins, cytokinetics and immunocompetence, tolerance, ontogeny and phylogeny of adaptive immunity, immunogenetics of transplantation, hypersensitivity states, and theories of antibody formation. *Prerequisites:* Consent of the instructor. Three hours. Mr. Boraker. Alternate years, 1970-71.

324 MEDICAL MYCOLOGY Lectures concerned with the etiology, epidemiology, pathogenesis, immunology, therapy and prognosis of the medical mycoses. Laboratory exercises devoted to the isolation, cultivation, and identification of actinomycetes, yeasts and molds. *Prerequisites:* Consent of the instructor. Four hours. Mr. A. Smith. Alternate years, 1970-71.

MEDICAL TECHNOLOGY

325 VIROLOGY Introduction to the nature of viruses, their physical, chemical, and biological characteristics with special reference to cell-virus interaction, viral replication, pathogenesis, viral inhibitors, and oncogenic viruses. *Prerequisites:* Consent of instructor. Four hours. Mr. Gallagher. Alternate years, 1970-71.

375 CELL CULTURE FOR STUDY OF CELLULAR AGING Principles of cell culture with special emphasis on cellular aging and the relation to organismic aging. *Prerequisite:* Permission of Department Chairman (Medical Microbiology). Three hours. W. Alton Jones Cell Science Center, Lake Placid, N. Y. June 21-July 9, 1971. Mr. Merchant & Staff.

376 PLANT CELL, TISSUE, AND ORGAN CULTURE Principles of plant cell, tissue, and organ culture including practical basic techniques necessary for *in vitro* studies. *Prerequisite:* Permission of Department Chairman (Medical Microbiology). Three hours. W. Alton Jones Cell Science Center, Lake Placid, N. Y. July 12-August 6, 1971. Mr. Merchant & Staff.

377 VERTEBRATE AND INVERTEBRATE CELL CULTURE Fundamentals of vertebrate and invertebrate cell culture techniques and theory. The course is designed for post graduate students interested in research or teaching utilizing *in vitro* techniques. *Prerequisite:* Permission of Department Chairman (Medical Microbiology). Three hours. W. Alton Jones Cell Science Center, Lake Placid, N. Y. August 9-September 3, 1971. Mr. Merchant & Staff.

378 ORGAN CULTURE Basic and advanced techniques of cultivation of vertebrate organs *in vitro*. Designed for post doctoral students who plan to do research or teach in appropriate areas. *Prerequisite:* Permission of Department Chairman (Medical Microbiology). Three hours. W. Alton Jones Cell Center, Lake Placid, N. Y. September 27-October 8, 1971. Mr. Merchant & Staff.

381 SEMINAR Current problems in medical microbiology. One hour. Staff.

391 MASTER'S THESIS RESEARCH Supervised research leading to acceptable thesis. Credit as arranged.

491 DOCTORAL THESIS RESEARCH Original research leading to acceptable doctoral dissertation. Credit as arranged.

• MEDICAL TECHNOLOGY

Professor Coon, Director of Program (Chairman, Department of Pathology); members of Pathology staff; Assistant Professors Breen, Jones; Instructors Barron, Kleiler and Sullivan.

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. GRE Aptitude Score required.

MINIMUM DEGREE REQUIREMENTS

Seminar; additional approved courses in areas including Biochemistry, Microbiology, Administrative and Educational Aspects of Medical Technology; thesis research.

381 SEMINAR Review and discussion of current areas of importance to students in Medical Technology. The seminar will emphasize Administration, Clinical Pathophysiology, Education, and Instrumentation. Selected topics are presented by the student with occasional supplemental discussions led by faculty members or guests. One hour. Dr. Coon.

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

• MICROBIOLOGY AND BIOCHEMISTRY

Professors Johnstone, Little and Racusen (Chairman); Associate Professors Foote, Sjogren and Weller; Instructor Husted.

Research currently involves the identification and metabolism of leaf proteins, the isolation and characterization of ribosomes from a variety of cell types, the synthesis and regulation of certain isozymes in the glyoxylate bypass of fungi, and the role of microorganisms in aquatic environments. The latter is in collaboration with the Lake Champlain Studies Center.

BIOCHEMISTRY PROGRAM

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.

MICROBIOLOGY AND BIOCHEMISTRY

MINIMUM DEGREE REQUIREMENTS

Microbiology and Biochemistry 201, 202, 203, 381-384; thesis research (12-15 hours).

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, a reading knowledge of one foreign language, French, German or Russian, and the Ph.D. candidacy requirements of the Graduate College. See similar program under Biochemistry (Medical).

MINIMUM DEGREE REQUIREMENTS

Biochemistry 301, 302, 303; 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 Microbiology and Biochemistry; and doctoral thesis research (30 hours).

MICROBIOLOGY PROGRAM

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

Microbiology and Biochemistry 254; Medical Microbiology 302, 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*

* Program offered jointly with Medical Microbiology.

One year of organic chemistry and biology and sufficient mathematics and physics to provide background for the candidate's program, a reading knowledge of one foreign language French, German or Russian, and the Ph.D. candidacy requirements of the Graduate College.

MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 302; Microbiology and Biochemistry 254; the balance of courses from Medical Microbiology, Microbiology and Biochemistry, Biochemistry, Botany and Zoology according to student's need as determined by a studies committee; participation in microbiology seminars throughout residency; doctoral thesis research twenty to thirty-five hours.

COURSES OFFERED

201 GENERAL BIOCHEMISTRY Broad coverage of fundamentals of biochemistry including the chemistry of carbohydrates, proteins, lipids, vitamins, enzymes, and hormones and their relation to processes of biological significance. Basic principles of analytical procedures in biochemical methods. *Prerequisite:* Chemistry 16 or 131. Four hours. Mr. Foote.

202 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 Microbiology and Biochemistry 201 (General Biochemistry), or 203 (Molecular Biology), the combined sequence providing a base for graduate research in biochemistry and related fields. *Prerequisite:* 201 or permission of instructor. Four hours. Mr. Racusen.

203 MOLECULAR BIOLOGY The structure and biological function of nucleic acids and proteins. Emphasis is on basic principles of instrumentation, physical methods, and analytical procedures. *Prerequisite:* Chemistry 142 or permission of instructor. Four hours. M. Weller.

220 ENVIRONMENTAL MICROBIOLOGY An advanced course dealing with the activities and role of microorganisms, primarily bacteria, in the specialized habitats of air, soil, and water. The influence of the cells upon their environment and the effect of the environmental conditions on metabolism will be emphasized. *Prerequisite:* a previous course in microbiology or bacteriology. Three hours. Offered alternate years. Mr. Johnstone.

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. Four hours. Offered alternate years, 1972-73. Mr. Sjogren.

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

MUSIC

381 SEMINAR A topical seminar with discussion of assigned and collateral reading. Required of graduate students. One hour.

391 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 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.

Undergraduate courses:

55 Introductory Microbiology

197, 198 Senior Research

• MUSIC

Professors Lidral (Chairman) and Pappoutsakis; Associate Professors Chapman, D. Kinsey and Schultz; Assistant Professors T. Read, Weinrich, and Wigness; Instructors Ambrose, Anand, Auchter, Dahl, Dorsam, Fleming, Hartman, F. Kinsey, Metcalfe, Peterson, Powell, and E. Read.

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 musicology, 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 on an instrument or voice; satisfactory scores on the aptitude and advanced music sections of the Graduate Record Examination.

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. 23. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for the MAT degree.

COURSES OFFERED

203, 204 ORCHESTRATION First semester: 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, 1971-72.

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, 1971-72.

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.

208 FORM AND ANALYSIS Creative approach to aural and sight analysis of musical construction. *Prerequisites:* 105-106; 205 recommended. Three hours. Mr. Kinsey.

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 may conduct university major ensembles. *Prerequisites:* 5-6; 211 for 212. Three hours. Mr. Pappoutsakis. 212 in alternate years, 1972-73.

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. May be repeated for credit. Three hours. Mr. 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. Chapman.

223 through 228 MUSIC LITERATURE Advanced studies in the literature of music. *Prerequisites:* 105-106 and 221, 222. Three hours. Mr. Chapman.

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 performance field and consent of instructor. May be repeated for credit. One hour. Staff.

271, 272 PERFORMANCE 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. Two hours. Staff.

PATHOLOGY

281 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.

301 PROSEMINAR IN MUSICOLOGY A study of the tools and methods of musical bibliography, including the critical and effective use of such materials. *Prerequisites:* 205, 208, 221, 222. Three hours. Mr. Chapman.

302 SEMINAR IN MUSICOLOGY Discussion of the bibliographic tools and methods covered in 301 in relation to the major areas of historical musicology; problems in musical research; introduction to musical paleography. *Prerequisite:* 301. Three hours. Mr. Chapman.

351, 352 ADVANCED PERFORMANCE STUDY Individual instruction in keyboard instruments, voice, strings, woodwinds, brass, percussion, and harp leading to public recital performance. *Prerequisite:* Graduate standing in performance field. May be repeated for credit. One or two hours. Staff.

381 SEMINAR Study of special topics appropriate to student needs. One hour. Mr. Kinsey.

391 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	51, 52 Performance Study
5-6 Theory I	71, 72 Class Performance Study
9, 10 Introductory Music	74 Instrument Repair Class
13 Contemporary Music	105-106 Theory II
14 Jazz Literature	193, 194 College Honors
41, 42 Major Ensembles	195, 196 Special Topics
45, 46 Chamber Music	197, 198 Reading and Research

• PATHOLOGY

Professors Coon (Chairman), Andrews, Craighead, Korson, Kusserow, and Luginbuhl; Associate Professors Clemmons, Duffell, Picoff, Rice, Stark, Taylor, and Trainer; Assistant Professors Harris, Howard, Kanich, Kaye and Tihen.

Research interests are in the fields of anatomic, clinical, and experimental pathology. Current studies include histochemistry, extracorporeal heart pumps, problems in blood flow, connective tissue pathology and biochemistry, electron microscopy, neoplasia, neuropathology, immunopathology, and virology.

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 (11 hours), Medical Microbiology 201 (4 hours), additional approved courses; thesis research (6-15 hours). This program is open only to those persons who have or are pursuing an M.D. Degree.

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. Eight hours. Staff.

310 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.

320 FUNDAMENTAL ASPECTS OF CELL AND TISSUE PATHOLOGY An in-depth survey of the mechanisms of inflammation and tissue repair; disorders of cell metabolism; coagulation phenomena; growth including neoplasia; and immune responses. *Prerequisites:* General Biochemistry (201 or equivalent); Zoology 112 or Anatomy 311 or equivalent; Zoology 231 or physiology 301 or equivalent. Immunology 323 is desirable. Four hours. Course limited to 10 students. Drs. Clemmons, Craighead, Duffell, Korson, Kusserow and Staff.

391 MASTER'S THESIS RESEARCH Investigation of a research topic under

PHARMACOLOGY

the direction of an assigned staff member, culminating in an acceptable thesis. Credit as arranged. Staff.

• PHARMACOLOGY

Professors Gans, Jaffe, Macmillan and Smith (Chairman); Associate Professors Doremus, Gray, McCormack, Reit and Robinson; Visiting Professor Maxwell.

Research interests of the staff cover the following areas: biochemical mechanisms involved in the action of anti-protozoal, anti-helminthic and anti-neoplastic drugs; regulation of steroid and lipoprotein metabolism; synthesis, physicochemical properties and structure-activity relationships of biologically-active nitrogen heterocyclic compounds; synthesis, chemical properties, and pharmacological actions of drugs affecting the cardiovascular and nervous systems; effect of drugs in preventing abnormalities in young rats born of psychologically stressed mothers; functions of neurohumoral substances in synaptic transmission and microcirculatory regulation. A program of clinical pharmacology is operated in cooperation with the Department of Medicine: pharmacotherapy of depressive illness and interactions between warfarin and concurrently administered drugs.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREES OF MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY

Year courses in Biology, Organic Chemistry, Physics, Analytic Geometry and Calculus; Physical Chemistry; a reading knowledge of one, two or no foreign languages, depending on the requirements of the research supervisor; satisfactory scores on verbal, quantitative and advanced sections of the Graduate Record Examination.

MINIMUM REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE

Pharmacology 301, 381, 382; supporting courses in Biochemistry and Physiology; master's thesis research (6-15 hours).

MINIMUM REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE

Physiology and Biophysics 301; Biochemistry 301, 302, 303, Pharmacology 301; 381 through 384; advanced courses in Pharmacology; Biometrics and Applied Statistics; doctoral thesis research (20-30 hours).

COURSES OFFRED

301 MEDICAL PHARMACOLOGY The chemical and biological properties of drugs. Lectures, demonstrations and laboratory exercises. *Prerequisite:* permission of the department. Six hours. Staff.

328 INTRODUCTION TO MEDICINAL CHEMISTRY Important classes of drugs are surveyed. Strong emphasis is placed on relationships between physiochemical properties and pharmacologic activity; synthetic aspects are considered. *Prerequisite:* Chemistry 131-132. Open to undergraduates with permission of the instructors. Two hours. Drs. Gray and McCormack.

372 SPECIAL TOPICS Topics of current interest and importance in pharmacology are considered in depth through presentations by staff and visiting scientists. *Prerequisite:* Permission of the department. One hour. Staff.

381 SEMINAR General and specific consideration of current developments and research in pharmacology are presented for discussion by students. *Prerequisite:* permission of the department. One hour. Staff.

391 MASTER'S THESIS RESEARCH Independent investigation under the direction of a staff member, culminating in an acceptable thesis. Credit as arranged.

491 DOCTORAL THESIS RESEARCH Original research under the direction of a staff member culminating in an acceptable doctoral dissertation. Credit as arranged.

• PHILOSOPHY AND RELIGION

*Professors Hall (Chairman), and Sadler; Assistant Professors Beckett, Martin, Miller, Paden, Rice, Sobers and Yarian; Instructors Anderson, Andrews, Brenne-
man, Ford, Gussner and Paskow.*

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, 1972-73. 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, 1972-73. Mr. Beckett.

204 THEORY OF KNOWLEDGE A study of basic concepts and problems involved in explaining the possibility of human knowledge. Topics such as sense perception, memory, truth, necessity, knowledge and belief, and the possibility and limit of human knowledge will be considered. Three hours. Mr. Rice. Alternate years, 1972-73.

206 SOCIAL PHILOSOPHY The meaning and values inherent in social life. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1972-73. Mr. Anderson.

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, 1971-72. 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, 1971-72. Mr. Sobers.

209 AMERICAN PHILOSOPHY The thought of such leading American philosophers as Royce, Peirce, James, Santayana, and Dewey and Whitehead. *Pre-*

PHILOSOPHY AND RELIGION

requisites: Two advanced courses in philosophy. Three hours. Alternate years, 1971-72. Mr. Miller.

211 NINETEENTH-CENTURY PHILOSOPHY A systematic analysis of the contributions to philosophical thought of such thinkers as Fichte, Schelling, Hegel, Schopenhauer, Nietzsche, Mill, Kierkegaard, Dilthey, and Marx. *Prerequisites:* Two advanced courses in philosophy. Three hours. Alternate years, 1970-71. Staff.

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. Staff.

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. Staff.

281 SEMINAR Selected topics in philosophy, determined according to the interest of students and instructor. *Prerequisites:* Two advanced courses in philosophy. Three hours. Staff.

391 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

3 Logic	152 Philosophy of the Arts
4 Ethics	153 Philosophy of Science
5 Intro. to Philosophical Problems	154 Philosophy of Religion
21, 22 Introduction to Philosophy	175 Chinese Religion and Thought
101, 102 History of Philosophy	181 Symbolic Logic
105 Contemporary Philosophic Thought	201 Theory and Method
151 Philosophy and Literature (alternate years)	281, 282 Problems in the History and Phenomenology of Religion

RELIGION

No Master's Degree Program Offered

201 THEORY AND METHOD Critical examination of some of the major theories and methods used in studying and interpreting religion. *Prerequisite:* nine hours in religion; junior standing. Three hours. Mr. Paden.

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281 PROBLEMS IN THE HISTORY AND PHENOMENOLOGY OF RELIGION Topics of special concern to historians of religions. *Prerequisite:* nine hours in religion; junior standing. Three hours. Staff.

Undergraduate courses:

21, 22 Religions of the World	142 Post-Biblical Judaism
101 Religious Institutions and Communities	145 Primitive Christianity
112 Mysticism, Shamanism, and Possession	148 Hellenistic Religion
122 Myth, Symbol, and Ritual	161 Studies in the Hindu Tradition
131 'Primitive' Religions	171, 172 Japanese Religion
141 Hebrew Scriptures	182 Studies in Folk Religion
	187 Religion and Secular Culture
	297, 298 Interdisciplinary Seminar

• PHYSICS

Professors Crowell (Chairman), Detenbeck, Juenker, Krizan, Nyborg and Scarfone, Associate Professor Brown; Assistant Professors Depatie, Nagy, 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. A new program in ion-atomic scattering is 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 211, 213 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. (Aptitude and Advanced Section)

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

A total of thirty credit hours, at least twelve of which shall be Physics courses numbered above 300 and including thesis research.

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 23.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS OF PHYSICAL SCIENCES

The requirements for admission to candidacy for the degree of Master of Science for Teachers of Physical Sciences are: (1) Completion of at least one full year of teaching, (2) Successful completion of Physics 128, Chemistry 131 and 141, and Mathematics 121, or their equivalents. (These courses may have been taken at the undergraduate level, as part of this graduate program, or credit may be obtained by transfer or examination.) and (3) Satisfactory scores on the Graduate Record Examination.

MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS OF PHYSICAL SCIENCES

The above prerequisites for admission to candidacy must be supplemented by: (1) Completion of thirty hours of credit, of which at least eighteen must be in Physical Sciences Option (A) or (B) as described below. The remaining twelve credits may be chosen, with the consent of the Joint Advisory Committee, from appropriate courses at any level in science, engineering, mathematics and educa-

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tion. (Credit in education courses is limited to six semester hours.) (2) Successful completion of a comprehensive examination administered by the Joint Advisory Committee. Satisfactory scores on the Graduate Record Examination.

Physical Sciences Option (A): Nine semester hours of Physics numbered 128 and above, Chemistry 212 and six semester hours of Chemistry chosen from Chemistry 142, 213, 224, 246 and 251. This option is primarily for teachers of chemistry.

Physical Sciences Option (B): Nine semester hours of Chemistry numbered 131 and above and nine hours of Physics in courses numbered above 200. This option is primarily for teachers of Physics.

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 121 or 123. In addition, the student must have passed his Comprehensive Examination for the Ph.D. degree. 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. 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.

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. *Prerequisite:* 27, Mathematics 121 or 123; 203 for 204. Three hours. Staff.

211 **MECHANICS** Newtonian dynamics of particles and systems of particles, with applications to such problems as driven and coupled harmonic oscillators and central field trajectories. Extensive use is made of descriptive, analytical,

and approximatinal techniques. *Prerequisites:* 27, mathematics 121 or 123. Three hours. Mr. Juenker.

213 ELECTRICITY AND MAGNETISM Fundamental principles of electricity and magnetism; charge, currents, circuits, theory of electrostatic fields, and magnetic fields of steady currents. Electrical and magnetic properties of matter and electromagnetic energy relationships. Vector analysis developed as necessary. *Prerequisite:* 27, mathematics 121 or 123. Three hours. Mr. Nagy.

214 ELECTROMAGNETISM AND RELATIVITY An introduction to time dependent electromagnetic fields. Maxwell's equations in space and matter. Electromagnetism as a relativistic phenomenon. Special relativity including an introduction to four-vectors. *Prerequisite:* 213. Three hours. Mr. Nyborg.

216 INTRODUCTION TO MATHEMATICAL PHYSICS Introduction to basic mathematical methods of theoretical physics. Particular emphasis on partial differential equations, especially the wave equation. *Prerequisite:* 211 or 213. Three hours. Mr. Depatie.

220 BIOLOGICAL PHYSICS Physical laws, concepts and methods discussed with respect to their reference to biology. Mechanics of solids, liquids and non-ideal media. Electric and magnetic fields, transport of dissolved gases and ions. Properties of macromolecules, radiation biophysics. *Prerequisite:* 6, chemistry 2, mathematics 12. Four hours. Mr. Nyborg.

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 121 or 123; and experience in applying differential equations. Departmental permission required. Four hours. Mr. Nyborg.

225 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 121 or 123 and consent of the department. Credit as arranged. Offered as occasion warrants. Mr. Nyborg.

231 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:* 216 and consent of the department. Credit as arranged. Offered as occasion warrants. Messrs. Sachs and Nyborg.

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251 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:* 265 or Chemistry 142 and Mathematics 121 and consent of the department. Credit as arranged. Offered as occasion warrants. Messrs. Crowell and Juenker.

265 THERMAL PHYSICS Basic concepts of thermodynamics including the characteristic functions, and their application to determination of equilibrium conditions in homogeneous and heterogeneous systems. Introduction to kinetic theory and statistical mechanics. *Prerequisite:* 128 and mathematics 121 or 123. Three hours. Mr. Brown. Alternate years, 1971-72.

271 ATOMIC AND NUCLEAR PHYSICS Phenomenological study of electronic structure of atoms, including vector model and various coupling modes. Development of quantum theory. Structure of the nucleus and properties of elementary particles. *Prerequisites:* 211. Three hours.

272 INTRODUCTORY QUANTUM MECHANICS Introduction to non-relativistic quantum mechanics. Schroedinger equation and applications to simple systems. Angular momentum and spin. Approximation techniques. *Prerequisite:* 271 and 216. Three hours. Mr. Detenbeck.

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:* 211, 214 and 216. Three hours.

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:* 211, 216; 311 for 312. Three hours. Mr. Thurnauer.

313 ELECTROMAGNETIC THEORY Development of Maxwell's theory of electromagnetism with emphasis on their physical basis and the modes of mathematical description. Boundary value problems in electrostatics, multipoles, electrostatics of macroscopic media, magnetostatics, time varying fields, Maxwell's equations, conservation laws, gauge transformations, wave equations, Green's functions are employed throughout. *Prerequisites:* 214 and 216. Three hours. Mr. Scarfone.

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, multipole fields. *Prerequisite:* Physics 313. Three hours. Mr. Krisan.

321 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 symmetry and the reciprocal lattice. Crystal binding and lattice vibrations. Thermal, electrical, and magnetic properties of solids, free electron theory of metals, and band theory. Introduction to cooperative phenomena; ferromagnetism and superconductivity. *Prerequisites:* 214, 265, and 272 or their equivalents; consent of instructor. Offered alternate years, 1971-72. Equivalent to and alternates with E.E. 363, 364. Three hours. Mr. Brown.

343, 344 ADVANCED SOLID STATE PHYSICS Introduction to group theory and its use in crystal physics and energy band theory. Introduction to quasi-particles, including phonons, plasmons, and ferromagnetic magnons. Systematic discussion of the theoretical and experimental analysis of the Fermi surface in metals. Green function analysis and neutron scattering. *Prerequisite:* 342 (or E.E., 363), 362 and 375. 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:* 211, 214, 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 interact-

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ing 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.

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. *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:* 265, 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 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 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 Celestial Physics

5, 6 Elementary Physics

17, 18, 27 General Physics

128 Introductory Modern Physics

101, 102 Intermediate Physics

Laboratory

197, 198 Reading and Research

• PHYSIOLOGY AND BIOPHYSICS

Professors Alpert (Chairman) Chambers, Kusserow, Nyborg and Tabakin; Associate Professors Hill, Levy, McCrorey, Webb, Hanson, Kelleher, Patterson, and Parsons; Assistant Professors Caldwell, Gibbons, Halpern, Hamrell, Low, Musty, and Whitehorn; Instructors MacDonald.

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; exercise and respiratory physiology. Opportunities exist in the department of Physiology and Biophysics for multi-disciplinary studies in Neurobiology, Cardiovascular Biology, Cell Biology, and Biological Motility.

Preference in awarding financial support will be given in 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. GRE required.

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 recommended. 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. GRE required.

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

PHYSIOLOGY AND BIOPHYSICS

20 hours; language requirement is flexible and will be determined for each individual after consultation with the Studies Committee.

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. Eight hours. Staff.

302 NEUROSCIENCE A correlated presentation of the neuroanatomy and neurophysiology of mammalian CNS. The course will consist of lectures, demonstrations and laboratory. The lab consists of both microscopic examination of the nervous system and gross dissection of the human brain. Clinical presentation of patients with neurological deficits are demonstrated when appropriate. Same course as Anatomy 302. *Prerequisites:* Permission of the instructor. Four hours. Anatomy and Physiology Staff.

303 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, 1971-72. 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, 1972-73. 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, 1971-72. Mr. A. Chambers.

313 SEMINAR ON ENDOCRINE PHYSIOLOGY The course will be devoted to a study of current problems in endocrine research. It will be restricted for the most part to mammalian endocrinology, with the major emphasis on the molecular mechanism of action of hormones. *Prerequisites:* Physiology and Biophysics 301 or Endocrinology 271; Biochemistry 301-302; and permission of the instructor. Three hours. Mr. Low.

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, 1972-73. 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 301, 302, permission of the instructor. Three hours. Alternate years, 1972-73. Mr. Parsons.

317 PHYSIOLOGY OF THE CENTRAL NERVOUS SYSTEM The course will cover electrophysiological studies of the central nervous system of mammals with particular emphasis on concepts dealing with information processing. Supplemental material drawing upon behavioral, neurochemical and clinical observations will also be used. *Prerequisites:* Physiology 301 or permission of instructor. Three hours. Mr. Whitehorn.

321, 322 CELLULAR PHYSIOLOGY AND BIOPHYSICS Fundamental physical and physiochemical 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.

323 PRINCIPLES AND ELEMENTS OF BIOMEDICAL INSTRUMENTATION This course is designed for the biologically trained researcher to provide

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a firm understanding of instrument methodology which is inseparable from intelligent planning and execution of experimental investigations. Topics include basic electrophysics; input and output transducers; the concepts and manipulation of bioelectric and other signals; fundamentals of computers, electrochemical and gas measurements; physiological instrument systems. A laboratory using biological material will support these theoretical ideas. Course limited to 12 students. *Prerequisites:* permission of the instructor. Five hours. Mr. Halpern and staff.

381 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 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 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.

RELEVANT COURSES IN THE PSYCHOLOGY DEPARTMENT

221 PHYSIOLOGICAL PSYCHOLOGY I

221 PHYSIOLOGICAL PSYCHOLOGY II

309 RESEARCH APPARATUS AND DESIGN

319 SENSORY PROCESS: VISION

320 SENSORY PROCESS: MECHANICAL AND CHEMICAL SENSES

321 SENSORY PROCESS: AUDITION

322 CENTRAL PROCESSES: BRAIN STEM MECHANISMS

323 CENTRAL PROCESSES: PALEOCORTICAL MECHANISMS

324 CENTRAL PROCESSES: CORTICAL

• PLANT AND SOIL SCIENCE

Professors Bartlett, Hopp, MacCollom and Wiggans (Chairman); Associate Professors Boyce, McIntosh, Pellett and Wood; Assistant Professors Evert and Flanagan; Lecturers Benoit, Calahan, Kunkle and Parker.

Current research projects are concerned with the solution of horticultural and agronomic problems with special emphasis on environmental physiology, soil chemistry and plant nutrition. Areas of research include winter hardiness of fruits and woody ornamentals; chemical and environmental control of plant growth; cultural and environmental interrelationships as they affect plant growth, crop adaptation and variety testing; crop establishment and soil pro-

ductivity; soil chemistry of the rhizosphere; behavior of nitrogen in the soil; nutrient availability to plants; soil physics of drainage; temperature effects on soil water retention and transmission; plant responses to microclimatic variations. A student's thesis research will be an integral part of the on-going research efforts of the department.

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

Satisfactory completion of one academic year of graduate study in the Department of Plant and Soil Science and of a written comprehensive examination.

MINIMUM DEGREE REQUIREMENTS

15-20 hours in Plant and Soil Science and closely related fields; satisfactory participation in seminars during residency; thesis research (8-12 hours).

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

Satisfactory completion of two academic years of graduate study in the Department of Plant and Soil Science at the University of Vermont. With the approval of the Dean of the Graduate College and the Department of Plant and Soil Science, a Master's degree may be accepted in partial fulfillment of this requirement.

Satisfactory showing in a general qualifying doctoral examination as prescribed by the Department.

A reading knowledge of a modern foreign language appropriate to the student's specialty. Proficiency in the use of computer language and programming may be substituted for the language requirement with the approval of the Studies Committee.

MINIMUM DEGREE REQUIREMENTS

The course requirements are as follows: a total of at least 40 credit hours of which a minimum of 30 must be taken in Plant and Soil Science and closely related disciplines (e.g. Botany, Forestry, Microbiology and Biochemistry, Geology). Satisfactory participation in seminars during residency is required. All doctoral students must take part in the Department's undergraduate teaching program.

COURSES OFFERED

201 MICROMETEOROLOGY A theoretical and practical consideration of

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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, 1971-72.

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, 1971-72.

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*: Botany 103 or equivalent. Three hours. Mr. Bartlett and Botany, Forestry and Plant and Soil Science Staff. Alternate years, 1971-72.

207 WATER RELATIONS OF PLANTS This course is identical with Forestry 207.

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, 1972-73.

S223 ADVANCED ORNAMENTAL HORTICULTURE Developmental landscape drafting, design, and composition. Taxonomy, ecology, and physiological considerations in adaptation of plants in the landscape environment. Physiological principles related to modern methods of greenhouse and landscape environmental control. *Prerequisite*: 125 or departmental permission. Three hours. Mr. Pellett.

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. Saturday field trips will be arranged. *Prerequisite*: 61 or a total of 6 hours in ecology, geology, or geography. Three hours. Mr. Bartlett. Alternate years, 1972-73.

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, 1971-72.

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, 1972-73.

281 SEMINAR Presentation and discussion of papers on selected topics of current interest by students and staff. *Prerequisite:* senior standing. One hour. Staff.

381 GRADUATE SPECIAL TOPICS Advanced readings and discussion of horticulture, crops, or soils research literature. Three hours. Staff.

391 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 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:

10 Home and Garden Horticulture	122 Small Fruit Crops
11 Principles of Plant Science	125 Ornamental Horticulture
61 Introductory Soil Science	138 Plant Propagation
99 Environmental Quality	141 Forage Crops
102 Natural Resource Conservation	144 Field Crops
104 Principles of Plant Pest Control	145 Turfgrasses
106 Economic Entomology	161 Soil Fertility and Management
108 Forest Entomology	197 Undergraduate Special Topics
110 Environmental Pollution	

• **POLITICAL SCIENCE**

Professors Dellin, Gould (Chairman), Haugen, Hilberg, G. T. Little, Nuquist and Staron; Associate Professors Parenti and Simon; Assistant Professors Brubaker, Flanders, Flannery, Pacy, Warner and Wertheimer; Adjunct Assistant Professor Eastman; Instructors Brewer, and Nelson.

Research interests of the Department of Political Science and the various library and data processing resources available enable graduate students to undertake research in American political institutions; public law; public policy; po-

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litical behavior; comparative political systems; international relations; political philosophy and empirical political theory.

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, including the advanced examination in political science.

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 HISTORY OF POLITICAL THOUGHT First semester: development of political thought from Plato to Burke. Second semester: recent political ideologies. *Prerequisite:* six hours in political science. Three hours. Mr. Staron.

213 CONTEMPORARY POLITICAL THOUGHT A discussion of the writings of several twentieth-century political thinkers, including writings in related fields such as psychology and economics. *Prerequisite:* six hours in political science. Three hours. Mr. Wertheimer.

214 THEORIES OF DEMOCRACY An examination of both empirical and normative-theories of democracy, including the ideas of "democrats" and their opponents. Social, economic, and psychological aspects of democracy will be considered. *Prerequisite:* six hours in political science. Three hours. Mr. Wertheimer.

216 AMERICAN POLITICAL THOUGHT American political thought from the colonial period to recent times. *Prerequisite:* six hours in political science. Three hours. Mr. Simon.

221, 222 CONSTITUTIONAL LAW First semester: judicial review, federalism, citizenship and suffrage, taxing power, commerce power. Second semester: Bill of Rights, Due Process, Equal Protection. *Prerequisite:* six hours in political science. Three hours. Mr. Gould.

224 LAW AND THE JUDICIAL PROCESS The development of law in west-

ern civilization. The role of law in contemporary societies. Varying conceptions of the organization and procedure of the courts in contemporary societies. Courts as a political process. Approaches to the study of judicial behavior. *Prerequisite*: six hours of political science. Three hours. Mr. Brubaker.

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*: six hours in political science. Three hours. Mr. Nuquist.

227, 228 INTERNATIONAL LAW Principles and applications of public international law. *Prerequisite*: six hours in political science. Three hours. Mr. Little.

231 THE LEGISLATIVE PROCESS Congressional and parliamentary organization and procedure. *Prerequisite*: six hours in political science. Three hours. Mr. Haugen.

232 LAWMAKING AND PUBLIC POLICY Influence of the executive and problems of congressional and parliamentary control. *Prerequisite*: six hours in political science. Three hours. Mr. Haugen.

233 THE NATIONAL EXECUTIVE Analysis of the functions and organization of the Presidency and the bureaucracy in American national government. *Prerequisite*: six hours in political science. Three hours. Mr. Warner.

235 DEFENSE POLICY Constitutional and historical framework; intelligence, R and D, procurement, manpower and deployment: U.S.-Soviet discrepancies, developments, and dilemmas. *Prerequisite*: six hours in political science. Three hours. Mr. Pacy.

239 AMERICAN POLITICS An examination of the politics of decision-making in the American political system. *Prerequisite*: six hours in political science. Three hours. Mr. Simon.

241 PUBLIC ADMINISTRATION Introduction to the role of administration in government, theories of administrative organization and their application, the basic functions of administrative management, and problems of democratic control. *Prerequisite*: twelve hours in political science, or six hours in political science and one sophomore course in social science; junior standing. Three hours. Mr. Nuquist.

242 PROBLEMS OF PUBLIC MANAGEMENT Analysis of policy and administrative issues of current domestic programs. *Prerequisite*: six hours in political science. Three hours. Mr. Warner.

250 THE CRAFT OF DIPLOMACY The craft of diplomacy in its totality.

POLITICAL SCIENCE

Emphasis on experiences and reflections of diplomatic personalities, supplemented by studies of specialists. History and analysis of diplomacy, foreign office organization, foreign service organization, etc. *Prerequisite*: six hours in political science. Three hours. Mr. Pacy.

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. *Prerequisite*: six hours of political science. Three hours. Mr. Hilberg.

256 **INTERNATIONAL ORGANIZATION** Theory and practice in supranational institutions. The United Nations, regional international organizations, and functional agencies as instruments of national diplomacy and as independent factors in international politics. *Prerequisite*: six hours in political science. Three hours. Mr. Little.

257 **POLITICAL GEOGRAPHY** See Geography 257. Three hours. Mr. Miles.

258 **PROBLEMS OF COMMUNISM** See Economics 258. Three hours. Mr. Dellin.

261 **URBAN GOVERNMENT AND POLITICS** The development of cities and urban life. The analysis of metropolitan areas and governments. Metropolitan problems and proposed solutions: the role of the city; the suburbs; the state; and the nation. *Prerequisite*: six hours of political science. Three hours. Mr. Brubaker.

263 **STATE GOVERNMENT** Processes of basic formulation and popular control, the nation-wide effort to improve governmental systems, the theoretical basis of reform movements, and trends in the treatment of governmental problems. *Prerequisite*: six hours in political science. 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*: six hours in political science. Three hours. Mr. Haugen.

265 **INTERGOVERNMENTAL RELATIONS** Problems of the Federal system. National-state-local cooperative administration of selected public functions. *Prerequisite*: six hours in political science. Three hours. Mr. Haugen.

273 **COMPARATIVE POLITICAL ANALYSIS** An intensive examination of

selected topics in comparative politics. *Prerequisite:* a semester course in Comparative Government. Three hours. Mr. Staron.

277 SOVIET POLITICS See History 277. Three hours. Mr. Flannery.

278 FOREIGN POLICY OF THE U.S.S.R. See History 278. Three hours. Mr. Flannery.

281 POLITICAL PARTIES Analysis of the electoral, administrative, legislative, and organizational activities of political parties from historical, behavioral, and comparative perspectives. Special emphasis will be placed upon voting behavior and campaign techniques. *Prerequisite:* six hours in political science. Three hours. Mr. Nelson.

282 POLITICAL COMMUNICATION Analysis of the development and mobilization of political attitudes as they relate to political socialization, public opinion formation, mass communication, and interest group activity in government. *Prerequisite:* six hours in political science. Three hours. Mr. Nelson.

283 SCOPE AND METHODS OF POLITICAL SCIENCE Approaches, sources of information, research methods and systematization in the study of political phenomena. Open to senior majors and graduate students only. Three hours. Mr. Wertheimer.

291 READING AND RESEARCH For advanced undergraduates and graduate students. Three hours. Staff.

295 SEMINAR Selected topics in Political Science. *Prerequisite:* six hours in political science. Three hours. Staff.

391 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:

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| 11 Introduction to Political Science | 172 Russian and Eastern European Political Systems |
| 13 Introduction to Political Thought | 173 Governments of Canada and the Commonwealth |
| 21 American Political Systems | 174 Latin American Political Systems |
| 51 International Relations | 175, 176 Asian Political Systems |
| 71 Comparative Political Systems | 193, 194 College Honors |
| 81 Political Behavior | 195, 196 Special Topics |
| 96 Seminar | 197, 198 Readings and Research |
| 161, 162 Local Government | |
| 171 Western European Political Systems | |

• PSYCHOLOGY

Professors Albee, Ansbacher and Forgays (Chairman), Chaplin; Associate Professors Burchard, Goldstein, Joffe, Lawson, Leitenberg, McKenzie, Patterson and Perrine; Assistant Professors Conquest, Does, Ferguson, Jeanne Goldstein, Gordon, Hasazi, Howell, Huntley, Kapp, Kessler, Leff, Musty, Rolf, and Stone.

The experimental program includes ongoing research in the following areas: Learning; e.g., utility of adding reinforcement of competing behaviors to extinction and/or punishment procedures; effects of attentional and motivational variables on simple learning in retarded and normal children: Perception; e.g., human stereoscopic depth perception and visual illusions; influence of alcohol on perceptual-cognitive behavior: Physiological; e.g., the role of psychochemistry and CNS mechanisms in the determination of innate behavior; mediating effects of the endocrine system on parental stress: Social; e.g., interpersonal conflict, bargaining; exploration of variables influencing interpersonal set: Neuropsychology; e.g., effects of sensory isolation on human behavior; circadian rhythms in humans; effects of trauma to specific portions of the brain on adaptive abilities and perceptual deficits: Cognitive processes; e.g., decision making; subjective probability; gambling behavior; computer simulations of psychological processes: Personality; historical documentation of Adlerian Psychology.

Clinical research includes: analysis of cheating behavior and other anti-social behaviors; development of social behavior in retarded children via operant procedures; analysis of communication disorders; effects of various therapeutic treatments on alcoholism; analysis of the applicability of behavioral procedures to the treatment of neurotic, sexual, and psychotic disorders; etiology of schizophrenia; and mental retardation.

The Ph.D. program in Clinical Psychology which was started in 1969 stresses early placement in a variety of clinical facilities, and research training relevant to clinical problems encountered in those settings.

An interdisciplinary program of study in neuroscience is available; it consists of a number of courses in physiological psychology, sensory and central processes as well as courses listed in the Physiology and Anatomy departments. Coordinator of this program is Dr. Musty who should be consulted for further information.

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.

MINIMUM DEGREE REQUIREMENTS FOR MASTER OF ARTS DEGREE

Twenty-four hours of Psychology courses and seminars, including Psychology 301, 302, 340, 341; thesis research for 6 credits. The requirement of the specific courses (301, 302, 340, 341) may be exempted by examination. Satisfactory performance on the departmental diagnostic examination (examination #1). There is no foreign language requirement.

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).

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. Satisfactory performance on the departmental final oral examination (examination #3). There is no foreign language requirement.

COURSES OFFERED

200 BEHAVIOR MODIFICATION A survey of techniques for the manipulation and control of human behavior, and evaluation of their effectiveness. Such topics as conditioning, brainwashing, and hypnosis will be discussed. *Prerequisite:* 1, 108. Three hours. Messrs. Lietenberg and Burchard.

205 BEHAVIOR DISORDERS OF CHILDHOOD Covers a wide range of topics from brain damage to childhood psychoses and nightmare. Each problem behavior will be considered in the context of normal child development with emphasis on the psychological factors responsible for their occurrence and remission. *Prerequisite:* 1 and 105 or 108. Three hours. Mr. Rolf.

210 COMPARATIVE PSYCHOLOGY Behavior of animals under controlled experimental conditions and in their natural environments. Consideration of behavior similarities and differences at various levels of the phyletic scale from lower forms to man. *Prerequisite:* 110, 123. Three hours. Staff.

221 PHYSIOLOGICAL PSYCHOLOGY I The structure and function of the mammalian nervous system, with emphasis upon neurological correlates of be-

PSYCHOLOGY

havior and receptor mechanisms. Individual laboratory experience in electrophysiological techniques and the recording of receptor potentials. *Prerequisite:* 110, 123. Staff.

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 experiences in assessing the effects of brain stimulation, hormones, and psychoactive drugs upon behavior. *Prerequisite:* 110, 123, 221. Mr. Musty.

225-226 PSYCHOLOGICAL TESTS Survey of important clinical tests of ability and personality; training in the administration of individual intelligence tests. *Prerequisite:* 110, 123, and permission of the instructor, who may waive the prerequisites in special cases. Three hours. Staff.

228 INTRODUCTION TO CLINICAL PSYCHOLOGY Examination of some of the critical issues in clinical psychology; its scientific status, problems of research; and probable future trends. A survey of the procedures for assessment and therapy will be provided. The topics of training, community approaches, and ethics will be explored. *Prerequisite:* 110, 123, 108. Three hours. Mr. Kessler.

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. Howell.

232 EXPERIMENTAL SOCIAL PSYCHOLOGY (2-2) A laboratory course in the experimental methods and techniques typically used in social psychological research. Topics include 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. Laboratory experiences are provided and students may undertake original experiments. *Prerequisite:* 110, 123. Three hours. Mr. Ferguson.

234 MOTIVATION AND EMOTION The nature and development of motives, emotions and their relation to other psychological processes. *Prerequisite:* 110, 123. Three hours. Mr. Joffe.

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. Staff.

237 SENSORY PERCEPTION An introduction to the sensory and perceptual

bases of human visual perception. Emphasis will be on research literature and methodologies concerning the perception of size, distance, shape, and color, perceptual constancies, and visual illusions. *Prerequisite:* 110, 123, or permission of instructor. Three hours. Mr. Lawson.

238 SOCIAL PERCEPTION Phenomenal and theoretical bases of perception. Experimental and theoretical study of the phenomena of the human perceptual process; with emphasis on the role of social, motivational, and learning factors. The major perceptual theories are examined critically in the light of recent research. Students may undertake original experiments. *Prerequisite:* 110, 123. Three hours. Mr. Perrine.

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.

301, 302 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.

303 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 behavioral apparatus design. Individual laboratory experience and demonstrations give the student exposure to the contemporary methodology used by the experimental psychologist. Three hours. Staff.

305 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. Howell.

306 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 short and long term memory, organizational structure of free recall, and pre-experimental associations will be examined. Three hours. Mr. Howell.

308 SEMINAR IN OPERANT CONDITIONING A review of current developments in this area of research. Topics such as extinction, punishment, avoidance, schedules of reinforcement, secondary reinforcement, generalization, discrimination training will be considered. Three hours. Mr. Leitenberg.

PSYCHOLOGY

310 SEMINAR IN PERCEPTION A review of the history and contemporary problems of human perceptual processes. Emphasis will be on perceptual mechanisms responsible for the coding and organization of visual sensory information. Three hours. Mr. Lawson.

315 SEMINAR IN ALCOHOL AND BEHAVIOR A study of the influences of alcohol upon selected aspects of psychological processes including perception, attention, cognition, learning, motivation, and emotion. A critical review of the experimental literature will provide a basis for developing an appropriate heuristic model and for further understanding of the neurophysiological correlates of attention and affect as inferred by the influences of alcohol upon these perceptual-cognitive processes. Three hours. Mr. Perrine.

320 COMPARATIVE PSYCHOLOGY OF BEHAVIORAL DEVELOPMENT An examination of the general principles underlying the development of behavior from parental 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. Joffe.

321 SENSORY PROCESSES: VISION A study of the psychological and physiological parameters of the visual receptor system. Emphasis will be placed upon the integration of recent advances in the area of visual perception, neurophysiology, and photochemistry. Three hours. Messrs. Lawson and Musty.

322 SENSORY PROCESSES: MECHANICAL AND CHEMICAL SENSES A study of selected topics from mechanical senses (somesthesia and kinesthesia) and the chemical senses (olfaction and gustation). Emphasis will be placed upon recent advances in perceptual theory, neurophysiology and ultrastructure, as they are related to these senses. Three hours. Staff.

323 SENSORY PROCESSES: AUDITION A study of the psychological and physiological parameters of the auditory system. Emphasis will be placed upon the integration of recent advances in the areas of auditory perception, physiological acoustics, and sensory coding. Three hours. Mr. Patterson.

324 CENTRAL PROCESSES: BRAIN STEM MECHANISMS Advanced studies of spinal, rhombencephalic, and mesencephalic mechanisms of the nervous system, in the control of elementary anamative activity, including reviews of historical and current literature. Three hours. Mr. Musty.

325 CENTRAL PROCESSES: PALEOCORTICAL MECHANISMS Advanced studies of paleocephalic mechanisms of the nervous system with special emphasis on central integrative function of the thalamus, hypothalamus, and rhinencephalon, in the control of vegetative and affective activity, including reviews of historical and current literature. Three hours. Mr. Musty.

326 CENTRAL PROCESSES: CORTICAL MECHANISMS Advanced studies of the prosencephalic systems in cognitive behavior, with reference to cortical function and its relationship to input and output systems, including reviews of historical and current literature. Three hours. Mr. Musty.

330 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. Staff.

331 INTERPERSONAL PROCESSES: MODES OF INTERACTING Examination of interpersonal conflict, cooperation, power relations, information transfer, and persuasion. Two major goals of the seminar will be to increase our understanding of the interpersonal behavior and to seek meaningful applications to problems of personal and social significance. *Prerequisite:* permission of the instructor. Three hours. Mr. Leff.

332 INTERPERSONAL PROCESSES: COGNITION IN SOCIAL BEHAVIOR Examination of social attribution, interpersonal set, problems of reciprocal perspectives in social encounter, and the formulation of interpersonal strategies. Combined emphasis on theoretical understanding, empirical research, and social applications. *Prerequisite:* permission of the instructor. Three hours. Mr. Ferguson and Mr. Leff.

333 INTERPERSONAL PROCESSES: MOTIVATION IN HUMAN INTERACTION Examination of current and historical theories of social motivation, the interrelations of cognition and affect as determinants of motivation in social contexts, and the operation of selected motives of social significance (such as aggression, altruism, and achievement). Combined emphasis on theory, research, and applications. *Prerequisite:* permission of the instructor. Three hours. Mr. Leff.

334 SEMINAR IN EXCHANGE THEORY Survey of the various approaches to exchange theory in human interaction. Theories will be set in the context of historical philosophical backgrounds of Mill and Bentham. Current positions of Homans, Blau and Scott, Adams, and Thibaut and Kelley will be surveyed. *Prerequisite:* permission of the instructor. Three hours. Mr. Ferguson.

335 SEMINAR IN SOCIAL JUDGMENT Traditional areas suggested by the work of Asch, Allport and Bruner will be examined with the eye toward target and perceiver variables. Attention will be to recent work by Kelley, Jones, de Charms and others in attribution theory with particular emphasis on the process of individual causal inference based on socially mediated events. A section devoted to experimental work in stimulus judgment with applications to aesthetics. *Prerequisite:* permission of instructor. Three hours. Mr. Furgeson.

PSYCHOLOGY

336 SEMINAR IN ATTITUDE CHANGE Coverage of many of the historical as well as contemporary attitude change theorists. The literature will be examined in the light of more recent conceptualization of attitudinal dimensions and structural models. Methodological problems of assessing attitudes and attitude change will be discussed. *Prerequisite:* permission of the instructor. Three hours. Mr. Leff and Mr. Ferguson.

337 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.

340 ADVANCED STATISTICAL METHODS I Study of Statistical methods as aids for understanding and evaluating psychological data. Critical study of such topics as sampling theory, statistical estimation, analysis of variance, and correlational techniques. Three hours. Mr. Howell.

341 ADVANCED STATISTICAL METHODS II A continuation of 340 with in depth study of nonparametric theory and method. Further study of problems in the analysis and interpretation of data from the behavioral sciences. *Prerequisite:* 340. Three hours. Mr. Howell.

342 CORRELATION AND REGRESSION In depth treatment of correlational techniques commonly used with data found in the behavioral sciences. Special emphasis will be given to continuous and discrete data and their distributions, covering special methods for measuring degree of association. Least square methods for the solution of linear regression problems and associated topics such as matrix algebra. *Prerequisite:* 340. Three hours. Messrs. Goldstein and Howell.

344 EXPERIMENTAL DESIGN Extended coverage of problems in the design and analysis of behavioral experiments to include repeated and non-repeated measures, interactions, confounding, individual comparisons, missing data, model building, Latin and higher order squares, lattice and block designs. Problems of covariate designs and their interpretations will be considered. *Prerequisite:* 340. Three hours. Messrs. Goldstein and Howell.

345 MATHEMATICAL MODELS IN PSYCHOLOGY The use of probabilistic models in contemporary psychology stressing basic probability theory. Markov chains, information theory, signal detection theory and Bayesian statistics. Three hours. Mr. Gordon.

347 MEASUREMENT AND SCALING Treatment of the philosophy of measurement and scaling including traditional psychophysical techniques. Thurstonian judgmental methods and recent topics in unidimensional scaling. Survey of techniques and applications in metric and non-metric multidimensional scaling.

Examination of the relation of these techniques to related areas such as mental test theory, including concepts of reliability and validity, factor analysis, and cluster analysis. *Prerequisite:* 340 and 342. Three hours. Mr. Gordon.

349 SPECIAL TOPICS IN APPLIED STATISTICS A course for advanced graduate students. Topics might include factor analysis, discriminate function analysis, multivariate analysis of variance, advanced experimental design, introduction to Bayesian statistics, computer application in data collection and analysis. *Prerequisite:* consent of the instructor. Three hours. Messrs. Goldstein, Gordon, and Howell.

351 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. *Prerequisite:* consent of the instructor. Three hours. Mr. Leitenberg.

352 INTRODUCTION TO CLINICAL HUMAN NEUROPSYCHOLOGY A clinical seminar dealing with the effects on human behavior of neocortical dysfunction. Review of the early theoretical and clinical approaches to brain function with major emphasis on recent developments in diagnostic techniques and the changes in theory that have occurred subsequently. Introduction to the interpretation of results obtained through the utilization of these techniques. *Prerequisite:* 221, 222 or equivalent. Three hours. Mr. Goldstein.

353 RESEARCH IN THE EDUCATION OF HANDICAPPED LEARNERS A broad survey of research undertaken to evaluate teaching/learning procedures, methodology, and materials employed in the education of the handicapped learner. *Prerequisite:* Education 312. Three hours. Mr. McKenzie.

356 MENTAL RETARDATION Study of abnormal behavioral development in the intellectual area. Emphasis will be placed on current psychological theory and research in the etiology, assessment, and modification of mental retardation. *Prerequisite:* Permission of instructor. Three hours. Mr. Hasazi.

357 RESEARCH IN SCHIZOPHRENIA An advanced seminar intended to investigate the adequacies of past and current research methodologies with respect to environmental, genetic, and biochemical theories of the etiology of schizophrenia. *Prerequisite:* Permission of the instructor. Three hours. Mr. Rolf.

358 ANTISOCIAL BEHAVIOR A review of the literature related to the development and modification of anti-social behavior. Special emphasis will be placed on the evaluation of previous research and the preparation of practical research proposals which will extend existing knowledge in the field. *Prerequisite:* Permission of instructor. Three hours. Mr. Burchard.

360 METHODS AND MODELS OF CLINICAL PREDICTION An in depth

PSYCHOLOGY

study of the clinical vs. actuarial problems in applied psychology. Consideration is given to historical precedents to the problem followed by treatment of models of intelligence and personality as classic examples of problems in prediction and description including reliability, validity and utility. Following a discussion of quantitative solutions, modern day positions in this controversy are covered. *Prerequisite:* 340 or permission of instructor. Three hours. Mr. Goldstein.

361 ADVANCED PERSONALITY THEORY A survey of present-day personality theories according to issues involved and explanatory demands made on a theory, rather than taking up one theory after another. With emphasis on usefulness to psychotherapy, an organism-operational-Adlerian type theory is favored. *Prerequisite:* Permission of instructor. Three hours. Mr. Ansbacher.

362 COMMUNITY CLINICAL PSYCHOLOGY A seminar in a current philosophy and approach to mental health problems. Topics will include: 1. History and development of community mental health and of community clinical psychology. 2. Consultation methodology in community clinical psychology and community mental health. 3. Research problems in community psychology. *Prerequisite:* Permission of instructor. Three hours. Mr. Kessler.

370, 371 INTRODUCTORY PRACTICUM: ASSESSMENT AND THERAPY I & II Introductory overview of clinical evaluation and therapy. Psychology 370 emphasizes psychodiagnostic testing, interviewing, and psychotherapy for the young adult, whereas Psychology 371 focuses on children's disorders, family psychodiagnosis and therapy. The facilities of the University of Vermont Counseling and Testing Center and the Howard Family Clinic will be utilized as part of the training. *Prerequisite:* graduate standing and permission of the instructors. Three hours. Staff.

372 through 377 ADVANCED CLINICAL PRACTICUM Supervised experience in a variety of clinical settings including the Medical Center Hospital; the State Hospital; a Community Mental Health Facility; a correctional facility; and Brandon Training School. *Prerequisite:* Graduate standing in Psychology and permission of the instructor. Six hours. Mr. Leitenberg and Staff.

380 CONTEMPORARY TOPICS Designed to cover selected topics in depth. The major emphasis will be on intensive and critical analysis of original literature in a given area. Suitable topics include: Accident Research, Memory, Fear and Frustration, Adlerian Theory, Behavioral Pharmacology, Information Theory, Instinct, Propaganda and Attitude Formation, Psycholinguistics. Three hours. Staff.

385 ADVANCED READINGS AND RESEARCH Readings, with conferences, to provide graduate students with backgrounds and specialized knowledge relating to an area in which an appropriate course is not offered. One to three hours. Staff.

391 MASTER'S THESIS RESEARCH Investigation of a research topic under the direction of a staff member. Credit as arranged. Staff.

491 DOCTORAL THESIS RESEARCH Acceptance as doctoral candidate is a prerequisite. Credit as arranged. Staff.

• RESOURCE ECONOMICS

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

The Department conducts research in the economics of recreation, regional planning and development, and environmental quality and control. It also has an active research program in agricultural production and marketing and business management.

Master of Science degrees are offered with concentrations in agricultural economics, resource economics, and economics of natural resource planning.

AGRICULTURE ECONOMICS

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

An undergraduate degree in economics, agriculture or a related field. Transcripts are evaluated on an individual basis.

MINIMUM DEGREE REQUIREMENTS

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

ECONOMICS OF NATURAL RESOURCE PLANNING

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

An undergraduate degree and satisfactory scores on the Graduate Record Examination. Transcripts are evaluated on an individual basis.

MINIMUM DEGREE REQUIREMENTS

At least 24 hours in courses numbered above the 200 level of which at least 6 hours shall be in courses numbered above 300. Thesis research, at least 6 hours.

COURSES OFFERED

201 FARM BUSINESS MANAGEMENT Organization and operation of suc-

RESOURCE ECONOMICS

cessful farm businesses with emphasis on resource allocation, production efficiency, and marginal analysis. Field trips are required. *Prerequisite:* economics 11, 12, or agricultural economics 61. Three hours. Mr. Tremblay.

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 agricultural economics 61. 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 alternatives to their solution. *Prerequisite:* economics 11-12, or agricultural economics 61. Three hours. Mr. Sinclair.

222 ADVANCED RESOURCE ECONOMICS A critical investigation of current research, allocation procedures, and methods of analysis in natural resource economics with emphasis on the public sector. *Prerequisite:* agricultural economics 121. Three hours. Mr. Gilbert.

223 REGIONAL PLANNING Delineation of regional boundaries, determination of public goals, tools of planning, and the legal and political process of planning. Study of the ecological approach to planning and current planning programs. *Prerequisite:* senior standing and economics 11, 12, or equivalent. Three hours. Mr. Sargent.

224 ENVIRONMENTAL POLICY The economic history, objectives, criteria, implementation, politics, and implications of natural resource policy. *Prerequisite:* agricultural economics 121, or permission of the instructor. Three hours. Mr. Sargent.

225 ECONOMICS OF OUTDOOR RECREATION An analysis of demand and supply of natural resources for outdoor recreation in the northeast. A study of methods of economic analysis applicable to outdoor recreation. Emphasis on current policy issues and management of recreational business firms. *Prerequisite:* economics 11, 12 or agricultural economics 61. Three hours. Mr. Gilbert.

254 ADVANCED AGRICULTURAL ECONOMICS Application of microeconomic theory to the problems of agricultural production and resource use; agricultural supply and demand analysis, price determination, market structures, and income distribution in competitive and imperfectly competitive markets. *Prerequisite:* twelve hours in agricultural economics and/or economics. Three hours. Mr. Sinclair.

255, 256 SPECIAL TOPICS IN ECONOMICS Readings and discussion of

SOCIOLOGY AND ANTHROPOLOGY

selected topics in economics at an advanced level. *Prerequisite:* departmental permission. Credit as arranged. Staff.

266 ECONOMICS OF MANAGERIAL DECISIONS Application of economic concepts to problems of business management. Cost concepts for financial planning, capital budgeting, and discounting cash flows. Emphasis on tax planning, pricing, and demand analysis. Cases. *Prerequisite:* economics 11, 12, or equivalent. Three hours. Mr. Fife.

324 ADVANCED REGIONAL PLANNING A discussion of concepts of ecological planning with special emphasis on economic base analysis, resource base analysis, and economic impact studies. Current literature and current problems will be discussed and each student will make a contribution to a regional planning project. Three hours. Mr. Sargent.

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. I or II. Mr. Fife.

381 RESOURCE ECONOMICS SEMINAR Discussion of problems and research in agricultural economics, resource economics, and regional planning. One hour. Staff.

391 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 Population
- 51 Agricultural Finance
- 61 Principles of Agricultural and Resource Economics
- 75 Participation in Recreation Management
- 103 Rural Sociology
- 121 Resource Economics
- 166 Small Business Management

• SOCIOLOGY AND ANTHROPOLOGY

ANTHROPOLOGISTS: Associate Professor Haviland; Assistant Professors Magarella, C. Pastner, S. Pastner, Woolfson; Instructor Basa.

SOCIOLOGISTS: Professor Lewis; Associate Professors Folta, Mabry, Stanfield (Chairman), Steffenhagen; Assistant Professors Deck, Bradshaw, Nixon, Schmidt; Instructors Fishman and Godfrey; Adjunct Assistant Professor Berkman.

SOCIOLOGY AND ANTHROPOLOGY

No Master's degree program offered
ANTHROPOLOGY

Research activities in anthropology include the investigation of prehistoric social organization and change among the MAYA; the study of French Vermonters and biculturalism; the ethnography of pastoral nomads; and the archaeology of Vermont.

221 CULTURE AND PERSONALITY Relationship of socialization to the sociocultural milieu; the cross-cultural comparison of personality development; the problem of delineating modal personality types; variations in child-rearing situations according to "social class" in contemporary Western Civilization. *Prerequisite:* 21, sociology 22 and one 100 level course in sociology or anthropology. Three hours. Mr. Steffenhagen.

225 CURRENT ANTHROPOLOGICAL THEORY Survey and analysis of 20th century theories of cultural evolution, diffusionism, functionalism, and the American historical school. *Prerequisite:* 21 plus one of following: 161, 162, 163, 165 or 170. Mr. Pastner.

228 SOCIAL ORGANIZATION Evaluation of the comparative method in anthropology; its use in the formulation of generalizations concerning the nature of society. *Prerequisite:* 21 and one of the following: 161, 162, 163, 165 or 170. Mr. Magnarella.

262 CULTURAL GEOGRAPHY (Same as Geography 262).

290 SEMINAR *Prerequisite:* twelve hours of anthropology and senior standing. Three hours.

Undergraduate courses:

- 21 The Cultures of Man
- 24 World Pre-History
- 26 Physical Anthropology
- 150 Language in Culture
- 161 Peoples of the Americas
- 162 Peoples of Africa
- 170 Pastoral Peoples
- 229 Political and Economic
Anthropology
- 283 Culture Change

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. Nixon.

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. Mr. Godfrey.

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. Msrs. Lewis and Schmidt.

213 URBAN SOCIOLOGY The place of the city in social organization. The emergence, nature and problems of modern urbanism. *Prerequisite:* 6 hours in Sociology. Three hours. Msrs. Lewis and Schmidt.

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

SOCIOLOGY AND ANTHROPOLOGY

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. Msrs. Nixon and Stanfield.

243 SOCIAL STRATIFICATION A comprehensive study or analysis of the various ways in which societies become stratified into social class and caste, or open and closed social systems; the relationship of stratification systems to other aspects of social structure and to societal change. *Prerequisite:* 6 hours in Sociology. Three hours. Mr. Nixon.

250 METHODOLOGY OF SOCIAL RESEARCH Methodological foundations of the social sciences; the nature of social facts and phenomena; formation of concepts and the application of logic in the social sciences. *Prerequisite:* 6 hours of Sociology. Three hours. Mr. Godfrey.

251 SOCIAL RESEARCH TECHNIQUES Current techniques of gathering, processing and analyzing social research data. *Prerequisite:* Sociology 250, Psychology 5, and three additional hours in Sociology or departmental permission. Three hours. Mr. Godfrey.

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. Godfrey.

257 CONTEMPORARY SOCIOLOGICAL THEORY A survey and analysis of modern schools of sociological theory with particular reference to present day issues or fundamental problems around which sociological theories are developing. *Prerequisite:* 255. Three hours. Mr. Godfrey.

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. Msrs. Berkman and Stanfield.

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. Msrs. Berkman and Stanfield.

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:* 22 and six additional hours in Sociology or department permission. Msrs. Mabry and Steffenhagen.

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 six additional hours in Sociology or departmental permission. Three hours. Mr. Steffenhagen.

281 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.

300 ADVANCED SEMINAR IN MEDICAL SOCIOLOGY Analysis of current problems relating to sociological aspects of medicine and the medical profession, with emphasis on an interdisciplinary approach. *Prerequisite:* Permission of the instructors. Three hours. Dr. McAree (psychiatry), Mr. Mabry (community medicine) and Mr. Steffenhagen (sociology).

305, 306 INDIVIDUAL STUDY IN MEDICAL SOCIOLOGY Independent study of socio-cultural factors influencing medicine and the medical profession. Study and research topics are chosen by the student with the approval of the instructor from epidemiology, community medicine or social psychiatry. Open to medical students, residents and graduate students. *Prerequisite:* permission of the instructor. Dr. McAree (psychiatry), Mr. Mabry (community medicine) and Mr. Steffenhagen (sociology).

Undergraduate courses:

22 Principles of Sociology
141 Social Problems
151 The Family
154 Minority Groups

193, 194 College Honors
195, 196 Special Topics
197, 198 Readings & Research

• SPANISH

Associate Professors Julow (Chairman), Ugalde and Weiger; *Assistant Professors* Zárate and Wesseling; *Instructors* Murad and Núñez-de-Cela.

SPANISH

Thesis research opportunities exist in Spanish literature of the 16th, 17, 19th and 20th centuries and in Spanish-American literature of the 20th century.

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

An undergraduate major or its equivalent in Spanish.

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours in Spanish, including at least one seminar which may also include 6 hours in a related field; 6 hours of thesis research.

A program is also offered leading to the degree of Master of Arts in Teaching:

See pg. 23. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

COURSES OFFERED

223, 224 **ADVANCED COMPOSITION AND CONVERSATION** Composition, conversation, stylistics, panel discussions, translation into Spanish of difficult English prose. Required of those who wish to be recommended to teach Spanish. *Prerequisite:* 122. Three hours. Mr. Ugalde.

261, 262 **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. Alternate years, 1972-73. Three hours. Mr. Núñez-de-Cela.

263, 264 **SPANISH LITERATURE: CERVANTES** Don Quijote, the Novelas Ejemplares, and the theater of Cervantes. *Prerequisite:* any Spanish literature course numbered 100 or above. Alternate years, 1971-72. Three hours. Mr. Núñez-de-Cela.

271, 272 **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:* 162 or Political Science 174 or History 203, 204 or 205. For those who do not present Spanish 162, a knowledge of Spanish is presumed. Three hours. Mr. Zárate. Alternate years, 1972-73.

281 **SPANISH LITERATURE: 19th CENTURY** Principal literary currents of the 19th century, from Romanticism to the "Generation of 1898." Representative readings from the poetry, drama, and novel of the period. *Prerequisite:* Any

Spanish literature course numbered 100 or above or departmental permission. Three hours. Mr. Ugalde. Alternate years, 1971-72.

282 SPANISH LITERATURE: 20th CENTURY Origins and main aspects of the intellectual conflicts in modern Spain, as reflected in the literary works from the "Generation of 1898" to the present. *Prerequisite:* Any Spanish literature course numbered 100 or above or departmental permission. Three hours. Mr. Ugalde. Alternate years, 1971-72.

301, 302 GENERATION OF 1898 The essays, novels, poetry and drama of Unamuno, Azorin, Valle-Inclán, Baroja, Benavente *et al.* Study of such thinkers as Ortega y Gasset and Julián Marias and critics such as Menéndez Pelayo 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 Alegría, Gallegos, Güiraldes, Latorre, López y Fuentes, Rivera and others. *Prerequisite:* 272. Three hours. Mr. Zárate.

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:* 272. Three hours. Mr. Zárate.

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:* 261. Three hours. Mr. Núñez-de-Cela.

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. Núñez-de-Cela.

381 SEMINAR Offered for resident candidates for the Master of Arts degree; opportunities for independent work are provided. Three hours. Mr. Wesseling.

391 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
19 Intermediate Grammar
51, 52 Intermediate Reading

151, 152 Spanish Masterworks
161 Reading in Spanish American
Literature: 19th Century

VOCATIONAL, TECHNICAL AND EXTENSION EDUCATION

119 Advanced Grammar
121, 122 Conversation and
Composition

162 Readings in Spanish American
Literature: Contemporary Period
292 Senior Seminar

• VOCATIONAL, TECHNICAL AND EXTENSION EDUCATION

Associate Professors Fuller; Assistant Professor Kelly; Mrs. Malone and Mr. Spaven.

The Department offers opportunities for personnel in vocational and technical education, extension and continuing education, business education and industrial arts education to pursue a program of graduate study. The Master of Arts in Teaching degree and the Master of Education degree are offered in cooperation with The College of Education. Programs are tailored to meet individual needs. Research is designed to solve practical problems.

VOCATIONAL AND TECHNICAL EDUCATION The degrees of Master of Arts in Teaching and Master of Education are offered for teachers. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for the MAT degree.

EXTENSION EDUCATION The degree of Master of Extension Education is offered for candidates concentrating in extension and continuing education.

COURSES OFFERED

251 METHODS OF TEACHING IN VOCATIONAL AND TECHNICAL EDUCATION Study of advanced techniques in teaching and program management. *Prerequisites:* 154 or 152, or permission of the department. Three hours. Mr. Fuller.

253 TEACHING ADULTS Needs, problems, and objectives for the education of adults. *Prerequisites:* senior standing, or permission of the department. Three hours. Mr. Kelly.

274 TECHNICAL REPORTING Study of communication of information through research and technical operations reports and articles in professional journals. Three hours. Mrs. Malone and Mr. Spaven.

282 SEMINAR Evaluation of student teaching experiences. *Prerequisites:* 155. Mr. Fuller.

295 SPECIAL TOPICS IN VOCATIONAL, TECHNICAL AND EXTEN-

SION EDUCATION Lectures, laboratories and/or readings and reports, to provide advanced students with background and specialized knowledge relating to a contemporary area of study. A student may enroll more than one time and accumulate up to nine hours. *Prerequisite:* Departmental permission. Credit as arranged. I, II. Staff.

301 RESEARCH IN VOCATIONAL, TECHNICAL AND EXTENSION EDUCATION Investigation of a research topic under the direction of an assigned staff member. A student may enroll more than one time and accumulate up to nine hours. Credit as arranged. I, II. Staff.

Undergraduate courses:

102 Extension Methods	156 Materials and Methods for Teaching
104 Leadership Preparation	
150 Technical Internship	157
152 Introduction to Vocational and Technical Education	158
	159
154 Teaching Internship	173 Communication Methods
155 Teaching Practicum	197 Special Problems

• **ZOOLOGY**

Professors Bell, Glade (Chairman), Henson, Lochhead, Moody, Potash, and Rothstein; Associate Professors Davison and Stevens; Assistant Professors Brammer, Keen, Landesman, and Woods.

Faculty research interests fall within the general areas of environmental biology, developmental biology, and cell biology. Current on-going projects include research in insect taxonomy and ecology, especially of the Carabidae; aquatic ecology with emphasis on Lake Champlain; chemical and experimental embryology of amphibians and crustaceans; arthropod anatomy and physiology; mechanisms of cell division; the synthesis of macromolecules during mitosis; comparative anatomy. 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).

ZOOLOGY

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 23. Satisfactory scores on the Graduate Record Examination are prerequisites for acceptance to candidacy for this degree.

PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS (BIOLOGY)

A bachelor's degree from an accredited institution and certification as a teacher of biology or an associated field. At least three years of secondary school teaching. Satisfactory scores on the graduate record examinations.

MINIMUM DEGREE REQUIREMENTS

Thirty hours of course work to include a selection of courses in the Department of Botany and Zoology which will broaden and balance the undergraduate work in biology. At least two 200 level courses in each department. Courses in four of the five following areas: anatomy; morphology and systematics; genetics; developmental biology; and environmental biology. Up to 12 hours of 100 level courses may be used for the above requirements. Students will be encouraged to select courses in related science department, mathematics, and in education to complete the required thirty hours. No thesis is required, however, each degree recipient must complete a written and oral examination.

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; a reading knowledge of two appropriate foreign languages. Students whose programs are to include Physical Chemistry should have had, or should take, mathematics through Mathematics 121 or its equivalent. Satisfactory showing in an oral qualifying examination administered by the Studies Committee with the participation of the Department. 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.

Each candidate must participate in the teaching of at least one undergraduate course.

COURSES OFFERED

201 CONTROL OF GROWTH AND DIFFERENTIATION Factors controlling the processes of growth and differentiation in selected animal forms. Lectures and discussion. Three hours. *Prerequisites:* 101, 211 and Chemistry 131, 132. Mr. Davison. Alternate years, 1971-72.

203 POPULATION ECOLOGY Dynamics, composition, and density regulation of animal populations. *Prerequisite:* 102. Three hours. Mr. Potash.

207 VERTEBRATES Classification, ecology, behavior, evolution, and distribution of vertebrates other than birds. *Prerequisite:* 104. Four hours. Mr. Bell. Alternate years, 1972-73.

208 GENERAL ENTOMOLOGY Study of insects; morphology, physiology, and evolution. *Prerequisite:* 102 or 103. Four hours. Mr. Bell. Alternate years, 1971-72.

209 FIELD ZOOLOGY Collection and identification of animals; study of local habitats, their nature, and the adaptations of animals to them; factors governing distribution of animals; methods of collecting and preparing study specimens. *Prerequisite:* 102 or 103. Four hours. Mr. Bell.

211 EMBRYOLOGY General principles of development exemplified by typical invertebrate and vertebrate embryos. *Prerequisite:* 104, junior standing. Four hours. Mr. Glade.

212 COMPARATIVE HISTOLOGY Microscopic anatomy of tissues, chiefly vertebrate. Basic tissue similarities and specializations of organs among the various groups of animals in relation to function. *Prerequisite:* 104. Four hours. Mr. Glade. Alternate years, 1971-72.

216 HUMAN GENETICS Principles of human inheritance; population genetics; interaction of heredity and environment; application of principles of heredity to human problems. *Prerequisite:* 101 or Botany 254. Three hours. Mr. Moody.

219 COMPARATIVE VERTEBRATE ANATOMY Structure, function, and phylogeny of vertebrates. Survey of important evolutionary and functional trends. Thorough investigation of the structure of all chordate groups by both lecture and laboratory techniques. *Prerequisite:* 104. Four hours. Mr. Woods.

220 MECHANISMS OF CELL DIVISION A study of the fine structure and

ZOOLOGY

physiology of normal and abnormal cell division with special emphasis upon mechanisms. *Prerequisite:* 103, a course in biochemistry, and the consent of the instructor. Three hours. Mr. Stevens. Alternate years, 1971-72.

222 EXPERIMENTAL EMBRYOLOGY Theoretical approach to major problems of development based on research in embryology, genetics, physiology, bacteriology, and related fields. *Prerequisite:* 211 and consent of the instructor. Four hours. Mr. Glade. Alternate years, 1971-72.

223 BIOCHEMICAL EMBRYOLOGY Examination of the inter- and intra-cellular processes occurring during oogenesis and embryogenesis of selected invertebrate and vertebrate organisms. Emphasis will be on the biochemical and structural differentiation of cells and tissues. *Prerequisite:* 101, 211, and consent of the instructor. A course in biochemistry is recommended. Three hours. Mr. Landesman. Alternate years, 1972-73.

225 ENVIRONMENTAL PHYSIOLOGY The physiological processes by which animals cope with moderate, changing, and extreme environments. *Prerequisite:* 102 and 104. Four hours. Staff. Alternate years, 1971-72.

231 CELL PHYSIOLOGY Study of cell function, with emphasis upon experimental techniques used to elucidate chemical and physical mechanisms within living cells. *Prerequisite:* 103; 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:* 102 and inorganic chemistry. Four hours. Mr. Henson.

250 INVERTEBRATE ZOOLOGY Anatomy, physiology, and life histories of representatives of the more important invertebrate phyla. *Prerequisite:* 104. Four hours. Mr. Lochhead.

251 INSECT PHYSIOLOGY Examination of some of the mechanisms developed by insects which enable them to function in a variety of environments. *Prerequisite:* 104 or consent of instructor; 208 or 209 recommended. Three hours. Mr. Brammer. Alternate years, 1972-73.

255 COMPARATIVE ANIMAL PHYSIOLOGY General principles of function in invertebrates and vertebrates. *Prerequisite:* 104; Chemistry 131, 132; and consent of the instructor. Four hours. Mr. Rothstein. Not offered 1971-72.

267 GENETICS OF DEVELOPMENT Problems of differentiation and morphogenesis approached from the viewpoint of gene action and biosynthesis; in-

fluence of hereditary material during ontogeny. *Prerequisite:* 101 and 104, and consent of the instructor. Four hours. Staff. Alternate years, 1972-73.

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:* 101 (102 recommended). Three hours. Mr. Moody.

271 ADVANCED LIMNOLOGY Analysis of current limnological concepts and problems. *Prerequisite:* 236. Four hours. Mr. Henson.

281 SEMINAR Review and discussion of current zoological research. Graduate students and seniors in zoological research programs are expected to enroll each semester. Without credit. Staff.

381 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 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 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 | 104 Comparative Structure and Function |
| 3 Biology and Man | 105 Genetics Laboratory |
| 5-6 Mammalian Anatomy and Physiology | 193, 194 College Honors |
| 101 Genetics | 195, 196 Special Topics |
| 102 Environmental Zoology | 197, 198 Undergraduate Research |
| 103 General Structure and Function | |

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A.M., Ph.D. (Harvard)

HERBERT EVERETT PUTNAM
M.A., Ph.D. (Minnesota)

Associate Professor of History

LYMAN SMITH ROWELL
M.S. (Vermont)

President Emeritus

NELSON LEE WALBRIDGE
M.S. (Vermont), Ph.D. (Chicago)

Professor of Physics

Members of The Graduate Faculty

JOSEPH ANTHONY ABRUSCATO	<i>Assistant Professor of Education</i>
M.A. (Trenton), Ph.D. (Ohio State)	
PATRICIA MARLENE ABSHER	<i>Assistant Professor of Medical Microbiology</i>
Ph.D. (North Carolina)	
RICHARD GAYLON ABSHER	<i>Assistant Professor of Electrical Engineering</i>
M.S. (New Mexico), Ph.D. (Duke)	
RUSSELL MAYNARD AGNE	<i>Assistant Professor of Education</i>
Ph.D. (Conn.)	
CHRISTOPHER WHITNEY ALLEN	<i>Assistant Professor of Chemistry</i>
M.S., Ph.D. (Illinois)	
ABBAS ALNASRAWI	<i>Associate Professor of Economics and Business Administration</i>
A.M., Ph.D. (Harvard)	
NORMAN RONALD ALPERT	<i>Professor of Physiology and Biophysics</i>
Ph.D. (Columbia)	
ZUELL PHILIP AMBROSE	<i>Associate Professor of Classics</i>
M.A., Ph.D. (Princeton)	
ALFRED JOHN ANDREA	<i>Assistant Professor of History</i>
Ph.D. (Cornell)	
EDWARD CLINTON ANDREWS, JR.	<i>Professor of Pathology</i>
M.D. (Johns Hopkins)	
HENRY VERNON ATHERTON	<i>Professor of Animal Sciences</i>
M.S. (Vermont), Ph.D. (Pennsylvania State)	
JOHN EMERSON BAKER	<i>Professor of Education</i>
M.A. (Minnesota), Ph.D. (Chicago)	
BETTY BANDEL	<i>Professor of English</i>
M.A., Ph.D. (Columbia)	
HORACE GARDINER BARNUM	<i>Associate Professor of Geography</i>
M.S., Ph.D. (Chicago)	
RICHMOND JAY BARTLETT	<i>Professor of Plant and Soil Science</i>
Ph.D. (Ohio State)	
ROSS TAYLOR BELL	<i>Professor of Zoology</i>
M.S., Ph.D. (Illinois)	
GEORGE RAYMOND BENOIT	<i>Lecturer, Plant and Soil Science</i>
M.S., Ph.D. (Iowa State)	
JOHN TREVOR BERRY	<i>Professor of Mechanical Engineering</i>
Ph.D. (Birmingham)	
FRANCIS ROYSTER BLISS	<i>Professor of Classics</i>
Ph.D. (North Carolina)	
SAMUEL NATHANIEL BOGORAD	<i>Frederick Corse Professor of English Language</i>
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THE GRADUATE FACULTY

BETTY MACHTEL BOLLER	<i>Professor of Education</i>
M.Ed. (Louisville), D.Ed. (Harvard)	
WESSON DUDLEY BOLTON	<i>Professor of Animal Pathology</i>
D.V.M. (Michigan State), M.S. (Vermont)	
DAVID KENNETH BORAKER	<i>Assistant Professor of Medical Microbiology</i>
Ph.D. (U.C.L.A.)	
BERTIE REYNOLD BOYCE	<i>Assistant Professor of Plant and Soil Science</i>
M.S. (Vermont), Ph.D. (Rutgers)	
PAUL BROCK	<i>Professor of Mathematics</i>
M.S., Ph.D. (NYU)	
DAVID BASSETT BROWN	<i>Assistant Professor of Chemistry</i>
M.S., Ph.D. (Northwestern)	
JOHN STEWART BROWN, JR.	<i>Associate Professor of Physics</i>
S.B. (M.I.T.), M.S., Ph.D. (Rutgers)	
JAMES WILLIAM BERGMEIER	<i>Assistant Professor of Mathematics</i>
M.S. (Colorado), Ph.D. (New Mexico)	
ANTHONY SAMUEL CAMPAGNA	<i>Associate Professor of Economics & Business Administration</i>
M.A., Ph.D. (Rutgers)	
CHARLES WARREN CASE	<i>Associate Professor of Education</i>
M.S. (Syracuse), Ed.D. (Rochester)	
ERLING WILLIAM CHAMBERLAIN	<i>Associate Professor of Mathematics</i>
M.A., Ph.D. (Columbia)	
ALFRED HAYES CHAMBERS	<i>Professor of Physiology and Biophysics</i>
Ph.D. (Pennsylvania)	
JAMES CLIEM CHAPMAN	<i>Associate Professor of Music</i>
M.Mus. (Michigan), Ph.D. (N.Y.U.)	
RICHARD XAVIER CHASE	<i>Associate Professor of Economics and Business Administration</i>
M.B.A., Ph.D. (Maryland)	
WALLACE WAYNE CHRISTENSEN	<i>Professor of Forestry</i>
M.F., Ph.D. (SUNY at Syracuse)	
VIRGINIA PRESCOTT CLARK	<i>Assistant Professor of English</i>
M.A. (Univ. of Vermont), Ph.D. (U. Conn.)	
JACKSON JOSHUA WALTER CLEMMONS	<i>Associate Professor of Pathology</i>
M.S., Ph.D. (Wisconsin), M.D. (Western Reserve)	
ROBERT WILLARD COCHRAN	<i>Professor of English</i>
M.A., Ph.D. (Michigan)	
PHILIP WILLIAM COOK	<i>Associate Professor of Botany</i>
M.S. (Vermont), Ph.D. (Indiana)	
ROGER LEE COOKE	<i>Assistant Professor of Mathematics</i>
M.A., Ph.D. (Princeton)	
ROBERT WILLIAM COON	<i>Professor of Pathology</i>
M.D. (Rochester)	
REX DEE COUCH	<i>Associate Professor of Pathology</i>
M.D. (Indiana)	
JOHN EDWARD CRAIGHEAD	<i>Professor of Pathology</i>
M.D. (Utah)	

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ALBERT DARY CROWELL	<i>Professor of Physics</i>
M.S. (Harvard), Ph.D. (Brown)	
MALCOLM DANIEL DAGGETT	<i>Professor of Romance Languages</i>
A.M., Ph.D. (Harvard)	
ROBERT VINCENT DANIELS	<i>Professor of History</i>
A.M., Ph.D. (Harvard)	
JEAN MARGARET DAVISON	<i>Professor of Classical Languages and History</i>
A.M., Ph.D. (Yale)	
JOHN AMERPOHL DAVISON	<i>Associate Professor of Zoology</i>
Ph.D. (Minnesota)	
ROBERT FRANK DAWSON	<i>Associate Professor of Civil Engineering</i>
M.S.C.E. (Cornell), Ph.D. (Purdue)	
LUBOMIR A. D. DELLIN	<i>Professor of Economics and Business Administration</i>
J.S.D. (Genoa)	
ROBERT WARREN DETENBECK	<i>Professor of Physics</i>
Ph.D. (Princeton)	
GERALD ALTON DONOVAN	<i>Professor of Animal Sciences</i>
M.S. (Connecticut), Ph.D. (Iowa)	
THOMAS WHITFIELD DOWE	<i>Professor of Animal Sciences</i>
M.S., Ph.D. (Kansas State)	
RICHARD NEAL DOWNER	<i>Assistant Professor of Civil Engineering</i>
Ph.D. (Colorado St. U.)	
HOWARD DUCHACEK	<i>Associate Professor of Mechanical Engineering</i>
M.S.A.E. (Georgia Institute of Technology)	
FRED WILLIAMS DUNIhue	<i>Professor of Anatomy</i>
M.S., Ph.D. (New York University)	
ALEXANDER HARRY DUTHIE	<i>Associate Professor of Animal Sciences</i>
M.S. (Connecticut), Ph.D. (Pennsylvania State)	
JULIUS SOLOMON DWORK	<i>Associate Professor of Mathematics</i>
Ph.D. (N.Y.U.)	
DAVID MILLER ELLIS	<i>Assistant Professor of Electrical Engineering</i>
M.S., Ph.D. (Washington)	
WARREN ORVEL ESSLER	<i>Professor of Electrical Engineering</i>
M.S. (Iowa), Ph.D. (Iowa State)	
BUD EThERTON	<i>Associate Professor of Botany</i>
Ph.D. (Washington State)	
FREDERICK CHRISTIAN EVERING	<i>Associate Professor of Electrical Engineering</i>
M.S.E., Ph.D. (Johns Hopkins)	
JON BAKER FACKLER	<i>Assistant Professor of History</i>
M.A., Ph.D. (Penn. State)	
JEREMY POLLARD FELT	<i>Professor of History</i>
M.A. (Duke), Ph.D. (Syracuse)	
JAMES GATES FERGUSON, JR.	<i>Assistant Professor of Psychology</i>
M.A., Ph.D. (North Carolina)	
CHARLES LYNN FIFE	<i>Assistant Professor of Agricultural Economics</i>
M.S. (Oregon), Ph.D. (Purdue)	

THE GRADUATE FACULTY

TED BENJAMIN FLANAGAN	
Ph.D. (Washington)	<i>Professor of Chemistry</i>
MURRAY WILBUR FOOTE	<i>Associate Professor of Microbiology and Biochemistry</i>
M.S. (Vermont), Ph.D. (Connecticut)	
DONALD GABRIAL FORGAYS	<i>Professor of Psychology</i>
M.A., Ph.D. (McGill)	
WAYNE LENIS FOX	<i>Associate Professor of Education</i>
Ph.D. (U. of Arizona)	
STEVEN LESLIE FREEDMAN	<i>Associate Professor of Anatomy</i>
Ph.D. (Rutgers)	
GERALD ROSS FULLER	<i>Associate Professor of Vocational,</i>
M.Ed., Ed.D. (Cornell)	<i>Technical, Extension Education</i>
DANIEL WAYNE GADE	<i>Associate Professor of Geography</i>
M.S., Ph.D. (Wisconsin)	
JAMES GERALD GALLAGHER	<i>Assistant Professor of Medical Microbiology</i>
M.S., Ph.D. (Illinois)	
JOSEPH HERBERT GANS	<i>Professor of Pharmacology</i>
V.M.D. (Pennsylvania), Ph.D. (Jefferson Medical)	
ALPHONSE HENRY GILBERT	<i>Assistant Professor of Agricultural Economics</i>
M.S. (Michigan), Ph.D. (Colorado)	
BRADY BLACKFORD GILLELAND	<i>Professor of Classical Languages</i>
M.A. (Oklahoma), Ph.D. (North Carolina)	
RICHARD WILLIAM GLADE	<i>Professor of Zoology</i>
M.S., Ph.D. (Illinois)	
ROBERT JOHN GOBIN	<i>Assistant Professor of Physical Education</i>
M.Ed. (Bowling Green), Ph.D. (Ohio State)	
LYMAN JAY GOULD	<i>Professor of Political Science</i>
M.A., Ph.D. (Michigan)	
ALLEN P. GRAY	<i>Associate Professor of Pharmacology</i>
A.M., Ph.D. (Columbia)	
EDWIN CHARLES GREIF	<i>Professor of Economics and Business Administration</i>
M.S. (New York University)	
MARY STARRITT HALL	<i>Assistant Professor of English</i>
M.A. (Univ. of Vermont), Ph.D. (Princeton)	
ROBERT WILLIAM HALL	<i>Professor of Philosophy and Religion</i>
M.A., Ph.D. (Harvard)	
SAMUEL B. HAND	<i>Professor of History</i>
Ph.D. (Syracuse)	
MORRIS HANDELSMAN	<i>Professor of Electrical Engineering</i>
M.E.E. (Ohio), Ph.D. (Syracuse)	
EDWARD MICHAEL HANLEY	<i>Assistant Professor of Education</i>
M.A. (Arizona), Ph.D. (Kansas)	
ROLF NORDAHL BRUN HAUGEN	<i>Professor of Political Science</i>
M.A., Ph.D. (Harvard)	
WILLIAM A. HAVILAND	<i>Associate Professor of Sociology and Anthropology</i>
M.A., Ph.D. (U. of Penn.)	

THE GRADUATE FACULTY

EARL BENNETTE HENSON	<i>Professor of Zoology</i>
M.S. (West Virginia), Ph.D. (Cornell)	
DAVID BYRNE HILL	<i>Associate Professor of Mathematics and Community Medicine</i>
M.S., Ph.D. (Stevens Institute of Technology)	
RICHARD JOHN HOPP	<i>Professor of Plant and Soil Science</i>
M.S. (New Hampshire)	
JAMES ROBINSON HOWE	<i>Assistant Professor of English</i>
M.A., Ph.D. (N.Y.U.)	
DAVID CHARLES HOWELL	<i>Assistant Professor of Psychology</i>
M.S., Ph.D. (Tulane)	
MAHENDRA SINGH HUNDAL	<i>Associate Professor of Mechanical Engineering</i>
M.S., Ph.D. (Wisconsin)	
ALLEN STANDISH HUNT	<i>Associate Professor of Geology</i>
M.S. (Michigan), Ph.D. (Harvard)	
LYMAN CURTIS HUNT, JR.	<i>Professor of Education</i>
M.A., Ed.D. (Syracuse)	
BEAL BAKER HYDE	<i>Professor of Botany</i>
A.M., Ph.D. (Harvard)	
YOSHINORI ISHIKAWA	<i>Instructor in Biochemistry</i>
Ph.D. (Univ. of Hokkaido)	
JOSEPH ANTHONY IZZO, JR.	<i>Professor of Mathematics</i>
M.S. (Illinois), Ph.D. (Columbia)	
JULIAN JOSEPH JAFFE	<i>Professor of Pharmacology</i>
M.A., Ph.D. (Harvard)	
JUSTIN MANFRED JOFFE	<i>Associate Professor of Psychology</i>
M.A. (U. of Witwatersrand), Ph.D. (U. of London)	
STUART LYNDE JOHNSTON	<i>Professor of Romance Languages</i>
Ph.D. (Harvard)	
DONALD BOYES JOHNSTONE	<i>Professor of Microbiology and Biochemistry</i>
M.S., Ph.D. (Rutgers)	
LEONIDAS MONROE JONES	<i>Professor of English</i>
A.M., Ph.D. (Harvard)	
DAVID WILLIAM JUNKER	<i>Professor of Physics</i>
Ph.D. (Notre Dame)	
ROY GEORGE JULOW	<i>Associate Professor of Romance Languages</i>
A.M. (Missouri), Ph.D. (Washington)	
MARC Z. KESSLER	<i>Assistant Professor of Psychology</i>
Ph.D. (Nebraska)	
JOHN L. KICE	<i>Professor of Chemistry</i>
M.A., Ph.D. (Harvard)	
DAVID LESLIE KINSEY	<i>Associate Professor of Music</i>
M.A., Ph.D. (Columbia)	
RICHARD M. KLEIN	<i>Professor of Botany</i>
M.S., Ph.D. (Chicago)	
ROY KORSON	<i>Professor of Pathology</i>
M.D. (Jefferson)	

THE GRADUATE FACULTY

ANDREW PAUL KRAPCHO	<i>Professor of Chemistry</i>
M.A., Ph.D. (Harvard)	
JOHN ERNEST KRIZAN	<i>Associate Professor of Physics</i>
M.S., Ph.D. (Lehigh)	
MARTIN ERIC KUEHNE	<i>Professor of Chemistry</i>
M.A. (Harvard), Ph.D. (Columbia)	
BERT KARL KUSSEROW	<i>Professor of Pathology</i>
M.D. (Yale)	
GENE EARL LABER	<i>Assistant Professor of Economics and Business Administration</i>
Ph.D. (U. Maryland)	
DAVID CHIN LAI	<i>Professor of Electrical Engineering</i>
D.Eng. (Johns Hopkins)	
LLOYD MILTON LAMBERT, JR.	<i>Professor of Electrical Engineering</i>
M.S.E.E., M.A., Ph.D. (California)	
MERTON PHILIP LAMDEN	<i>Associate Professor of Biochemistry</i>
Ph.D. (M.I.T.)	
RICHARD H. LANDESMAN	<i>Assistant Professor of Zoology</i>
M.S. (N.Y.U.), Ph.D. (British Columbia)	
HELENE WANDA LANG	<i>Assistant Professor of Education</i>
M.Ed., Ed.D. (Boston Univ.)	
ROBERT LOWELL LARSON	<i>Assistant Professor of Education</i>
M.Ed. (Bridgewater), Ed.D. (Boston Univ.)	
ROBERT BERNARD LAWSON	<i>Associate Professor of Psychology</i>
M.A., Ph.D. (Delaware)	
HAROLD LEITENBERG	<i>Associate Professor of Psychology</i>
Ph.D. (Indiana)	
WILLIAM J. LEWIS	<i>Professor of Speech</i>
M.A. (Northwestern), Ph.D. (Florida)	
FRANK WAYNE LIDRAL	<i>Professor of Music</i>
M.Mus. (Northwestern), Ph.D. (Eastman School of Music)	
HARRY LIGHTHALL, JR.	<i>Professor of Mathematics</i>
M.S. [Chemistry], M.S. [Mathematics] (M.I.T.), Ph.D. (Brown)	
JOHN HUTCHISON LOCHHEAD	<i>Professor of Zoology</i>
M.A. (St. Andrews), Ph.D. (Cambridge)	
NORMAN THEODORE LONDON	<i>Professor of Speech</i>
M.A., Ed.D. (New York University)	
LITTLETON LONG	<i>Professor of English</i>
M.A., Ph.D. (Yale)	
WILLIAM HOSSFELD LUGINBUHL	<i>Professor of Pathology</i>
M.D. (Northwestern)	
WILLIAM HOOPER MACMILLAN	<i>Professor of Pharmacology</i>
Ph.D. (Yale)	
FRANK MANCHEL	<i>Associate Professor of English</i>
M.A. (Hunter), Ed.D. (Columbia)	
FRANK MARTINEK	<i>Associate Professor of Mechanical Engineering</i>
M.E. (Czechoslovakia), M.E. (McGill), Ph.D. (Cincinnati)	

THE GRADUATE FACULTY

JAMES WALLACE MARVIN	<i>Professor of Botany</i>
M.S. (Vermont), Ph.D. (Columbia)	
JOHN JOSEPH McCORMACK, JR.	<i>Associate Professor of Pharmacology</i>
Ph.D. (Yale)	
MAXWELL L. McCORMACK, JR.	<i>Associate Professor of Forestry</i>
M.F., D.F. (Duke)	
H. LAWRENCE McCROREY	<i>Associate Professor of Physiology and Biophysics</i>
M.S. (Illinois), M.S. (Michigan), Ph.D. (Illinois)	
JERRY LEON McINTOSH	<i>Associate Professor of Plant and Soil Science</i>
M.S., Ph.D. (Missouri)	
HUGH STRATTON McKENZIE	<i>Associate Professor of Education</i>
Ph.D. (Arizona)	
RICHARD WARREN McLAY	<i>Associate Professor of Mechanical Engineering</i>
M.S., Ph.D. (Wisconsin)	
DONALD BURTON McLVILLE	<i>Professor of Biochemistry</i>
M.S., Ph.D. (Illinois)	
BRUCE ELWYN MESERVE	<i>Professor of Mathematics</i>
M.A., Ph.D. (Duke)	
WILLIAM CRAIG METCALFE	<i>Associate Professor of History</i>
M.A., Ph.D. (Minnesota)	
WILLIAM LAROS MEYER	<i>Associate Professor of Biochemistry</i>
Ph.D. (University of Washington)	
GARY KEITH MICHAEL	<i>Associate Professor of Economics</i>
M.B.A. (Michigan State), C.P.A.	<i>and Business Administration</i>
EDWARD JERVIS MILES	<i>Professor of Geography</i>
M.A., Ph.D. (Syracuse)	
EAGAN MIRCHANDANI	<i>Assistant Professor of Electrical Engineering</i>
M.S. (Syracuse), Ph.D. (Cornell)	
THOMAS JOHN MOEHRING	<i>Assistant Professor of Medical Microbiology</i>
M.S., Ph.D. (Rutgers)	
ELLEN HASTINGS MORSE	<i>Professor of Home Economics</i>
M.A. (Smith), M.S. (Massachusetts), Ph.D. (Connecticut)	
DONALD EUGENE MOSER	<i>Professor of Mathematics</i>
A.M. (Brown), Ph.D. (Pittsburgh)	
H. NICHOLAS MULLER III	<i>Associate Professor of History</i>
Ph.D. (Rochester)	
RICHARD E. MUSTY	<i>Assistant Professor of Psychology</i>
M.A., Ph.D. (McGill)	
MILTON JOSEPH NADWORNY	<i>Professor of Economics and Business Administration</i>
M.A. (Columbia), Ph.D. (Wisconsin)	
ROBERT JAMES NASH	<i>Assistant Professor of Education</i>
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CHARLES PRYOR NOVOTNY	<i>Assistant Professor of Medical Microbiology</i>
Ph.D. (Pittsburgh)	
WESLEY LEMARS NYBORG	<i>Professor of Physics</i>
M.S., Ph.D. (Pennsylvania State)	

THE GRADUATE FACULTY

ELBERT AUSTIN NYQUIST	<i>Professor of Economics and Business Administration</i>
M.S. (Vermont), C.P.A.	
JOSEPH CLARENCE OPPENLANDER	<i>Professor of Civil Engineering</i>
M.S.C.E. (Purdue), Ph.D. (Illinois)	
RALPH HARRY ORTH	<i>Professor of English</i>
Ph.D. (University of Rochester)	
JOHN OGDEN OUTWATER, JR.	<i>Professor of Mechanical Engineering</i>
M.A. (Cambridge), Sc.D. (M.I.T.)	
JAMES HARRIS OVERFIELD	<i>Assistant Professor of History</i>
M.A. (Chicago), Ph.D. (Princeton)	
WILLIAM EDWARD PADEN	<i>Assistant Professor of Philosophy & Religion</i>
M.A., Ph.D. (Claremont)	
IPPOCRATES PAPPOUTSAKIS	<i>Professor of Music</i>
M.Mus. (N. E. Conservatory)	
RODNEY LAWRENCE PARSONS	<i>Associate Professor of Physiology & Biophysics</i>
Ph.D. (Stanford)	
WAYNE CURTIS PATTERSON	<i>Associate Professor of Psychology</i>
M.S., Ph.D. (Delaware)	
NORMAN EUGENE PELLETT	<i>Associate Professor of Plant and Soil Science</i>
M.S., Ph.D. (Minnesota)	
MERVYN WILLIAM PERRINE	<i>Associate Professor of Psychology</i>
M.A., Ph.D. (Princeton)	
JAMES ALLAN PETERSON	<i>Associate Professor of Education</i>
M.Ed. (South Dakota State University), Ed.D. (Boston University)	
SIDNEY BORIS POGER	<i>Associate Professor of English</i>
M.A., Ph.D. (Columbia)	
MILTON POTASH	<i>Professor of Zoology</i>
M.A. (Indiana), Ph.D. (Cornell)	
RONALD EUGENE PRATHER	<i>Associate Professor of Mathematics</i>
M.S., M.A. (Berkeley), Ph.D. (Syracuse)	
DAVID WILLIAM RACUSEN	<i>Professor of Microbiology and Biochemistry</i>
Ph.D. (Iowa State)	
ERNEST REIT	<i>Associate Professor of Pharmacology</i>
D.V.M. (Cornell), Ph.D. (Yale)	
HEATH KENYON RIGGS	<i>Professor of Mathematics</i>
M.S. (Vermont), M.S., Ph.D. (Chicago)	
S. ALEXANDER RIPPA	<i>Professor of Education</i>
M.A. (Vanderbilt), Ed.D. (Harvard)	
DONALD STETSON ROBINSON	<i>Associate Professor of Pharmacology</i>
M.S. (Vermont), M.D. (Pennsylvania)	
ALFRED BROOKS ROLLINS	<i>Professor of History</i>
M.A. (Wesleyan University), Ph.D. (Harvard)	
WILFRED ROTH	<i>Professor of Electrical Engineering</i>
Ph.D. (M.I.T.)	
HOWARD ROTHSTEIN	<i>Professor of Zoology</i>
Ph.D. (Pennsylvania)	

THE GRADUATE FACULTY

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M.A., Ph.D. (Columbia)	
STANLEY RUSH	<i>Professor of Electrical Engineering</i>
M.E.E., Ph.D. (Syracuse)	
ALBERT WILLIAM SADLER	<i>Professor of Philosophy and Religion</i>
M.A., Ph.D. (Columbia)	
FREDERIC OBERLIN SARGENT	<i>Professor of Agricultural Economics</i>
Ph.D. (Wisconsin)	
LEONARD MICHAEL SCARFONE	<i>Professor of Physics</i>
M.A. (Williams), Ph.D. (R.P.I.)	
WARREN IRA SCHAEFFER	<i>Professor of Medical Microbiology</i>
M.S., Ph.D. (Rutgers)	
ROBIN RUDOLF SCHLUNK	<i>Associate Professor of Classics</i>
Ph.D. (Cincinnati)	
WOLFE WILHELM SCHMOKE	<i>Professor of History</i>
M.A., Ph.D. (Yale)	
NORMAN JAMES SCHOONMAKER	<i>Flint Professor of Mathematics</i>
M.S. (Chicago), Ph.D. (Pittsburgh)	
HAROLD SEESSEL SCHULTZ	<i>Professor of History</i>
M.A., Ph.D. (Duke)	
HERBERT LEWIS SCHULTZ	<i>Associate Professor of Music</i>
M.A., Ed.D. (Columbia)	
ALLEN GLASS SHEPHERD, III	<i>Associate Professor of English</i>
M.A. (Brown), Ph.D. (Penn.)	
KENNETH ROGERS SIMMONS	<i>Associate Professor of Animal Sciences</i>
M.S., Ph.D. (Cornell)	
ROBERT ORVILLE SINCLAIR	<i>Professor of Agricultural Economics</i>
M.S. (Vermont), Ph.D. (Michigan State)	
ROBERT ERIK SJOGREN	<i>Associate Professor of Microbiology & Biochemistry</i>
M.S., Ph.D. (Cincinnati)	
ALBERT MATTHEW SMITH	<i>Professor of Animal Sciences</i>
M.S., Ph.D. (Cornell)	
ANDREW GEORGE SMITH	<i>Professor of Medical Microbiology</i>
M.S., Ph.D. (Pennsylvania)	
DURWOOD JAMES SMITH	<i>Professor of Pharmacology</i>
M.D. (Syracuse)	
THOMAS JOHN SPINNER, JR.	<i>Associate Professor of History</i>
M.A. (Columbia), Ph.D. (Rochester)	
THOMAS SPROSTON, JR.	<i>Professor of Botany</i>
Ph.D. (Cornell)	
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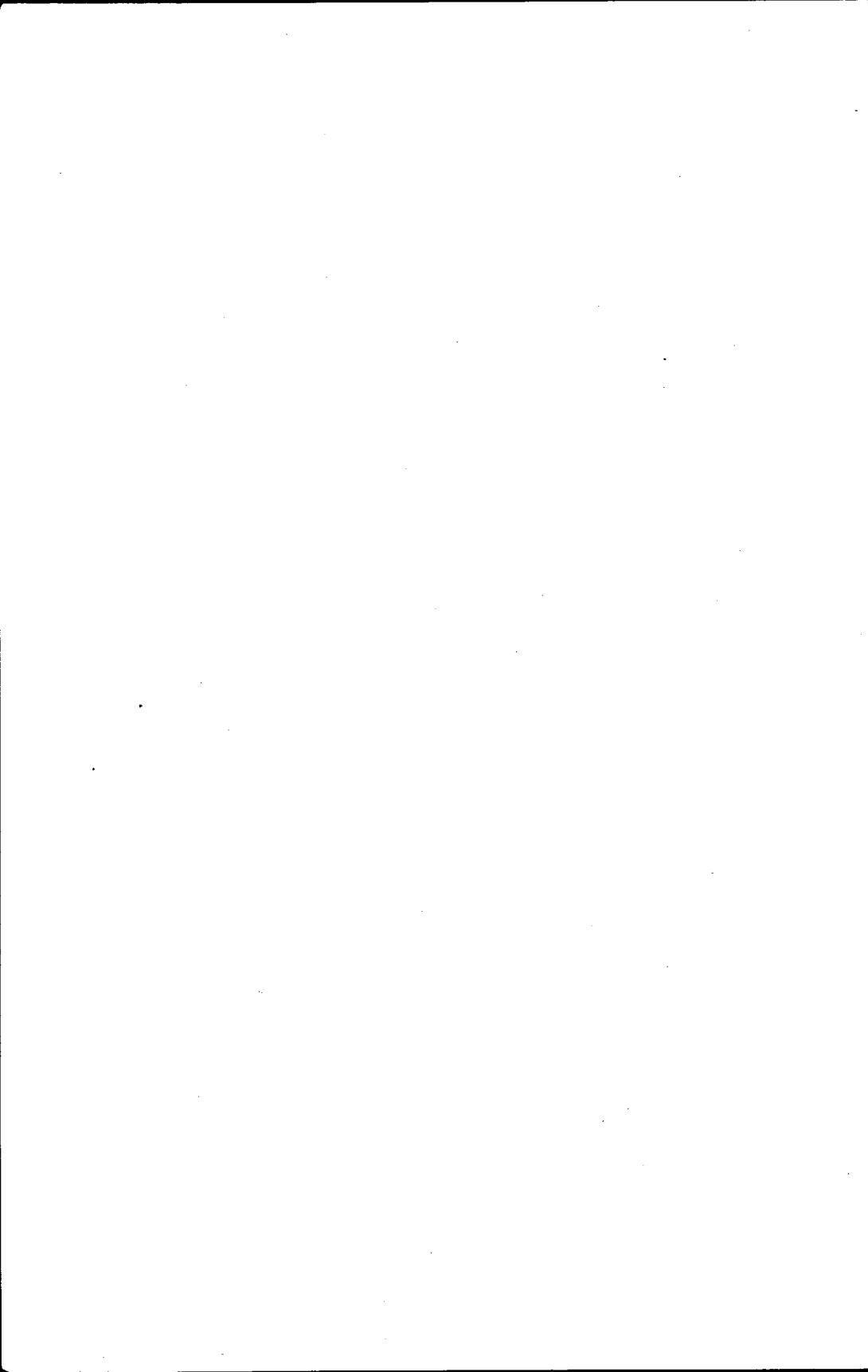
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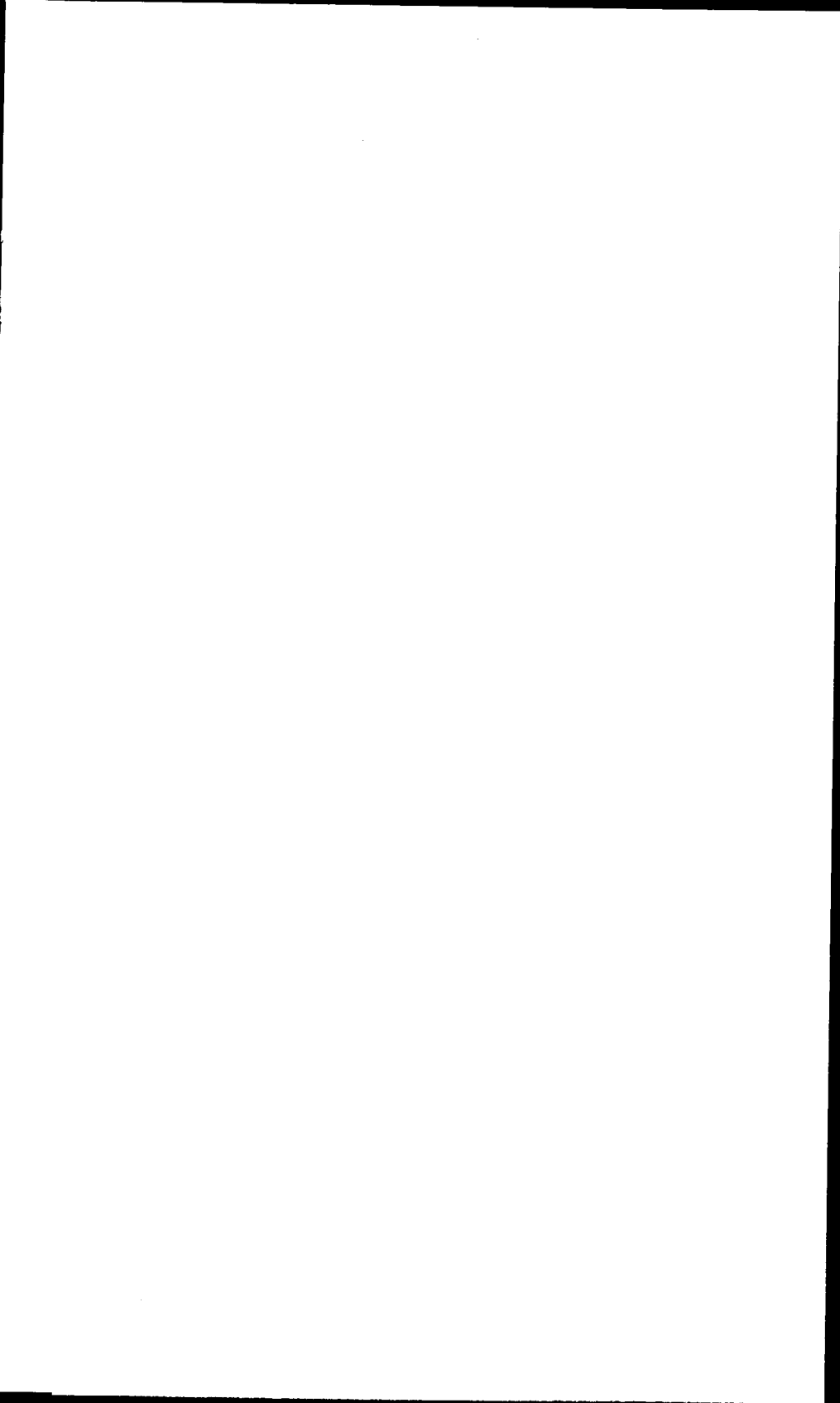
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tur statim erubescences: qui dicunt michi euge
euge. **E**xultent et letentur in te oēs qui que-
runt te/ & dicāt semp magnificetur dñs qui dili-
gunt salutare tuū **E**go vero egen⁹ et pauper
sum deus adiuua me. **E**diutor meus & libe-
rator meus es tu: domine ne moreris. **G**loria pñ.
v. 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 scdm pñā nra, facias no-
bis. r. Neq; scdm iniquitates nras retribuas no-
bis. v. Oremus p pñtifice nro. r. Dñs cōseruet
eū & viuificet eū & bñm faciat eū in terra: & nō
tradat eū in aīam inimicor ei⁹. v. Orem⁹ p bñs
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.
v. Pro fratribus nris absentibus. r. Saluos fac
seruos tuos deus meus sperantes in te. v. Mitte
eis domine auxilium de sancto. r. m. Et desyō
tuere eos. v. Domine exaudi orationem meam
r. Et clamor meus ad te veniat. v. Domin⁹ vo-
bis cum. r. Et cum spiritu tuo. **O**ratio.

Deus cui proprium est misereri semper/
et parcere: suscipe deprecationem no-
stram. vt nos & omnes famulos tuos quos deli-
ctorum cathena constringit/ miseratio tue ples-
tatis absoluat.

Oratio.