



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


qualis esset ista salutatio. Et ait angelus ei. Ne ti  
meas maria inuenisti enim grām apud deū. Ec  
ce concipies in vtero & paries filium: & vocabis  
nomē eius iesum. Hic erit magnus & filius altis  
simi vocabit⁹. Et dabit illi dñs deus sedē dauīd  
p̄ris ei⁹: & regnabit ī domo iacob in eternum:  
& regni ei⁹ nō erit finis. Dixit autē maria ad an  
gelū. Quō fiet istud qm virū nō cognosco? Et  
rñdens angelus dixit ei. Spūs sct⁹ supueniet in  
te: & virt⁹ altissimi obūbrabit tibi. Ideoq; & qđ  
nasce⁹ ex te sctm 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.

**I**n initium sancti euangelij: secundum  
Matheum. Gloria tibi domine.

The University of Vermont

THE GRADUATE COLLEGE

Catalogue and Announcements



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 MONTER 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, "ROTHERHITHE," BY THE AMERICAN-ENGLISH ARTIST, JAMES MCNEIL WHISTLER.

# GRADUATE COLLEGE

THE UNIVERSITY OF VERMONT

Burlington, Vermont

CATALOGUE and ANNOUNCEMENTS  
1976-77

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; telephone (802) 656-2699. For other matters concerning the Dean, telephone (802) 656-3160.*

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 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 (Details, Pg. 15):

**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, religion, sex or national origin.*

*The University has embarked on a program to remove architectural barriers to make facilities accessible to and usable by the handicapped. Questions should be referred to the Office of Architectural Barrier Control.*

*Please be advised that information provided herein is subject to change without notice in accordance with the established procedures by which changes may be authorized and implemented. Circumstances occasionally require instructor changes and changes in the timing of specific course offerings.*



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# Academic Calendar

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- FALL SEMESTER 1976

August 30-31	Registration
September 1	Classes Begin
September 6	Labor Day Holiday
November 15-19	Pre-enrollment for Spring Semester
November 24-27	Thanksgiving Recess
December 10	Classes End
December 13	Exams Begin
December 18	Exams End

- SPRING SEMESTER 1977

January 25	Registration
January 26	Classes Begin
March 7-8	Town Meeting Recess
April 4	Spring Recess Begins
April 11	Classes Resume
April 20	Honors Day
April 25-29	Pre-enrollment for Fall Semester
May 12	Classes End
May 13	Exams Begin
May 19	Exams End
May 27-29	Commencement

- SUMMER SESSION 1977

Two, three, four, and six week sessions  
Contact Continuing Education for further information

- FALL SEMESTER 1977

August 30-31	Registration
September 1	Classes Begin
November 14-18	Pre-enrollment for Spring Semester
November 23-26	Thanksgiving Recess
December 13	Classes End
December 15	Exams Begin
December 21	Exams End

- SPRING SEMESTER 1978

January 17	Registration
January 18	Classes Begin
March 6-7	Town Meeting Recess
March 27	Spring Recess Begins
April 3	Classes Resume
April 17-21	Pre-enrollment for Fall Semester
April 19	Honors Day
May 5	Classes End
May 8	Exams Begin
May 13	Exams End
May 20-21	Commencement

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# The University of Vermont

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## • *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 has developed rapidly since its inception. In 1953, following its formal establishment by the trustees, 46 master's degrees were awarded. In 1976, 371 master's degrees and 35 Doctor of Philosophy degrees were awarded. The Graduate College currently enrolls over 800 students pursuing advanced degrees with about 200 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, the College of Engineering, Mathematics and Business Administration, the College of Education and Social Services, the College of Medicine, the Graduate College, the School of Allied Health Sciences, the School of Nursing, the School of Home Economics, the School of Natural Resources, and Continuing Education.

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 main Library, dedicated in 1961, is named to honor the late Guy W. Bailey, thirteenth president of the University. It holds the largest book collection in Vermont, and acquires regularly the major periodicals, scholarly journals and indexing and abstracting services. The University collections also include books in medicine and health-related sciences, and a strong collection in medical periodical literature, maintained in the Dana Medical Library of the Division of Health Sciences.

The Bailey Library is a depository for United States and Canadian government publications, and acquires newspapers, pamphlets, maps, and materials in microfilm. The Special Collections Department includes books and manuscripts from the library of George P. Marsh, a significant Masefield poetry collection, and its Wilbur Collection is rich in books and manuscripts of those associated with the State, including Ira Allen, Henry Stevens, Dorothy Canfield, Vermont Governors and members of the State Congressional delegation.

The Physics and Chemistry Library is located in the Clinton D. Cook Physical Sciences building.

The University Archives in the Waterman Building contain the permanent official records of the University.



*The Robert Hull Fleming Museum* The Museum is a notable University collection of Western and non-Western art, a center for research and museological studies as well as a place for aesthetic exploration. The Reed Collection of Plains Indian Art and the Schnackenberg Collection of 19th- and 20th-century American Art, for examples, are outstanding and of particular interest to students of American art and history. Exhibits are frequently rotated to serve class and seminar needs. Two galleries are given to changing exhibitions on special topics. These are frequently augmented by lectures, gallery talks, and films. Besides facilities to support the scholarly use of the collections, the Museum also houses class and seminar rooms for Art History and the Art Department slide library of 40,000 slides.

*The Academic Computing Center* The Academic Computing Center was organized in 1960 to provide computing facilities for the campus community. The Center (Xerox Sigma 6) services the computation needs of the varied research projects on campus; its facilities are also used as an integral part of many graduate and undergraduate courses.

The staff of the Computing 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 a major series of concerts, 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 Springfield.

*The George Aiken Lectures.* The annual George Aiken lectures, established in honor of Vermont's dean of the United States Senate, focus on issues of

## THE UNIVERSITY OF VERMONT

national and international importance. They bring together speakers of prominence, University faculty, and the University community in an attempt to achieve greater understanding of significant human concerns.

*The Placement Service* To assist graduates in exploring and selecting among various career employment possibilities, the University operates 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. Graduate students may not enroll in Physical Education classes without prior approval by the Dean of the Graduate College; Graduate College tuition scholarships do not cover Physical Education activities.

### • 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 Allegheny Airlines, Delta Airlines, Air New England, Vermont Transit and Greyhound Bus Lines, and Amtrak. The expanded Vermont interstate highway system has correspondingly shortened automotive travel time.

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## Degree Programs Offered

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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	Greek and Latin
English	History
French	Political Science
Geography	Psychology
German	

- ***MASTER OF SCIENCE***

Programs are offered in the following fields:

Agricultural Economics	Geology
Anatomy	Home Economics
Animal Sciences	Mathematics
Animal Pathology	Mechanical Engineering
Biochemistry	Medical Microbiology
Biomedical Engineering	Medical Technology
Biostatistics	Microbiology
Botany	Natural Resource Planning
Cell Biology	Pathology
Chemistry	Pharmacology
Civil Engineering	Physics
Communication Disorders	Physiology and Biophysics
Computer Science	Plant and Soil Science
Electrical Engineering	Statistics
Forestry	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:

Botany	Greek and Latin
Chemistry	History
English	Mathematics
French	Physics
Geography	Occupational and Practical Arts
Geology	Zoology
German	

### • *MASTER OF SCIENCE FOR TEACHERS*

This degree is designed primarily for secondary school teachers already certified 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	Occupational and Practical Arts
(Elementary and Secondary)	Organization and Human
	Resource Development

### • *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 for persons who have educational responsibilities outside the regular school settings. Programs are individually designed to provide knowledge and competencies associated with a career field. Emphasis is placed upon preparation for educational leadership functions. Programs are planned in the following specializations:

- Agricultural Agencies and Organizations
- 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	Physiology and Biophysics
Cell Biology	Plant and Soil Science
Chemistry	Psychology
Electrical Engineering	Zoology

### • *FIFTH YEAR CERTIFICATE IN EDUCATION*

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

Persons enrolled in the fifth year certificate program transferring to M.Ed. programs are subject to the restrictions on validation of credit outlined on page 22.

### • *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 and Social Services 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 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 and Social Services.

• *CERTIFICATE IN RUSSIAN  
AND EAST EUROPEAN AREA STUDIES*

A specialization on the area, leading to a Graduate Certificate, obtained in conjunction with an M.A. program in a particular discipline. The program is designed to serve as a foundation for doctoral study with specialization in the area; for teaching in the area at the secondary level; or for employment in internationally-oriented organizations. Requirements are 30 credit hours of study in the area, of which up to 18 could simultaneously be counted toward the M.A. in a discipline and a minimum of 12 hours of additional area work. For details contact the Center for Area and International Studies.

• *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.

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## Regulations of the Graduate College

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*Persons intending to apply to graduate school are urged to consider future employment opportunities in their proposed field of study. Specific information regarding employment prospects may be obtained on request from the appropriate department chairman.*

### • 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. 16.

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-



## REGULATIONS OF THE GRADUATE COLLEGE

degree student who has accumulated nine hours of graduate study at the university must seek approval for further enrollment from 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. 17. *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.

*When to apply* The deadline for receipt of completed applications and supporting materials for admission in the fall semester is *April 1* for all departments, except that a *March 1* deadline is observed in the Historic Preservation, Student Personnel Services, and Counseling programs. Most departments process applications soon after all the supporting information is received. Applications will not be processed after the openings in a program have been filled. Therefore, for fall admission, it is important to file applications well in advance of April 1, as some programs can accommodate only a limited number of new graduate students.

It is sometimes possible to admit new graduate 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 financial assistance in the form of fellowships as well as admission should have applications with all supporting materials including GRE scores on file by *March 1* of the academic year preceding that for which application is made. Applications for fellowship assistance *must* include GRE aptitude scores. No special forms for requesting fellowship aid are necessary. Persons interested in obtaining information on loans and/or work-study should contact the Financial Aid Office.

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

### *New England Regional Student Program*

This program is a part of The New England Higher Education Compact. It offers:

## REGULATIONS OF THE GRADUATE COLLEGE

An opportunity for qualified legal residents of New England states to enroll at in-state tuition rates for programs which are not offered by the home state university but are offered in another New England state is available under an arrangement entitled the New England Regional Student Program. A list of available graduate programs can be seen in the Graduate College Office or obtained from The New England Board of Higher Education, 40 Grove Street, Wellesley, Massachusetts 02181 at \$2 per copy.

A resident of any New England state wishing to apply for study under this Program at one of the six state universities or the University of Lowell must first obtain certification from the Dean of the Graduate School of his home state university to the effect that the program of study desired is *not available* at the home-state university. Applicants must, therefore, examine course offerings carefully. In cases where an apparently similar program of study is available at both institutions involved, this certification will normally take the form of endorsement of a statement from the chairman of the relevant department of study. In cases where a program of study is clearly unique or distinctive to the out-of-state institution, the Graduate Dean's office will certify directly. Students may request that this certification be obtained through the office of the Graduate Dean of the recipient institution, i.e., the institution at which the student wishes to enroll.

Applicants must clearly indicate, both in their initial inquiries and on their application forms, that they are seeking admission under the terms of the New England Regional Student Program. Those seeking admission to a general subject area, e.g., History, must specify precisely the area of specialization they wish to follow.

*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.

## REGULATIONS OF THE GRADUATE COLLEGE

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

For *Africa*: The African-American Institute, 833 U.N. Plaza, N.Y., N.Y. 10017. For the *Middle East*: American Friends of the Middle East, Inc., Middle East House, 1607 New Hampshire Ave., N.W., Washington, D.C. 20009. For *Korea*: The American Korean Foundation, Inc., 345 E. 46 St., N.Y., N.Y. 10017. For *Europe, South America, and South East Asia*: Institute of International Education, 809 U.N. Plaza, N.Y., N.Y. 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 \$5,500 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.

Foreign applicants interested in services or activities available to foreign students are urged to contact the Office of the Foreign Student Advisor, The University of Vermont, Burlington, Vermont 05401.

*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). Business Administration applicants must submit scores on the Graduate Management Admissions Test.

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 or the Graduate Management Admissions Test may be obtained from the Counseling and Testing Office or directly from the Educational Testing Service, Box 889, Princeton, New Jersey 08540.

*All applicants requesting fellowship support must submit scores on the*

## REGULATIONS OF THE GRADUATE COLLEGE

*Graduate Record Examination prior to March 1.* Arrangements should be made to take the GRE test no later than January 1976 so that test results will be available by March 1.

*Health Record* A satisfactory health record must be submitted to the Student Health Service 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.)

*Enrollment Guidelines* The normal full-time graduate enrollment is 12 hours; the maximum enrollment is 15 hours. The normal range of full-time enrollment is 6 to 10 hours for Graduate Teaching Fellows, 6 to 12 hours for Graduate Research Fellows, and 6 to 9 hours for Graduate Residence Fellows. *Completion of thesis* is considered full-time enrollment. Enrollment in excess of the respective normal full-time course load must have the approval of the Graduate Dean.

*Changes in Enrollment* Any changes in enrollment must be approved by the student's advisor and authorized by the Dean of the Graduate College. A student may add a course only during the first week of classes; he may drop a course without academic penalty only during the first three weeks of classes; the exact dates to add or drop courses may be found in the 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. 33 Fees). Enrollment for completion of thesis may be accomplished by mail or in person through 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.



## REGULATIONS OF THE GRADUATE COLLEGE

***Auditing Courses*** Courses may be taken for audit, however, the credit hours are charged as usual. Under no circumstances will credit or grade be allowed for courses audited. Students whose tuition is funded by the university may not audit courses.

***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 department is deemed unsatisfactory at any time may be requested by the Dean or the department concerned to withdraw from the Graduate College.

***Undergraduate Enrollment for Graduate Credit*** The Dean of the Graduate College must receive a written request from the Dean of the undergraduate college to have the student in the senior year take an appropriate course for graduate credit. This must be received prior to enrollment for the particular course, the course must not be computed as part of the bachelor's degree, and the total enrollment including the course in question for that senior semester must not exceed 12 credit hours. Such graduate credit is limited to 6 hours, and is not available for transfer to another institution as graduate credit. It can be used only at UVM if and when the student enters a UVM graduate program and only if the course is judged appropriate by the student's advisor for the particular graduate program.

### • 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*** Acceptance to the Graduate College is valid for one year prior to initial enrollment. 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

## REGULATIONS OF THE GRADUATE COLLEGE

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 fulfilled 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 Computer Science, it may be achieved by satisfactory completion of Computer Science 11 and 241 or by satisfactory completion of an examination (on a pass-fail basis) set and graded by the staff of the Academic Computing 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

## REGULATIONS OF THE GRADUATE COLLEGE

levels of performance for credits received in Thesis Research and may be used to indicate levels of performance in Seminar.

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

A student may be dismissed from the Graduate College if he receives more than two grades below a *B*, 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. Courses at the 200 level or above may not be taken on a pass-fail basis for graduate credit.

### *Maximum Time Limits for Degree Completion*

#### MASTER'S 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

#### DOCTORAL DEGREE

All Students	9 Years
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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.

If a student does not register at the University of Vermont for course

## REGULATIONS OF THE GRADUATE COLLEGE

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 and his file deactivated. It will be necessary to reapply for admission to the Graduate College should the student wish to continue his graduate program after his file has been deactivated.

*Transfer of Credit* Upon request of the department and approval by the Graduate College Dean, transfer of credit for appropriate courses completed at other institutions may be accepted by the Graduate College. In cases where such transfer is approved, it is the credit only, and not the grade, which is accepted for transfer. 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). A fee of \$10 per credit is charged.

*Validation of Credit* In order to insure effective planning of a graduate program, usually not more than nine hours of graduate credit acquired at the University of Vermont as a non-degree student prior to admission to the Graduate College may be validated on the students record as applicable toward the credit requirements of an advanced degree. Validation of credit is subject to the same restrictions as stated for transfer of credit. If an applicant is enrolled as a non-degree student in appropriate graduate courses during the semester in which his application is approved for admittance, these credits, up to a maximum of 6 hours, will also be applied

## REGULATIONS OF THE GRADUATE COLLEGE

to his degree program and do not reduce the number of validation credits available.

*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.

*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.

### 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 29.

## REGULATIONS OF THE GRADUATE COLLEGE

*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 and Social Services. Students with questions regarding the education component of their program should consult with the office of the Dean of the College of Education and Social Services.

## REGULATIONS OF THE GRADUATE COLLEGE

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 Record Examination (Verbal and Quantitative), and be acceptable to the departments concerned. Advanced GRE scores are required for certain programs as indicated.

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 certification 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 and Social Services 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 Record

## REGULATIONS OF THE GRADUATE COLLEGE

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 foundations of Education, unless this requirement or its equivalent has been previously met. Graduate courses which currently fulfill this requirement include: EDSS 202, 204, 205, 206, 252, 254, 255, 277, 313 and 399.

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 the Graduate College.

### *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



## REGULATIONS OF THE GRADUATE COLLEGE

examination with the College of Education and Social Services. 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.

### *MASTER OF BUSINESS ADMINISTRATION*

Management is the art of applying principles of the mathematical and social sciences to decision making in an organizational environment characterized by uncertainty and limited resources. The program is designed (1) to develop the individual's ability to practice the art and (2) to build a foundation that will facilitate and encourage the continuation of this development beyond a formal university setting. Courses in the program emphasize understanding and critically evaluating conceptual/theoretical principles relevant to the decision process in each functional area of business.

Upon completion of the program students will have been exposed to each functional area, and will have been required to demonstrate an ability to engage in individual and group research projects, and a capacity to coherently present and defend his or her views orally and in writing.

The program is designed to be completed in a minimum of two semesters after completion of prerequisite courses.

#### *Examinations*

A written comprehensive examination with emphasis in the fields of specialization. Normally the comprehensive examination is administered upon completion of all course work for the degree. 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 nine credit hours of graduate work completed prior to admission to the Graduate College will be applied toward the degree requirements.

## REGULATIONS OF THE GRADUATE COLLEGE

### *MASTER OF EXTENSION EDUCATION*

A minimum of thirty semester hours in courses numbered above 200 is required. At least six semester hours will be completed in agriculture, or a related field, and at least six semester hours in education courses offered by the College of Agriculture. A minimum of eighteen additional semester hours will be selected to meet individualized program objectives. Normally, no thesis is required.

The candidate may complete the degree requirements through Summer Session, Evening Division and/or full-time residency. A candidate will be expected to spend at least one semester or a minimum of two summers in residence at the University of Vermont campus in Burlington.

A satisfactory score on the Miller Analogies Test is required. Before the degree is awarded, the candidate must have completed the equivalent of one year of professional experience. This requirement may be completed by an internship or practicum experience approved by the candidate's studies committee.

#### *Examinations:*

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

Satisfactory completion of the written examination is prerequisite to taking the oral examination. All comprehensive examinations are taken on the University of Vermont campus in Burlington. One re-examination 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 of

## REGULATIONS OF THE GRADUATE COLLEGE

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 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.

## REGULATIONS OF THE GRADUATE COLLEGE

### *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.

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## Definition of "Vermont Resident"

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ADOPTED BY BOARD OF TRUSTEES, DECEMBER 14, 1974

The Vermont Legislature has established a lower rate of tuition for students who are Vermont residents. Such a policy appears to have as its objective the attempt to more evenly distribute the cost of operating and supporting the University of Vermont between Vermont residents whose taxes have previously supported the University and non-residents who have not done so.

The Legislature has stated that enrollment at an institution for higher learning or presence within the State for purposes of attending an institution of higher learning shall not constitute residence for tuition purposes.

The following requirements must be met by a student prior to being granted resident status for the purpose of admission, tuition and other University charges:

1. The applicant shall be domiciled in Vermont, said domicile having been continuous for one year prior to the date of application for a change in residency status. Changes in residency status shall become effective for the semester following the date of application.
2. Domicile shall mean a person's true, fixed and permanent home, to which he intends to return when absent. A residence established for the purpose of attending an educational institution or qualifying for resident status for tuition purposes shall not of itself constitute domicile. Domicile shall not be determined by the applicant's marital status.
3. The applicant must demonstrate such attachment to the community as would be typical of a permanent resident of his age and education.
4. Receipt of financial support from the applicant's family will create a rebuttable presumption that the applicant's domicile is with his family.
5. An applicant becoming a student at an institution of higher learning in Vermont within one year of first moving to the state shall have created a rebuttable presumption of residence in Vermont for the purpose of attending an educational institution.
6. A student who is eligible for tuition purposes to enroll as a resident student in another state shall not be enrolled as a "Vermont Resident."

#### DEFINITION OF VERMONT RESIDENT

7. A student enrolling at the University of Vermont shall be classified by the appropriate admissions officer (Director of Admissions, Dean of the Graduate College, Associate Dean of the College of Medicine) as a resident or non-resident for admission and tuition purposes. The decision by the officer shall be based upon information furnished by the student and other relevant information. The officer is authorized to require such written documents, affidavits, verifications or other evidence as he deems necessary.
8. The burden of proof shall in all cases rest upon the student claiming to be a Vermont resident and shall be met upon a showing of clear and convincing evidence.
9. The decision of the admissions officer on the classification of a student as a resident or non-resident may be appealed in writing to the Committee on Residence whose decision shall be final.

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## Student Expenses

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*Application Fee* All applications for admission must be accompanied by a \$15 application fee. This is non-refundable.

*Tuition* Rates for the academic year 1976-77 will be as follows: For Vermont residents, \$50 per credit hour, \$600 flat rate for 12 hours, and \$50 per credit hour in excess of 12 hours.

For nonresidents of Vermont, \$135 per credit hour, \$1615 flat rate for 12 hours, and \$135 per credit hour in excess of 12 hours.

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 and more than three credit hours. No fee is assessed for registration of one to 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 \$32 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.

## STUDENT EXPENSES

*Advanced Degree Fee* A fee is charged to each recipient of an advanced degree according to the following schedule:

Ph.D.	\$25.00
Masters Degree (With thesis)	20.00
Masters Degree (No thesis)	10.00

This fee may be paid at any time but must be paid prior to the last date established for submission of theses in each of the three graduation periods.

It is the responsibility of the degree candidate to pay the appropriate amount at the Cashiers' Office and present a receipt of this to the Graduate College Dean in order to have a degree awarded.

*Living Expenses* A limited number of University owned apartments are available for full-time married students. Located just outside Winooski on Route 15 at Fort Ethan Allen, these apartments are a five-mile drive from the main campus. Detailed rental information may be obtained from the Director of Family Housing, 600 Dalton Drive, Winooski, Vermont 05404. Telephone 802-656-3228.

Up-to-date listings for available departments, houses and rooms for rent in the area are maintained by the Department of Residential Life. This service allows community landlords and rental agents a way to make known their housing availability to persons associated with the University. Students may examine up-to-date listings at the Billings Center or on a bulletin board just off the College Street entrance of Waterman Building on the main campus. The University is not responsible for the approval of off-campus housing facilities. It is impractical to send information concerning individual listings by mail. A catalog of available listings is issued each May, August and December. To reserve a catalog, contact the Office of Residential Life, 25 Colchester Avenue, Burlington, Vermont 05401. Telephone 656-3434.

Rents in the Burlington area vary from approximately \$20.00 per week for a single furnished room to \$160.00 or more per month for a furnished, two-bedroom apartment. A single student should expect minimum overall living expenses of \$225.00 to \$250.00 per month. If desired, meals may be obtained in University Dining Halls.

*Bill Adjustment* Bills will be adjusted at the end of the drop period and at mid-semester. Students will be held liable for the total number of credit hours enrolled in at those times. A refund of 100 percent will be processed



## STUDENT EXPENSES

for reductions effected prior to the end of the drop period, and a 50 percent refund for reductions prior to mid-semester. No refund will be allowed after mid-semester. At the end of the semester, an audit will be made of each student's record. If the audit reveals total hours are greater than at the end of the specified drop period, the student will be financially liable for the number of hours for which he was enrolled. Students will be charged for all hours as specified in policy statements regarding tuition.

*Withdrawals* A student may voluntarily withdraw from the university by notifying the Graduate Dean and the Registrar. Withdrawal for reasons of health requires the approval of the university physician. In either case, the student will receive a refund of 100 percent if withdrawal occurs prior to the end of the add/drop period, a 50 percent refund until mid-semester, and no refund thereafter. Date and time of withdrawal normally will be the date the withdrawal notice is received by the Registrar.

*Dismissal* If a student is suspended or dismissed, a refund will be processed according to the above schedule.

*Death* In case of death of the student, tuition which has been paid for the semester during which the death occurs, will be fully refunded.

*Change of Status* A student who reduces his enrollment below twelve hours by an approved change of enrollment before the end of the drop period may be entitled to a partial refund of tuition and fees to reflect his new credit hour load.

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## Financial Aid

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*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. Information on and applications for loans and/or work-study may be obtained from the Financial Aid Office.

Tuition scholarships accompanying Graduate Teaching, College, Research, and Residence Fellowships do not cover physical education courses or activities, and cover courses numbered below 200 only upon prior approval of the Dean of the Graduate College.

### • GRADUATE COLLEGE FELLOWSHIPS

The Graduate College offers Graduate College Fellowships of \$1000 each, plus a full tuition scholarship to cover the minimum number of credit hours needed to fulfill the requirements for a Master's Degree and not to exceed thirty-six hours.

These fellowships are open to applicants for Fall admission in the social sciences and humanities. Holders of Graduate Fellowships are expected to carry a full-time graduate program towards an advanced degree. These Fellowships are not renewable and are not given to students previously enrolled in the Graduate College.

### • GRADUATE TEACHING FELLOWSHIPS AND GRADUATE RESEARCH FELLOWSHIPS

Graduate Teaching Fellowships are awarded in many of the departments offering graduate work. Graduate Teaching Fellows are appointed for nine months with stipends averaging \$3200. Teaching Fellows may enroll for a maximum of 10 hours per semester; the fellowship award includes a tuition scholarship covering the number of hours specified in the award letter and not to exceed 10 hours per semester in addition to the stipend for the period of the fellowship.

Graduate Research Fellowships are awarded in some of the science departments offering graduate work. Fellows are appointed for eleven months with a stipend of \$3400, and a tuition scholarship covering a maximum of 12 hours per semester.

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

Appointments will be announced on or about April 2.

• *GRADUATE RESIDENCE FELLOWSHIPS*

Graduate students, men and women, are eligible to apply for Graduate Residence Fellowships. The candidates selected to fill these positions will normally be assigned administrative and advisory positions in the residence halls. Student Personnel Fellows have the opportunity to gain valuable experience in the areas of group advising, administration, personal advising and educational programming. Such positions are open to either married or single students who have been accepted for graduate work in any of the academic programs of the University of Vermont. Selection is based upon academic record, character, recommendations, and quality of related experiences. A personal interview is required. Graduate Resident Fellows receive a stipend of \$3200 plus a tuition scholarship covering a maximum of 9 credit hours per semester for a nine-month period. The award is renewable only once. Room and board is deducted from this stipend. Requests for applications and additional information should be addressed to Office of Residence Halls, Mansfield House. Applications received after March 1 will be considered only for unanticipated openings. Appointments will be announced on or about May 1.

• *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: Special Education, Medical Technology, Physiology and

## FINANCIAL AID

Biophysics, and Communication Disorders. 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.

### • *GRADUATE ASSISTANTSHIPS*

Graduate Assistantships are generally available when a department member receives a grant from a source external to the University. The appointment is for twelve months and supplies a salary starting at about \$5150 per year. Part of the salary is for tuition at the in-state rate with a maximum enrollment of nine credit hours each semester and six credit hours during the summer.

A maximum of one-half time assistance on the research project is expected and more than one academic year will be necessary for the completion of the master's degree and at least four calendar years for completion of the doctoral degree. For information on the availability of an assistantship, contact the chairman of the department concerned.

### • *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*

The fellowship is awarded to a degree candidate pursuing a program of study wherein the principles of physics or physical chemistry are applied to biological or medical science. Applicants for the fellowship must possess an M.S. in physics or physical chemistry or the equivalent, and must be recommended by the appropriate UVM department chairman. The award includes a \$3400 stipend, plus tuition, fees, and a travel allowance.

### • *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.

• ***LONG TERM LOANS and/or WORK-STUDY JOBS***

The University is able to provide, through the Office of Financial Aid, long-term loans and/or work-study jobs for students who have demonstrable need for such aid.

***Loans***

The loans are primarily from the Federally funded National Direct Student Loan (formerly National Defense Student Loan). The availability of such loans is dependent on the level of federal allocation to the University. In addition the University has a limited amount of endowed loan funds. Both types of loan are interest free while the student is in at least half time attendance in a degree program; repayment and interest at the rate of 3 percent begins when the loan goes into repayment status.

***Work-Study***

The College Work-Study Program provides financial assistance through employment on campus or with certain kinds of off campus agencies. Every effort is made to place students in jobs related to their field of study, interest, and skills. The amount of CWSP assistance committed reflects both the degree of financial need and a reasonable projection of the amount it is possible to earn at a rate of pay commensurate with the student's skills and experience.

Additional information and application forms are available from the Office of Financial Aid, 330 Waterman Building. Only one application is needed in order to apply for either type of aid, as the applicant is able to indicate on the application if one or the other, or both are preferred.

• ***VETERANS BENEFITS***

Students who are eligible to receive educational benefits from the Veterans Administration are advised to obtain advice from the University Registrar.

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## Courses of Instruction

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### *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 from 200 through 299 are advanced courses for undergraduates which may also be taken for graduate credit by graduate students. To obtain graduate credit the graduate student generally is expected to meet higher qualitative or quantitative expectations than the undergraduate student. 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 prior to enrollment. Non degree students are not permitted to receive graduate credit for courses numbered 100-199. 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.

## AGRICULTURAL AND RESOURCE ECONOMICS

### • AGRICULTURAL AND RESOURCE ECONOMICS

*Professors Sargent, Sinclair (Chairman), Tremblay, and Webster; Associate Professors Fife, Gilbert, and Pelsue; Adjunct Professor Hougaboom; Adjunct Associate Professors Bevins, and Eddy.*

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.

### AGRICULTURAL ECONOMICS

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

Undergraduate degree in economics, agriculture or related field. Satisfactory scores on the Graduate Record Examination. Transcripts are evaluated on an individual basis.

#### **MINIMUM DEGREE REQUIREMENTS**

Advanced courses in Agricultural or Resource Economics, and related fields, 15-24 hours; thesis research, 6-15 hours; a total of 30 hours.

#### **COURSES OFFERED**

**201 FARM BUSINESS MANAGEMENT** Organization and operation of successful farm businesses with emphasis on resource allocation, production efficiency, and marginal analysis. Field trips required. *Prerequisites:* Economics 11, 12, or Agri. and Res. Econ. 61. Three hours. Tremblay.

**205 RURAL COMMUNITIES IN MODERN SOCIETY** See Sociology 205. Three hours. Schmidt.

**207 MARKETS, FOOD, AND CONSUMERS** Market structure, prices, and economic forces involved in the movement of farm products from producers to consumers. *Prerequisites:* Economics 11-12, or Agri. and Res. Econ. 61. Three hours. Webster.

**208 AGRICULTURAL POLICY** History and institutional development of agricultural policy. Price and income problems of American agriculture and alternative solutions. *Prerequisites:* Economics 11-12, or Agri. and Res. Econ. 61. Alternate years, 1976-77. Three hours. Sinclair.

**218 COMMUNITY ORGANIZATION AND DEVELOPMENT** See Sociology 207. Three hours. Schmidt.

**222 NATURAL RESOURCE EVALUATION** An analysis of economic pro-

## AGRICULTURAL AND RESOURCE ECONOMICS

cedures used in the evaluation of public natural resource developments, with emphasis on benefit-cost analysis. *Prerequisite:* Agri. and Res. Econ. 121. Three hours. Staff.

**225 ECONOMICS OF OUTDOOR RECREATION** An economic analysis of demand and supply of natural resources for outdoor recreation. Emphasis on current policy issues and management of recreational business firms. *Prerequisites:* Economics 11, 12 or Agri. and Res. Econ. 61. Three hours. Bevins.

**232 COMMUNITY DESIGN** See Civil Engineering 232. Oppenlander.

**233 REGIONAL PLANNING** Delineation of regional boundaries, determination of public goals, tools of planning, quality environment planning, and the political process of planning. *Prerequisites:* Senior standing and Economics 11, 12, or equivalent. Three hours. Sargent.

**234 ADVANCED REGIONAL PLANNING** Concepts of ecological planning with special emphasis on economic base analysis, resource base analysis, and economic impact studies. Each student will participate in a municipal or regional planning project. *Prerequisite:* Agri. and Res. Econ. 233 or consent of instructor. Three hours. Sargent.

**235 LEGAL ASPECTS OF PLANNING AND ZONING** An examination of Vermont planning and zoning law with comparisons with other states. Cases in planning and zoning and land use controls. *Prerequisite:* Senior standing or consent of instructor. Three hours. Ewing.

**243 SPATIAL ANALYSIS** See Geography 243. Three hours. Leinbach.

**254 ADVANCED AGRICULTURAL ECONOMICS** Theories of supply and demand analysis, price determination, market structure, and income distribution in competitive and imperfectly competitive markets. *Prerequisites:* Twelve hours in agri. and res. econ. and/or economics, and permission of instructor. Three hours. Sinclair.

**255, 256 SPECIAL TOPICS IN AGRICULTURAL AND RESOURCE ECONOMICS** Readings and discussion of selected topics in economics at an advanced level. *Prerequisite:* Departmental permission. Credit as arranged. Staff.

**266 ECONOMICS OF MANAGERIAL DECISIONS** Applying economic concepts to problems of capital budgeting, tax planning, pricing, demand analysis, and discounting cash flows. Cases. *Prerequisites:* Economics 11, 12, or equivalent. Three hours. Fife.

**322 ADVANCED RESOURCE ECONOMICS** A critical evaluation of contemporary natural resource allocation procedures in the public sector. *Prerequisite:* Agri. and Res. Econ. 222 or equivalent. Three hours. Gilbert.



## ANATOMY

**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. Staff.

**381 AGRICULTURAL AND RESOURCE ECONOMICS SEMINAR** Discussion of problems and research in agri. and res. econ., and regional planning. One hour. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged. Staff.

### • ANATOMY

*Professor W. J. Young (Chairman); Associate Professors Freedman, Ring, and Wells; Assistant Professors Boushey, Kriebel, Krupp, Ryugo, and Schwaber.*

Research activities include experimental neuroanatomy and autoradiography of the mammalian and avian central nervous systems; histology and electron microscopy of "simple" nervous systems; light and electron microscopy of the caudal neurosecretory system in fish; mammalian visual system pathways; cytophysiology of the thyroid follicular and parafollicular cells.

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

Year course in Organic Chemistry; year course or equivalent in Advanced Biology; Graduate Record Examination required. Note: Recommendations to Medical Colleges are not provided students enrolled in this Department prior to completion of M.S. requirements.

### **MINIMUM DEGREE REQUIREMENTS**

Anatomy 301, 302, 311, Physiology 301; comprehensive examination and dissertation.

### **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. Comprehensive examination and successful completion of dissertation.

### **COURSES OFFERED**

Note: Departmental permission for all courses.

## ANATOMY

**301 GROSS ANATOMY** This course consists of individualized laboratory instruction, small group conferences and clinically correlated lectures. It provides a sound base of anatomical information and stresses the importance of the relationship between normal human structure and function. Six hours. Krupp.

**302 NEUROSCIENCE** A correlated presentation of the neuroanatomy and neurophysiology of the mammalian central nervous system. The course consists of lectures, demonstrations, laboratory, and patients with neurological deficits are presented. Same course as Physiology 302. *Prerequisite:* 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. Young.

**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. *Prerequisite:* Anatomy 302. Two hours. Alternate years. Kriebel and 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. *Prerequisite:* Anatomy 302. Three hours. Freedman, Kriebel, and Wells.

**341, 342 SPECIAL DISSECTIONS IN GROSS ANATOMY** This course provides for a detailed and independent study of a single anatomical region, utilizing gross, microscopic and embryologic materials. *Prerequisite:* Anatomy 301. 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. *Prerequisites:* 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 pertinent observations in human somatic and meiotic cells, as well as in selected plant and animal species. *Prerequisites:* Zoology 115 or equivalent; permission of the instructors.

## ANIMAL SCIENCES

Same course as Botany 374. Two hours. Young, Hyde (Botany). Alternate years.

**381 SEMINARS IN ANATOMY** Research presentations and critical review of the literature in various areas of the anatomical sciences. *Prerequisite:* Graduate standing. Credit as arranged.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

### • ANIMAL PATHOLOGY

*Professor Bolton (Chairman); Associate Professor 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 Science, Biochemistry, Microbiology, Pathology or Physiology and Biophysics; additional courses in related fields; thesis research (12-15 hours).

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

### • ANIMAL SCIENCES

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

Research activities in basic and applied science encompass a broad range of interests. The areas of study and research include genetics; nutrition; physiology; dairy and food plant management, chemistry, or bacteriology; 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, Biolo-

## ANIMAL SCIENCES

gy, or a related field. Satisfactory scores on the Graduate Records Examination must be presented.

### MINIMUM DEGREE REQUIREMENTS

15-21 hours in Animal Sciences and related fields; thesis research (9-15 hours).

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

Satisfactory scores on 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 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.

### COURSES OFFERED

**211 ICE CREAM AND FROZEN DAIRY PRODUCTS** Fundamentals of ice cream manufacturing, the physico-chemical and biological factors involved; calculation of formulas; sherbets and specialties; merchandising; and sanitary control. *Prerequisites:* 104; credit or concurrent enrollment in 109. Three hours. Nilson. Alternate years, 1977-78.

**232 QUANTITATIVE GENETICS IN ANIMAL AND PLANT IMPROVEMENT** Principles of quantitative and statistical genetics including systems of mating and forces which change gene frequency are studied in relation to animal and plant breeding. *Prerequisites:* Introductory course in genetics; Statistics 111 or permission of instructor. Three hours. Gilmore.

**246 ADVANCED NUTRITION** See Home Economics 246. Three hours. Tyzbir.

**249 NUTRITION SEMINAR** See Home Economics 249. Three hours. Tyzbir.

**251 ADVANCED DAIRY CATTLE MANAGEMENT** The organization and

## ANIMAL SCIENCES

operation of dairy enterprises. Theories and methods of application of feeding, breeding, and management programs and principles. *Prerequisite:* 43. Three hours. Woelfel.

**256 DAIRY PLANT MANAGEMENT** Organization and operation of milk processing and manufacturing milk products plants. *Prerequisites:* 153, Agri. and Res. Econ. 62. Three hours. Nilson. Alternate years, 1976-77.

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

**281, 282 ANIMAL SCIENCES SEMINAR** Reports and discussions of problems and special investigation 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. Tyzbir.

**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 246, Home Economics 246, or a 200 level course in biochemistry. Three hours. Staff. Alternate years, 1977-78.

**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. *Prerequisites:* a 200 level course in nutrition and in bio-chemistry. Two hours. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

## ANTHROPOLOGY

### • ANTHROPOLOGY

*Professor Haviland; Associate Professors Magnarella, Mitchell, Woolfson; Assistant Professors C. Pastner, S. Pastner, Power.*

No Master's Program offered

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; the archaeology of Vermont; and tradition and change in Turkey.

**212 CULTURE AND PERSONALITY** The crosscultural comparison of personality development; the problem of delineating modal personality types. *Prerequisites:* 21, Sociology 10 and one 100 level course in sociology or anthropology. Three hours. Mabry, Magnarella, and Steffenhagen.

**225 CURRENT ANTHROPOLOGICAL THEORY** Schools of Anthropological thought; evolutionism, cultural ecology, functionalism, relativism, diffusionism, structuralism and cognitive school, examined in relation to data on non-western societies and the historical/social context in which the anthropologist works. *Prerequisites:* 21 plus one 100 level course. Three hours. Magnarella, C. Pastner, and S. Pastner.

**228 SOCIAL ORGANIZATION** The study of social relationships of peoples living in various cultures and different parts of the world; focuses on such topics as residence, descent and kinship in tribal organization and community life. *Prerequisites:* 21 and one 100 level course. Three hours. Magnarella and Mitchell.

**229 POLITICAL AND ECONOMIC ANTHROPOLOGY** The analysis of traditional exchange and subsistence systems and the ways these relate to interest-based, or political behaviors. *Prerequisites:* 21 and one 100 level course. Pastner.

**267 THE FRANCO AMERICANS** A seminar designed to explore the cultural patterns of French speaking peoples in New England, with particular reference to Vermont. Each student will be expected to develop a research project exploring some aspect of Franco American culture. *Prerequisite:* Permission of the instructor. Three hours. Woolfson.

**270 REVITALIZATION MOVEMENTS** An examination of prophetic, millenarian and revolutionary sects and movements with an emphasis on non-western, non-industrial societies. Analytical perspectives will be drawn from a variety of disciplines. *Prerequisites:* 21 and one advanced course in anthropology, sociology, or religion. Three hours. S. Pastner.

**283 CULTURE CHANGE** The study of socio-cultural transformations in non-western countries with emphasis on such topics as industrialization, urbanization and modernization and their impact on the lives of previously traditional peoples. *Prerequisites:* 21 and one 100 level course, or 21 and six hours in the social sciences. Three hours. Magnarella.

**284 URBAN ANTHROPOLOGY** The study of urbanization and urban life in nonwestern countries including such topics as urban-rural ties, peasant migrations, and socio-cultural adjustment to urban living. *Prerequisites:* 21 and one 100 level course, or 21 and six hours in the social sciences. Three hours. Magnarella.

**290 METHODS OF ETHNOGRAPHIC FIELD WORK** Examination of the theoretical and ethical premises of field work methodology with practical experience using selected techniques including participant observation, interviewing, the genealogical method and the recording of data. *Prerequisite:* Twelve hours of anthropology. Three hours. Mitchell.

**295, 296 ADVANCED SPECIAL TOPICS** *Prerequisites:* 21 and one 100 level course.

**397, 398 ADVANCED READINGS AND RESEARCH** Directed individual study of topics not appropriately covered in existing courses.

## • ART

*Professors J. Davison and Janson (Chairman); Associate Professors W. Davison, Hewitt, Lipke, and Owre; Assistant Professors Fengler, Okino, Rindler, Roland, and Versweyeld; Instructors Blasdel, Spivak; Lecturers Aschenbach, Higgins, Liebs, and Parris.*

### No Master's Program offered

**207 STUDIES IN AMERICAN ART** Topics in art and design, particularly as represented in the Fleming and Shelburne Museums. *Prerequisite:* By permission to students of art history, American history or literature. Three hours. Janson or Lipke.

**210 STUDIES IN MODERN ART** Topics in 19th and 20th century art, stressing research and reports. *Prerequisite:* Instructor's permission. Three hours. Roland or Lipke.

**223 ARCHITECTURE AND THE ENVIRONMENT** See History 223. Three hours. Liebs.

**281, 282 DIRECTED STUDIES** Special topics tutorials or seminars in a particular area. *Prerequisites:* Six hours advanced in chosen area and permission. Three or six hours. Staff.

## BIOCHEMISTRY

285, 286 MUSEUM STUDIES Museum methods as concerning the research, care and administration of a collection; as furthering aesthetic insight and the communication of ideas. *Prerequisite:* Instructor's permission. Three hours. Parris.

### • BIOCHEMISTRY

*Professors Bresnick (Chairman), Lamden, Melville, and Woodworth; Associate Professors Cutroneo, Meyer and Thanassi; Assistant Professor Hart.*

Current research programs include studies of the relationship of polycyclic hydrocarbon metabolism to carcinogenesis (E. Bresnick); the effects of anti-inflammatory steroids on proline metabolism and collagen synthesis (K. R. Cutroneo); the toxicity of cadmium and its reactions in biological systems (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); regulatory mechanisms for protein and nucleic acid processing and breakdown in muscle (W. L. Meyer); catalytic mechanisms involved in transamination and decarboxylation reactions (J. W. Thanassi); and the nature of the binding of metals to proteins, particularly the iron-binding proteins of blood plasma (R. C. Woodworth).

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

Year courses in organic chemistry, physical chemistry, and physics (equivalent to Chemistry 131, 132, Chemistry 141, 142, and Physics 15, 16); 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 including Biochemistry 301, 302 or 305-306, 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 15, 16); 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 or 305-306, 303 and participation through-



out residence in Biochemistry Seminars; 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.

### **COURSES OFFERED**

Biochemistry 204, 211-212, 301-302, 303, 305-306, and 381 are offered annually. Advanced courses are given in alternate years.

**204 INSTRUMENTATION LABORATORY** Primarily for medical technology students. Mechanical, optical, and electrical features of selected instruments used in clinical chemistry are studied as an aid to their proper use and maintenance. *Prerequisite:* Biochemistry 102 or 211-212, or equivalent experience in biochemical laboratory work. Three hours. Melville.

**211-212 BIOCHEMISTRY FOR HEALTH SCIENCES** Primarily for medical technology students. Lectures provide a comprehensive study of mammalian biochemistry particularly as it relates to man. Medically-oriented experiments utilizing modern clinical chemistry techniques are performed in the laboratory. Case studies from the files of the MCHV are used to correlate lecture and laboratory material. *Prerequisites:* Biochemistry 102 or quantitative chemistry; organic chemistry. Physiology is strongly recommended. Four hours per semester. Hart.

**301, 302 GENERAL BIOCHEMISTRY** Survey of biochemistry primarily for 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. *Prerequisites:* Chemistry 131, 132 and permission of the department. Three hours per semester. Staff.

**303 BIOCHEMISTRY LABORATORY** Experimental work designed to demonstrate important principles and to illustrate methods and techniques of modern biochemistry. *Prerequisites:* 301, 302 or 305-306, or concurrent registration therein, and permission of the department. One to four hours. Staff.

**305-306 MEDICAL BIOCHEMISTRY** For medical students. A survey of physiological and molecular biochemistry with special reference to man: chemistry and metabolism of cellular and dietary constituents; enzymes and bioenergetics; blood, respiration, acid-base balance, and mineral metabolism; metabolic controls. *Prerequisites:* Chemistry 131, 132 and permission of the department. Given on a trimester basis in the College of Medicine calendar; equivalent to three hours per semester for two semesters. Staff.

**307, 308 SPECIAL TOPICS IN BIOCHEMISTRY** Areas of biochemistry not treated in concurrent offerings of advanced courses. Topics are from the

## BIOMEDICAL ENGINEERING

fields of intermediary metabolism, organic and physical biochemistry, enzymology, and physiological chemistry. Two areas will usually be covered each semester. *Prerequisites:* 301, 302 or 305-306; Chemistry 141, 142. Two hours per semester. Staff.

**320 GENERAL ENZYMOLOGY** A general consideration of enzyme nomenclature, purification, assay, introductory kinetics, mechanisms, cofactors, active sites, subunit structure, allosteric and regulatory properties, and the control of multienzyme systems. *Prerequisites:* 301, 302 or 305-306; Chemistry 141, 142. Two hours. Meyer.

**340 ORGANIC BIOCHEMISTRY** Organic reaction mechanisms as related to substances of biochemical interest, with emphasis on catalytic mechanisms. *Prerequisite:* 301, 302 or 305-306. Two hours. Thanassi.

**350 RADIOISOTOPE LABORATORY** The practical aspects of the use of radioisotopes as tracers in biochemical research. *Prerequisites:* 301, 302 or 305-306, 303 and permission of the department. Three hours. Staff.

**371 PHYSICAL BIOCHEMISTRY** Protein interaction, solubility and fractionation, electrophoresis, sedimentation, phase rule study, diffusion, viscosity, spectrophotometry, and related topics. *Prerequisites:* 301, 302 or 305-306; Chemistry 141, 142. Two hours. 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** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

## • BIOMEDICAL ENGINEERING

A cooperative program offered by the Department of Electrical Engineering (S. Rush, *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 or Mechanical Engineering satisfies the principal requirements. Courses in biology and chemistry may be recommended as prerequisites. Applicants with backgrounds other than Electrical or Mechanical Engineering will generally be required to make up undergraduate deficiencies.

### **MINIMUM DEGREE REQUIREMENTS**

Physiology and Biophysics 301; twelve hours in Electrical or Mechanical

## BIOSTATISTICS

Engineering, Physics and Mathematics; additional approved courses; thesis research (6-12 hours) in the Departments of Electrical or Mechanical Engineering. Each applicant should consult the department to determine if the program offered meets his specific educational objectives.

Biomedical engineering is one of the areas of research interest in the graduate programs in Electrical and Mechanical Engineering.

### • BIOSTATISTICS

This is an interdisciplinary program administered through the Biostatistics Division of the Department of Epidemiology and Environmental Health. Dr. D. L. Sylwester is the program director.

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 Statistics Program, Biostatistics and Community Medicine courses taught in the Department of Epidemiology and Environmental Health and includes experience in a wide variety of health, biomedical, and related research projects at the University of Vermont. The program aims to give trainees maximal opportunity to use their academic training and program experience to assist in defining problems, formulating rational methods of inquiry, and gathering, analyzing, and interpreting data as they relate to the specific problem under investigation.

### **PREREQUISITE FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE**

An undergraduate major which includes an indication of statistical ability and an interest in applying statistical methodologies and concepts to health and biomedical problems. Three semesters of calculus including multiple integration, partial differentiation, infinite series, and introductory differential equations are required. Students without a background in linear algebra and various topics included in Mathematics 271 may be required to make up deficiencies as part of their graduate degree program. The Graduate Record Examination is strongly advised and is required of any applicant who wishes to be considered for a teaching fellowship.

### **MINIMUM DEGREE REQUIREMENTS**

**Plan A:** Twenty-four semester hours of coursework. This would generally include Statistics 251, Biostatistics 211, 221, 233, 241, 242, and 300; six hours of approved thesis research.

**Plan B:** Thirty semester hours of coursework. This would generally include Statistics 251, Biostatistics 211, 221, 233, 241, 242, 300, 381, and six hours of approved electives; no thesis required.

## BOTANY

All students are expected to participate in the projects of the Biometry Facility and to attend the regular seminar series as part of their training. During the latter part of his training the student will be expected to take major responsibility for some project, including the presentation of the final report for this project.

The person entering with a strong statistics background may, upon approval, substitute more advanced statistics courses or courses in allied fields for the requirements listed above.

### COURSES OFFERED

202 POPULATION DYNAMICS For description see Sociology 202.

211, 221 STATISTICAL METHODOLOGY I, II For description see Statistics 211, 221.

231 EXPERIMENTAL DESIGN For description see Statistics 231.

233 SAMPLING METHODS For description see Statistics 233.

237 NONPARAMETRIC METHODS For description see Statistics 237.

241, 242 STATISTICAL THEORY I, II For description see Statistics 241, 242.

300 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.

354 MEDICAL SOCIOLOGY For description see Sociology 354.

381 BIOMETRY PRACTICUM See Statistics 281.

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 Hyde (Chairman), Klein, and Vogelmann; Associate Professors Cook and Etherton; Assistant Professors Ullrich and Worley; Assistant Plant Pathologist Gotlieb; Herbarium Curator and Teaching Associate Barrington.*

The Botany Department has ongoing research programs in several areas of phycology, bryology, pteridology and mycology including host-parasite inter-relations, biogeography, molecular genetics and limnology; physiological studies including growth and development, mineral nutrition, translocation,

tissue cultures, photophysiology, photobiology, cellular electrophysiology and membrane function; phytopathology including physiological virology; ultrastructure of cytoplasm and nucleus. The Botany Department participates actively in the Cell Biology Program and provides opportunities for interdisciplinary research with other life science departments.

**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). Each candidate must participate in the teaching of at least one undergraduate course.

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24.

**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 Departments 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

## BOTANY

131-132 at the University of Vermont or its equivalent); a year of mathematics comparable to Mathematics 21, 22 and in some cases Mathematics 121 or its equivalent; one year in physics, *i.e.*, Physics 15, 16 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.) 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

**201 ELECTRON MICROSCOPY** Theory and practice of electron microscopy including microscope operation, specimen preparation, and interpretation of electron micrographs. *Prerequisite:* Departmental permission. Four hours. Staff.

**205 MINERAL NUTRITION OF PLANTS** See Plant and Soil Science 205.

**207 WATER RELATIONS OF PLANTS** See Forestry 207.

**213 PLANT COMMUNITIES** Plant sociology; structure and organization of the plant community; sampling methods and analysis of data; climatic and edaphic factors; field work. *Prerequisite:* 109 or departmental permission. Three hours. Vogelmann. Alternate years, 1976-77.

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

**250 MICROTECHNIQUE** Theory and practice in the preparation of biological materials for anatomical and cytological study, including histochemistry and photomicrography. *Prerequisites:* Introductory chemistry; some knowledge of organic chemistry, anatomy, or cytology is desirable. Three hours. Cook. Alternate years, 1976-77.

**253 MYCOLOGY** Taxonomy, genetics, physiology, ecology and economic

importance of the fungi. Representatives of each major group are explored with respect to the above. Includes microbiological technique and laboratory culture. *Prerequisites:* Biology 101 or Botany 104 or permission of the instructor. Four hours. Ullrich. Alternate years, 1976-77.

**255 STRUCTURE AND FUNCTION OF CHROMOSOMES** Advanced analysis of recombination in eucaryotes. Arrangement of DNA and proteins in chromosomes. DNA duplication and mapping of certain DNA regions. Molecular nature of meiotic processes and control of gene expression with particular reference to the nucleolus. *Prerequisites:* 101; Chemistry 16 or 131, 132. Three hours. Hyde. Alternate years, 1976-77.

**256 CYTOLOGY** Principles of structure in biological macromolecules and cellular organelles such as membranes, chloroplasts, and chromosomes. Their composition, origin and relationship between their structure and function. *Prerequisites:* Biology 103 or permission of the instructor; Chemistry 16 or 131, 132. Three hours. Hyde. Alternate years, 1977-78.

**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 11, 12 or 15, 16; Four hours. Etherton and staff. Alternate years, 1976-77.

**259 PLANT GROWTH AND DEVELOPMENT** Chemical and physical factors regulating growth and development of plant tissues and the plant body. Morphogenesis and differentiation. *Prerequisites:* 104; departmental permission. Four hours. Klein. Alternate years, 1976-77.

**260 PHYCOLOGY** The morphology, classification and general biology of the algae, with special consideration of the freshwater forms. *Prerequisites:* 105 or two courses in zoology or botany above 100. Four hours. Cook. Alternate years, 1978-79.

**281 BOTANY SEMINAR** Presentations of personal research by faculty and graduate students from within and outside the University. Attendance required of botany graduate students and seniors in botanical research programs. Without credit. Staff.

**295 SPECIAL TOPICS** Courses for small groups of selected advanced students within areas of expertise of faculty and staff. Various aspects of ecology, physiology, genetics, cytology, bryology, pteridology, paleobotany, photobiology, membrane physiology, cell biology. *Prerequisite:* Permission of the instructor. Staff. Credit as arranged.

**381 SELECTED PROBLEMS IN MODERN BOTANY** Subject matter

## BUSINESS ADMINISTRATION

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 Credit as arranged. Staff.

491 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

## • BUSINESS ADMINISTRATION

*Professors Greif, Nyquist, and Severance (Chairman); Associate Professors Laber, Michael, Shirland, and Squire; Assistant Professors Antil, Battelle, Gatti, Hutt, Schermerhorn, and Tashman.*

### BUSINESS ADMINISTRATION

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

The following subject areas (exemplified by UVM course equivalents) are required as prerequisites for admission to candidacy:

- (1) Calculus and Introductory Linear Algebra (BSAD 40)
- (2) Marketing Management (BSAD 154)
- (3) Financial and Managerial Accounting (BSAD 60, 61)
- (4) Organizational Behavior (BSAD 170)
- (5) Statistics (BSAD 144/STAT 111)
- (6) Operations Management (BSAD 173)
- (7) Corporate Finance (BSAD 180)
- (8) Principles of Economics (ECON 11, 12)

Elementary knowledge of computer programming is expected and may be acquired through the non-credit course available at UVM.

In addition to transcripts of prior undergraduate and graduate training, the applicant is required to submit scores on the Graduate Management Admissions Test. (GMAT scores are accepted in lieu of Graduate Record Examination scores for financial assistance in this program.)

#### **MINIMUM DEGREE REQUIREMENTS**

Students must complete a minimum of thirty hours of graduate credit selected from course offerings in Groups I, II, and III. All students must take BSAD 396, Business Policy. Of the total 30 hours: (1) a *minimum* of 15 must be in Group I courses including BSAD 396; (2) a *maximum* of 6 hours may be in Group III courses; and (3) the remaining hours may come from either Group I or Group II courses.



**COURSES OFFERED**

**GROUP I**

**340 QUANTITATIVE METHODS IN MANAGEMENT** The application of statistical tools to management problems. Sampling, decision making, and strategy selection are covered. *Prerequisite:* MBA standing. Three hours. Tashman.

**341 STATISTICAL METHODS FOR RESEARCH AND FORECASTING** The application of multivariate statistical models to business research and economic forecasting. Emphasis on understanding the rationale, structure, and capabilities of multivariate techniques including regression, factor analysis, discriminant analysis, time series and econometric forecasting models. *Prerequisite:* MBA standing. Three hours. Tashman.

**359 MARKETING POLICY** Marketing response in changing environments. An analytical approach is used to discover solutions to new and recurrent problems. Concepts from quantitative methods, economics and the behavioral sciences are applied. Included for consideration are: marketing opportunities, organizing for marketing, planning the marketing program and the control of marketing effort. Case book method. *Prerequisite:* MBA standing. Three hours. Hutt.

**360 CONTEMPORARY ACCOUNTING THEORY** A critical examination of the current structure of the accounting system, focusing on contemporary debates concerning the consistency between current practice and some theoretical optimum. *Prerequisite:* MBA standing. Three hours. Staff.

**365 MANAGERIAL ACCOUNTING** The use of budgeting, forecasting, transfer pricing, and cost control in management of the firm. A case orientation. *Prerequisite:* 268. Three hours. Staff.

**375 ORGANIZATION THEORY** Organization theories are examined for their insights into the behaviors of organizations and their members. An open systems perspective is used to identify contingencies in organization design based on human, structural, technological and environmental variables. *Prerequisite:* 70 or 170, 173. Three hours. Schermerhorn.

**376 THE MANAGEMENT OF CHANGE IN ORGANIZATIONS** This course adopts an applied behavioral science perspective to identify conceptual issues, develop diagnostic skills and examine alternative intervention strategies relevant to the accomplishment of planned changes in organizational systems. *Prerequisite:* 170 required; 375 desirable. Three hours. Schermerhorn.

## BUSINESS ADMINISTRATION

**380 MANAGERIAL FINANCE** This course focuses on key financial decisions that affect asset values. Topics include optimal capital structure, estimation and application of the cost of capital, mergers and acquisitions, and capital market theories and evidence. A major case involving valuation of the assets of a real firm constitutes an integral part of the course. *Prerequisite:* 180. Three hours. Laber.

**384 FINANCIAL MARKETS AND INTEREST RATES** A study of the mechanism determining the level and structure of interest rates. Specific subjects include: flow of funds accounting, market vs. natural rate of interest, interest rate structure, and behavior of interest rates over the business cycle. *Prerequisite:* MBA standing. Three hours. Gatti.

**396 BUSINESS POLICY** A case course focusing on the resolution of complex cases involving simultaneous solutions of problems in two or more functional areas. *Prerequisite:* 21 hours of graduate credit. Three hours. Staff.

## GROUP II

**257 CONSUMER BEHAVIOR** An exploration and evaluation of the body of research evidence from marketing and the behavioral sciences relevant to a theory of consumer behavior. Emphasis is also given to research methodologies employed. *Prerequisite:* 157. Three hours. Hutt.

**281 MUNICIPAL FINANCE** An examination of the issues and policy options facing the financial administrators of municipal government. Topics include property and nonproperty taxation, debt and cash management, budgeting, expenditure and revenue forecasting, and intergovernmental aid programs. *Prerequisite:* 180. Three hours. Tashman.

**283 INTERNATIONAL FINANCIAL MANAGEMENT** Theories and practices of international financial management are examined. Topics investigated include: systems of international exchange, spot and forward markets, and expropriation and exchange risk as parameters in investment and financing decisions. Cases used. *Prerequisite:* 180, 184. Three hours. Gatti.

## GROUP III

**242 MANAGEMENT INFORMATION SYSTEMS** The problems of designing business information processing systems. Manual and computer based systems are evaluated in terms of cost versus effectiveness. Systems design and programming projects are undertaken using the COBOL language. *Prerequisite:* 173. Three hours. Staff.

**244 APPLIED REGRESSION ANALYSIS** The nature and applications of basic regression-correlation models in investigating relationships, testing hypotheses and making predictions. Emphasis on the art of developing appropriate models and evaluating existing research. *Prerequisite:* Statistics 111. Three hours. Tashman.

**245 INTRODUCTION TO OPERATIONS RESEARCH** Application of quantitative techniques to the formulation and solution of management decision problems. Topics include linear programming applications, inventory management, and service center cost-effectiveness measurement. *Prerequisite:* Math 18, Computer Science 11, Statistics 111. Three hours. Staff.

**258 CURRENT MARKETING DEVELOPMENTS** Discovery and analysis of both internal and environmental changes affecting marketing theory and practice. Topics include: social change, functional and institutional marketing system change, and legislative and regulatory trends. Individual research projects required. *Prerequisite:* 151 or 154. Three hours. Greif.

**259 MARKETING MANAGEMENT** The use of advanced cases to aid in the formulation of overall policies and planned strategies for marketing programs. Topics include product planning and channel selection. *Prerequisite:* 151 or 154. Three hours. Greif.

**264 FUND ACCOUNTING** Study of accounting principles and practices of governmental organizations including appropriation systems, funds, revenues accounting for other nonprofit organizations, and third party reimbursement accounting for Medicare and health insurance intermediaries. *Prerequisite:* 162 or experience in public administration. Three hours. Michael.

**265 ACCOUNTING THEORY** Study of underlying concepts, principles and structure of accounting theory. Topics covered include financial accounting standards, opinions of the APB professional literature and current applications. *Prerequisite:* 162. Three hours. Battelle.

**266 ADVANCED ACCOUNTING** Accounting for partnerships, special sales contracts, parent-subsidiary relationships, fiduciary relationships and governmental units. *Prerequisite:* 162. Three hours. Nyquist.

**267 AUDITING** Study of the C.P.A. as an independent auditor. Topics covered include standards, ethics and legal responsibilities of the profession, financial statements, audit concepts and techniques, and the audit opinion. *Prerequisite:* 266. Three hours. Battelle.

**268 COST ACCOUNTING** Accounting for inventory valuation and income determination, nonroutine decisions, policy making and long range planning. *Prerequisite:* 61. Three hours. Nyquist.

## CELL BIOLOGY

269 C.P.A. PROBLEMS Review of questions and problems from past C.P.A. examinations coupled with a study of the *Opinions of the Accounting Principles Board*. Prerequisite: 266. Three hours. Nyquist.

271 PERSONNEL MANAGEMENT The personnel function in organizations; selecting and training employees; job analysis and evaluations; and wage administration. Prerequisite: 170. Three hours. Squire.

### • CELL BIOLOGY (Interdisciplinary)

*Participating faculty are from the following departments: Botany; Biochemistry; Medical Microbiology; Medical Technology; Medicine; Microbiology and Biochemistry; Pathology; Pharmacology; Physics; Physiology and Biophysics; Zoology.*

An interdisciplinary program leading to M.S. and Ph.D. degrees in Cell Biology is offered under the direction of a committee composed of faculty members drawn from the participating departments. The program provides the flexibility necessary for a student to gain competence in the area of his choice. The extensive research facilities of the participating departments are available to all graduate students enrolled in the program. Inquiries should be directed to the Cell Biology Program Chairman, Dr. Beal B. Hyde, Dept. of Botany.

Research includes: (Albertini) human somatic cell genetic mutations, histocompatibility genetics; (Brammer) structure and function of insect visual systems; (Brody) pathogenesis of lung diseases using electron microscopy; biology and fine structure of mites and ticks; (Clemmons) biochemistry and pathology of embryonic growth and development; (Cook) cytology and cytochemistry of host-parasite interactions between algae and aquatic fungi; (Craighead) pathogenesis of viral infections and viral oncogenesis; (Davison) population regulation in fresh-water invertebrates; (Etherton) electrophysiology and membrane transport in plants; (Glade) establishment of bilateral symmetry in amphibian eggs; cellular contributions in regeneration; (Hart) effect of cadmium and zinc on fresh-water algae; (Hyde) plant cytogenetics and ultrastructure; (Johnstone) biochemical capacity of microbial cells; (Jones) electrophysiology of cultured cardiac cells; (Kelleher) biochemistry of mammalian development with emphasis on serum proteins; (Landesman) gene control during development; (Low) protein metabolism in eukaryotic systems; (McCormack) nitrogen heterocycles, chemotherapy of neoplastic and protozoal diseases; (Meyer) physiological control of neural proteases, ribonucleases and esterases in normal and diseased skeletal muscle; (Moehring) cell structure; mechanisms of pathogenesis of toxins; replication of animal viruses; (Morselli) tissue and organ culture studies on growth and differentiation of woody plants; (Novotny) synthesis and assembly of bacterial pili and their function in conjugation; (Nyborg) biophysics of ultrasound; (Racusen) biochemistry of plant

proteins; (Rothstein) control of cell division; (Schaeffer) transformation of normal rat liver cell cultures to the tumorigenic state using the carcinogen aflatoxin B<sub>1</sub>; (Sjogren) microbial ecology of Lake Champlain; (Stevens) mechanisms of cell division; (Ullrich) cellular and molecular studies on the genetic regulation of development in eukaryotes, particularly fungi; (Woodworth) biochemistry of iron-binding and transport proteins.

#### **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 Record 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 hours of graduate level credit including one course in each of the four following areas: genetics, biochemistry (one year), cell structure, and cell physiology; cell biology seminar each semester; thesis research.

#### **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. Studies Committee will advise course selection. Thesis research, minimum 20 credits. Regular participation in seminar program.

#### **COURSES OFFERED**

381 SEMINAR One hour. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

491 DOCTORAL THESIS RESEARCH Credit as arranged. Staff.

#### **• CHEMISTRY**

*Professors Allen, Flanagan, Gregg, Krapcho, Kuehne (Acting Chairman), and*

## CHEMISTRY

*Wulff; Associate Professors Brown, Strauss and Weltin; Assistant Professors Geiger and Sayer.*

Current research in organic chemistry includes isolation and structure determination of natural products; the nucleophilic reactions of bivalent carbon species; the reactivity of spiro systems; the synthesis of naturally occurring compounds; problems relating to biogenesis; structure-activity correlation in medicinal chemistry; molecular orbital correlation of reactivity; enzyme studies; neighboring group participation; nucleophilic aromatic substitution; molecular complexes; biorganic mechanisms.

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 mixed valence chemistry, organometallic compounds, inorganic polymers, and studies of the syntheses, structures, reactivities, and spectroscopic properties of phosphorus-nitrogen and sulfur-nitrogen compounds.

Research in analytical chemistry includes electrochemical studies of transition metal complexes and organometallic complexes, electron spin resonance studies of materials in unusual oxidation states. Novel reactions of reactive compounds generated electrochemically under high vacuum, studies of factors influencing heterogeneous electron transfer processes in non-aqueous media.

### **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.) Satisfactory scores on the Graduate Record Examination.

A program is also offered leading to the degree of Master of Arts in Teaching, Cf. p. 24.

### **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 above 100 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.

**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, 201, 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 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 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.

## CHEMISTRY

### **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); (2) satisfactory performance in the cumulative examinations in his specialty field; (3) demonstration of basic competence in 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, 381-384, 3 semester hours credit of advanced level work in three of the four areas of chemistry (analytical, inorganic, organic and physical). The remainder of 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**

**201, 202 ADVANCED CHEMISTRY LABORATORY** Modern analytical, physical and synthetic techniques. Syntheses requiring advanced methods such as controlled atmosphere box, autoclave, etc. Development of techniques used for measurement of a variety of phenomena, e.g. thermochemistry, kinetics, electrochemistry, spectroscopy. Students wishing to take one semester only may concentrate in a particular area of interest, such as instrumental analysis. *Prerequisites:* 11, 12 or 123; credit for or concurrent enrollment in 141 and 142. Four hours each semester. Geiger.

**212 ADVANCED INORGANIC CHEMISTRY** Structure, bonding, and reactions of inorganic compounds. Ionic compounds, the lanthanides; theories of acids and bases; electron-deficient bonding; covalent bond chemistry; simple models for structure prediction; introduction to crystal field theory; substitution



reactions of transition metal complexes. *Prerequisite:* 142 or equivalent. Three hours. Allen, Brown.

**213 ADVANCED INORGANIC CHEMISTRY** Application of symmetry concepts to inorganic chemistry; ligand field theory and electronic spectra; multiply-bonded systems; metal carbonyls; introduction to organometallic chemistry; biologically important inorganic complexes. *Prerequisite:* 212. Three hours. Allen, Brown.

**223 CHEMICAL INSTRUMENTATION** The design and usage of modern instrumentation to facilitate chemical research. Selected laboratory studies in instrumentation and analysis. *Prerequisite:* Chem. 201, 202 or consent of instructor. Credit as arranged with maximum of four hours. Offered as occasion warrants. Staff.

**231 PHYSICAL ORGANIC CHEMISTRY—PRINCIPLES** Structure-reactivity relationships, molecular properties and their interpretation, Methods and results of investigations of mechanisms of common organic reactions. *Prerequisites:* 132; 142. Three hours. Strauss, Krapcho, or Sayer.

**235 MOLECULAR ORBITAL THEORY** An introduction to the Huckel molecular orbital method. Energy levels and orbitals, molecular properties and their interpretation. Effects of substituents on electronic structure. Extensions of the Huckel method. *Prerequisites:* 132, 142, or equivalent. Three hours. Weltin.

**242 CHEMICAL KINETICS AND MECHANISMS** Theoretical and experimental aspects of chemical kinetics. Use of kinetics to deduce mechanisms of organic and inorganic reactions. Gaseous reactions, catalysis, isotope and solvent effects, chain reactions and very fast reactions. *Prerequisites:* 132; 142. Three hours. Flanagan, Krapcho, and Sayer.

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

**247 INTRODUCTION TO QUANTUM MECHANICS** General considerations of quantum mechanics. Development of techniques pertinent to the application of quantum mechanics to chemical problems. *Prerequisites:* 141, 142 or equivalent. Three hours. Offered as occasion warrants. Weltin.

**248 CHEMICAL THERMODYNAMICS** Systematic study of the application of thermodynamics to chemical problems. Concepts of statistical thermo-

## CHEMISTRY

dynamics to be introduced. *Prerequisites:* 141, 142 or equivalent. Three hours. Wulff.

249 CHEMICAL STATISTICAL MECHANICS Development of statistical mechanics and its application to problems of chemical interest. *Prerequisites:* 141, 142 or equivalent; 247 recommended. Three hours. Alternate years. Wulff.

251, 252 ADVANCED ORGANIC CHEMISTRY Detailed discussion of fundamental principles and reactions in organic chemistry. Stereochemistry, conformational analysis, ring strain, reactivity criteria in the main reaction classes, reaction mechanisms, and important synthetic methods are discussed. *Prerequisites:* 132, credit for or concurrent enrollment in 141, 142; 251 for 252. Three hours. Kuehne, Krapcho, and Strauss.

271 ADVANCED ANALYTICAL CHEMISTRY A systematic survey of modern methods of chemical analysis. Principles and applications of analytical and molecular spectroscopy, electrochemistry, and separation techniques. *Prerequisite:* 141; 142. Three hours. Geiger.

282 ORGANOMETALLIC CHEMISTRY A systematic survey of the syntheses, properties, structures, bonding and reactions of organometallic compounds. Variation of the structure and stability of the metal-carbon bond throughout the periodic system. *Prerequisite:* 212. Three hours. Alternate years. Allen and Brown.

284 PHYSICAL INORGANIC CHEMISTRY Ligand field theory, magnetic properties, magnetic resonance techniques (NMR, ESR, and NQR), Mossbauer spectroscopy, and optical activity. *Prerequisite:* 213 or equivalent. Three hours. Alternate years. 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. *Prerequisite:* Credit or concurrent enrollment in 252 or permission of the instructor. Three hours. Alternate years. Kuehne.

334 NATURAL PRODUCTS—THE TERPENES The chemistry of monosesqui di 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. 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.

## CIVIL ENGINEERING

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

**372 METHODS OF CHEMICAL INVESTIGATION** Introduction to advanced 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** Credit as arranged. Staff.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged. Staff.

## • CIVIL ENGINEERING

*Professors Cassell and Oppenlander (Chairman); Associate Professors Dawson and Downer; Assistant Professors Hemenway, Laible, and Olson; Lecturer Dunham; Adjunct Professor Knight.*

The Department of Civil Engineering is presently conducting research in environmental engineering, structures, transportation, and urban planning.

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

A Bachelor's degree and the approval of this Department. Additional course

## **CIVIL ENGINEERING**

work may be required of candidates who lack a strong science background. Satisfactory scores on the Graduate Record Examination.

### **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 six to nine 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**

**210 AIRPHOTO INTERPRETATION** Techniques in aerial photographic interpretation; principles of stereoscopic viewing and identification of the airphoto features related to landform, vegetation, drainage, soil color tone, and topography; and the use of airphoto interpretation in soil identification. Three hours. Olson.

**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. Staff.

**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. 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. Oppenlander.

**231 URBAN PLANNING ANALYSIS** History and development of urban planning; approaches to planning with attention to city design and appearance, quantitative methods in planning, and social welfare planning; plan implementation; organization and administration of planning agencies; and financial planning. Three hours. Oppenlander.

**232 COMMUNITY DESIGN** Basic principles and methods of planning and designing the total community; site selection and elements of physical layout and design. Design projects dealing with community elements such as subdivisions, industrial parks, new towns, etc. Three hours. Oppenlander and Sargent.

**233 REGIONAL PLANNING** See Resource Economics 233.

**240 TRAFFIC ENGINEERING CHARACTERISTICS** Basic components of highway travel including driver, vehicle, roadway, environmental, and pedestrian characteristics; traffic flow and intersection characteristics; highway and intersection capacities; performance of traffic systems; and techniques for measuring traffic characteristics. Three hours. Staff.

**241 TRANSPORTATION SYSTEMS ENGINEERING** Interdisciplinary aspects of transportation systems and their technological characteristics; mathematical analysis and synthesis of system problems; economic consideration of transportation; fiscal studies and financial planning; and administration of transportation systems. Three hours. Staff.

**242 TRAFFIC ENGINEERING OPERATIONS** 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; design of street lighting, and evaluation of traffic engineering improvements. *Prerequisite:* 240. Three hours. Staff.

**244 URBAN TRANSPORTATION SYSTEMS** Transportation planning process for urban areas; inventory, use, and desire studies for urban transportation; techniques of travel forecasting and trip generation, distribution, and assignment; planning, design, and operation of mass transit systems; location and design of terminal facilities. Three hours. Oppenlander.

**250 ENVIRONMENTAL FACILITIES DESIGN-WATER** Design of water supply systems including; source evaluation, transmission, distribution; water treatment plant design; equipment selection; wells. Spring of odd years. *Prerequisite:* 151. Three hours. Cassell.

**251 ENVIRONMENTAL FACILITIES DESIGN-WASTEWATER** Design of wastewater conveyance and treatment facilities; sewage-treatment plant design; equipment selection. *Prerequisite:* 151. Three hours. Spring of even years. Cassell.

**252 INDUSTRIAL HYGIENE** Industrial hygiene problems; effects of pollutants on health; threshold limit values; emphasis on the engineering evaluation of the hazard and control techniques. *Prerequisites:* Chemistry 5, Physics 25. Three hours. Spring semester. Hemenway.

## CIVIL ENGINEERING

**253 AIR POLLUTION** Sources of air pollution, methods of measurement, standards, legal aspects and control techniques available. Emphasis placed on source testing and source control. *Prerequisites:* Chemistry 5 and Math 11. Three hours. Fall semester. Hemenway.

**254 SOLID WASTES** Significance of solid wastes from municipal, industrial, agricultural, mining; optimization and design of collection, disposal, recycle systems; sanitary landfills, incineration, composting, material recovery. *Prerequisites:* Chemistry 5 and Physics 25. Three hours. Spring of even years. Cassell.

**255 WATER RENOVATION PROCESSES-CHEMICAL/PHYSICAL** Design theory of chemical/physical processes for treating waters and wastewaters; mass transfer, coagulation/precipitation, sedimentation, filtration, mixing, absorption, ion exchange, membrane processes; pilot plant experimentation. *Prerequisites:* 160, Chemistry 5, Math 14, Senior or Graduate standing. Three hours. Fall of even years. Cassell.

**256 WATER RENOVATION PROCESSES-BIOLOGICAL** Design theory of biological processes for treating waters and wastewaters; aerobic, anaerobic, photosynthetic processes; disinfection; pilot plant experimentation. *Prerequisites:* Math 14, Senior or Graduate standing. Three hours. Fall of odd years. Cassell.

**257 ANALYSIS OF AQUATIC SYSTEMS** Quantitative study of biological, chemical and physical phenomena in lakes, streams and estuaries; mathematical modeling applied to management of water quality. *Prerequisites:* 150 and 160. Three hours. Spring of odd years. Cassell.

**258 ENVIRONMENTAL FACILITIES DESIGN-AIR** Advanced design principles for air pollution control equipment including scrubbers, precipitators, cyclones and filters. *Prerequisites:* 150; 252 or 253. Three hours. Spring of odd years. Hemenway.

**259 MEASUREMENT OF AIRBORNE CONTAMINANTS** Quantifying airborne contaminants from processes and ambient levels. Laboratories demonstrate calibration and measurement, stack sampling and ambient air monitoring of specific contaminants. *Prerequisites:* 252 or 253. Three hours. Spring of even years. Hemenway.

**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. 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. Downer.

**263 MEASUREMENTS IN APPLIED HYDROLOGY** Design of hydrologic experiments; observational methods, equipment and problems in 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. 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. Laible.

**271 PRESTRESSED CONCRETE STRUCTURES** Ultimate strength theory for concrete structures with emphasis on prestress effects; 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. Dunham.

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

**281 HIGHWAY AND AIRPORT PAVEMENT DESIGN** Structural design of flexible and rigid pavements; types of wheel and axle configurations; frost action; design of bases and subbases; theory of stresses; methods of design; and pavement evaluation. *Prerequisites:* 140, 180. Three hours. Olson.

**282 ENGINEERING PROPERTIES OF SOILS** Study of soil properties that influence the engineering behavior of soils; subject areas include soil mineralogy, physiochemical concepts, plasticity properties, permeability, and compaction; and laboratory study of soil index properties, permeability, and compaction tests. *Prerequisite:* 180. Three hours. Olson.

**290 ENGINEERING INVESTIGATION** Independent investigation of a special topic under the guidance of a staff member. Preparation of an engineering report is required. Three hours. Staff.

**333 ADVANCED REGIONAL PLANNING** See Resource Economics 333.

**360 ADVANCED HYDROLOGY** Application of statistics to problems in engineering hydrology; the concept and use of the instantaneous unit hydro-

## CLASSICS

graph; 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. Downer.

**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** Credit as arranged.

## • CLASSICS

*Professors Ambrose (Chairman) (on sabbatical 1976-77), Bliss, Davison, Gilleland; Associate Professor 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; lyric and elegiac poetry; Petronius; satire; Roman Imperial Families; Mythology; Etruscology; Medieval Studies.

## **PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS IN GREEK AND LATIN**

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 and Latin, six hours of which must be 381; 6 additional hours in Greek and Latin, History or Philosophy; thesis research (normally 6 hours). Comprehensive examinations in Greek and Latin translation, Greek and Roman history, literature, and philology are required. In addition to course work, students will have a reading list of authors in Greek and Latin.

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.

A program is also offered leading to the degree of Master of Arts in Teaching: Cf. p. 24. Satisfactory scores on the Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

Three hours of graduate credit are offered in the Summer Institute. Consult Summer School catalogue.

## **COURSES OFFERED**

### GREEK

**201 GREEK ORATORS** Selected speeches of Lysias and Demosthenes. Three hours. Alternate years, on request. Bliss.



202 GREEK COMEDY Two plays of Aristophanes. Three hours. Alternate years, 1976-77. Ambrose, Schlunk.

203 GREEK HISTORIANS Thucydides, Books I and II; selections from Herodotus and Xenophon's *Hellenica*. Three hours. Alternate years, 1976-77. Bliss, Davison.

204 GREEK TRAGEDY Sophocles' *Antigone* and Euripides' *Medea*, or two equivalent plays. Three hours. Alternate years, 1977-78. Ambrose.

205 GREEK PHILOSOPHERS Plato, *Republic*, Books I and II; selections from the Pre-Socratics and from Aristotle. Three hours. Alternate years, on request. 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, 1977-78. Bliss.

## LATIN

### COURSES OFFERED

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

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

227 ROMAN LYRIC POETS Selections from the works of Catullus, Horace, Propertius, Tibullus. Three hours. Alternate years, 1976-77. Bliss.

252 COMEDY Two plays of Plautus and Terence. Study of the precursors of this literary form. Three hours. Alternate years, on request. 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, on request. Gilleland.

255 HISTORIANS OF THE EMPIRE Augustus, *Res Gestae*; Tacitus, *Annals*, I-IV; selections from Suetonius and Ammianus Marcellinus. Three hours. Alternate years, on request. Davison.

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

271 SILVER LATIN Extensive reading of post-Augustan authors not included in other advanced courses. Three hours. Alternate years, 1976-77. Bliss, Gilleland.

## COMMUNICATION AND THEATRE

### GREEK AND LATIN

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 and Latin authors not read in the candidate's undergraduate program. Credit as arranged. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Normally total 6 hours.

### • COMMUNICATION AND THEATRE

*Professors Feidner, Lewis, London, Manchel; Associate Professors Bryan (Acting Chairman), Schenk, Wilson; Assistant Professors Cover, Guitar, Leake, Lyon, Schultz, Shane, Worden, Yadav; Instructors Collett, Robbins, Williams; Lecturers Dilley, Houghton, A. Orth; Coordinators Daruvala, Turpin.*

Current interests and research in the Department of Communication and Theatre include diagnostic-therapeutic programming; the effectiveness of the classroom teacher in improving articulation 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 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; mass media in Britain and Canada; cross-cultural communication; the effects of environment on communication; creative film making; the development of informational and persuasive films and mass media campaigns involving audience research.

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

### **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 COMMUNICATION DISORDERS**

A minimum of 30 hours in communication disorders and selected areas to include 101, 281 (or their equivalents); a course in 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**

Thirty hours of graduate level courses including 18 hours in communication disorders, 6 hours in communication disorders or a related field; thesis research (6 hours). Undergraduate plus graduate courses must include 6 hours of audiology.

### **COURSES OFFERED**

**201 THEORIES OF HUMAN COMMUNICATION** The relationship of language, perception, thinking, and social context to human communication. *Prerequisite:* Nine hours of related courses, including 1. Three hours. Yadav.

**211 PERSUASIVE COMMUNICATION** 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. Leake.

**214 ISSUES IN PUBLIC ADDRESS** Selected 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. Leake.

**215 GROUP COMMUNICATION** Each semester, one of the following topics will be studied in depth: (1) Group Communication Theory, (2) Leadership in Groups, and (3) Communication in Organizations, (4) Communication in the Classroom. *Prerequisite:* Nine hours of related courses, including 14. Three hours. May be repeated up to nine credit hours. Schultz.

**223 INTERPERSONAL COMMUNICATION** A study of human communication on the interpersonal level. *Prerequisite:* Nine hours of related courses, including 121. Three hours. Lewis and Yadav.

**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. Yadav.

## COMMUNICATION AND THEATRE

**243 REPERTORY THEATRE OPERATION** Lectures, research, observation and practical experience relating to the problems of producing Shakespeare in a repertory theatre. Special emphasis on the productions of the Champlain Shakespeare Festival. *Prerequisite:* Permission of the instructor. May be taken up to nine hours. Staff.

**245 THE CLASSICAL THEATRE** An investigation of the earliest dramatic rituals and the theatres of Greece and Rome as evidenced by historical remains and extant dramas. *Prerequisites:* 39 plus three hours. Three hours. Bryan.

**246 THE MEDIEVAL AND RENAISSANCE THEATRE** An overview of the medieval and renaissance theatre, accompanied by an evaluation of relevant historical materials and representative dramas. *Prerequisites:* 39 plus three hours. Three hours. Bryan.

**247 SEVENTEENTH AND EIGHTEENTH CENTURY THEATRE** An intensive view of the dramas and theatrical conditions in Europe and America from the closing of the English theatres to the end of the eighteenth century. *Prerequisites:* 39 plus three hours. Three hours. Bryan.

**248 NINETEENTH AND TWENTIETH CENTURY THEATRE** An examination of the backgrounds, theatrical conventions, and dramas representative of Romanticism, Realism, and revolts against Realism. *Prerequisites:* 39 plus three hours. Three hours. Bryan.

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

**254 ADVANCED SCENE DESIGN** Analysis of the drama from the standpoint of its visual creation upon the stage; audience-stage relationships, styles of production. *Prerequisite:* 154. Three hours. Schenk.

**260, 261 SEMINAR IN MASS MEDIA** An intensive examination of selected areas of study related to mass media. *Prerequisite:* Nine hours of related courses, including 63. Three hours. Staff.

**262 WRITING FOR MASS COMMUNICATION** A comparative study of the principles of writing for the mass communications media. *Prerequisite:* Nine hours of related courses, including 63. Three hours. Lewis and Worden.

**263 INTERNATIONAL MASS COMMUNICATION** Mass media systems of other countries, i.e., Britain, Canada. *Prerequisite:* Nine hours of related courses. Three hours. May be repeated up to nine credit hours. London.

**264 ADVANCED TELEVISION PRODUCTION** Emphasis on the following

## COMMUNICATION AND THEATRE

types of programs; educational, news, documentary, dramatic and variety. Laboratory use of the ETV studio. *Prerequisite:* 164. Three hours. Dilley.

**265 CINEMATOGRAPHY** Advanced study of film expression and production of student films. *Prerequisite:* 167 or permission of the instructor. Three hours. Worden.

**266 SEMINAR IN FILM** A study of various topics, film criticism and research. *Prerequisite:* Nine hours of related courses, including 165 or 166. Three hours. May be repeated up to nine credit hours. Manchel.

**267 THE CONTEMPORARY CINEMA** Lectures, screenings, and reports on modern filmmakers, recent trends and new techniques. *Prerequisite:* Six hours of related courses, including 165 or 166. Three hours. Manchel.

**268 THE BLACK MAN IN FILM** A study of black artists in movies from 1895 to the present, with an emphasis on American films. *Prerequisite:* Six hours of related courses, including 165 or 166. Three hours. 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. Wilson.

**271 COMMUNICATION DISORDERS I** Etiology, symptomatology, and principles of habilitation for voice disorders (including the laryngectomized) and cleft palate. *Prerequisites:* 74, 101 and 270. Three hours. Staff.

**272 COMMUNICATION DISORDERS II** The nature of articulation and the etiology, diagnosis, and treatment of disorders of articulation. *Prerequisites:* 281. Three hours. Shane.

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

**275, 276 CLINICAL STUDY** Supervised practicum experiences with children and adults presenting disorders of speech, hearing, and language. *Prerequisites:* 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. *Prerequisites:* Nine hours of speech and psychology including 74. Three hours. Lyon.

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282 ANATOMY-PHYSIOLOGY OF AUDITION Anatomy and physiology of the normal auditory system. Basic acoustics and subjective correlates of the auditory stimulus. *Prerequisites:* Nine hours of speech and psychology including 74. Three hours. Staff.

283, 284 SEMINAR Discussion and research in the selected areas of communication and theatre. *Prerequisite:* Departmental permission. Three hours. Staff.

287 CURRENT RESEARCH IN LANGUAGE ACQUISITION Recent advances in child language. *Prerequisite:* 270. Three hours. Wilson.

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:* Twelve hours. Three hours. London.

300 RESEARCH METHOD AND DESIGN Research method and design, bibliographical resources, and professional writing in the field of communication and theatre. Three hours. Staff.

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. Worden.

377 HABILITATION AND REHABILITATION PROCEDURES FOR THE HEARING IMPAIRED *Prerequisite:* 273. Three hours. Houghton.

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

383 SEMINAR IN SPEECH PATHOLOGY An intensive study of selected topics in speech pathology. *Prerequisites:* 271, 272. Three hours. Staff.

384 SEMINAR IN ARTICULATION Etiology, diagnosis, pathology, and habilitation and rehabilitation of articulation. *Prerequisites:* 271, 272. Three hours. Lyon.

385 SEMINAR IN VOICE Study of the research in voice production and speech. Application to pathological and non-pathological problems. *Prerequisites:* 271, 272. Three hours. Shane.

386 SEMINAR IN CEREBRAL PALSY Etiology, pathology, diagnosis, and principles of habilitation of cerebral palsy and related conditions. Emphasis

## COMPUTER SCIENCE

on disorders of oral communication and associated disturbances. *Prerequisites:* 271, 272. Three hours. Shane.

**387 SEMINAR IN LANGUAGE DISORDERS** Identification, evaluation, and rehabilitation procedures for the preschool and school-age child with language disabilities. *Prerequisite:* 270. Three hours. Wilson.

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

**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. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged. Staff.

### • COMPUTER SCIENCE

*Professor Dawson; Associate Professors Absher, Hill (Chairman); Assistant Professors Aggarwal, Fellingner; Lecturers Charbonneau, Cobb, Fischl, Halsted, Thomas, Whalen.*

#### **PREREQUISITES FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE IN COMPUTER SCIENCE**

Bachelor's degree from an accredited institution; Mathematics 21, 22, 104, 124 or the equivalent; Computer Science 11, 101, 102, 103, 104, or the equivalent. Satisfactory scores on the aptitude portion of the Graduate Record Examination.

#### **MINIMUM DEGREE REQUIREMENTS**

Thirty semester hours of acceptable graduate credit. Thesis is optional. Required courses are Computer Science 201, 202, 222, 241, 242, 283 and Electrical Engineering 230. The additional nine hours required may be selected from an area of minor concentration or may be composed of one additional CS course and a six credit thesis. CS 301 is suggested for entering students with an undergraduate major other than computer science.

#### **COURSES OFFERED**

**201 OPERATING SYSTEMS** An introduction to the principle components and algorithms involved in operating systems design and implementation. Memory, processor, device and file management techniques are presented and compared. Protection and security schemes are examined for both memory and file organizations. Synchronization primitives are discussed. *Prerequisite:* 222. Three credits. Staff.

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**202 COMPILER CONSTRUCTION** Organization of a compiler including compile and run time symbol tables, lexical scan, syntax scan and object code generation. *Prerequisite:* 104. Three hours. Hill.

**204 ADVANCED SYSTEMS PROGRAMMING** Advanced study and research in a selected area of systems programming. *Prerequisite:* 201. Three hours. Aggarwal.

**222 COMPUTER ARCHITECTURE** The architecture of computing systems. Levels of computer description. Taxonomy of computing machines. Addressing structures, memory concurrency, processor concurrency. Hardware features desirable for various software systems. Hardware, software, firmware tradeoffs. *Prerequisites:* 102, Math 104, EE 230. Three hours. Staff.

**241 INTRODUCTION TO THE THEORY OF COMPUTING** A study of various theoretical models of computing devices including the basics of automata theory, recursion theory, formal grammars and Turing machines. *Prerequisite:* Math 104. Three hours. Aggarwal.

**242 SEQUENTIAL MACHINES AND AUTOMATA THEORY** Capabilities and limitations of finite state automata. Minimization, control and identification of machines. Structure and loop-free decomposition of machines. State-identification and fault-detection experiments. Finite state recognizers and regular expressions. *Prerequisites:* 241 or Math 104 or EE 230. Three hours. Aggarwal.

**283 SPECIAL TOPICS IN COMPUTER SCIENCE** Lectures, reports and directed readings on advanced topics. *Prerequisite:* Permission of the instructor. Three hours. Staff.

**301 INTRODUCTION TO COMPUTER SOFTWARE FOR GRADUATE STUDENTS** Language translation, operating systems fundamentals, data base organization. *Prerequisite:* 101. Three hours. Fellingner.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

## • ECONOMICS

*Professors Alnasrawi, Campagna (Chairman), Dellin and Nadworny; Associate Professor Chase; Assistant Professors Bates, Fritz and Stoler; Lecturer Rosenberg; Adjunct Associate Professor Francisco.*

No Master's Program offered



**COURSES OFFERED**

**200, 201 ECONOMIC HISTORY OF THE UNITED STATES** Economic development and the evolution of capitalism in the United States. *Prerequisite:* 186 or 190 or permission of the instructor. Three hours. Nadworny.

**210 INCOME, WEALTH AND WELFARE** Analysis of the distribution of income and wealth and policies which affect them. *Prerequisite:* Nine hours in Economics. Three hours. Bates.

**216 ECONOMIC DEVELOPMENT** Theories of economic growth applied to underdeveloped areas of the contemporary world, including the political and social determinants of economic progress. *Prerequisites:* 11, 12; 190 recommended. Three hours. Alnasrawi and Stoler.

**217 URBAN AND REGIONAL ECONOMICS** Economic analysis applied to the problems of cities, states and regions. *Prerequisite:* Nine hours in Economics. Three hours. Fritz.

**234 ADVANCED MACRO AND MONETARY THEORY** Analysis of classical, Keynesian and modern macroeconomic models; micro and macro demand for and supply of money; portfolio choice and the influence of financial intermediaries. *Prerequisites:* 101 and 190. Three hours. Campagna.

**241 HUMAN RESOURCES** The theory and policy, the labor sector, and human capital in an advanced economy. *Prerequisite:* 141. Three hours. Nadworny.

**242 LABOR-MANAGEMENT RELATIONS** Economic influences of unionization. The grievance process, arbitration and labor relations laws. *Prerequisite:* 141. Three hours. 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:* Twelve hours in history and/or other social sciences. Three hours. Dellin.

**267 ECONOMETRICS** A combination of economic theory, mathematics, and statistics for the testing of economic hypotheses and developing economic models. *Prerequisites:* 131, 186, 190, and 130 recommended. Three hours. Fritz.

**290 THE SOVIET AND EASTERN EUROPEAN ECONOMIES** Analysis of the economic development, structure, performance and direction of the Soviet and related economies. *Prerequisite:* Nine hours in economics or permission of the instructor. Three hours. Dellin.

## ECONOMICS

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

## 296 SEMINAR AND SPECIAL TOPICS

## 297 READINGS AND RESEARCH

**300, 301 INDEPENDENT READING AND RESEARCH** Designed 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. Campagna and Stoler.

**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:* 267 and Math 11-12. Three hours. Fritz.

**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. Chase.

**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. Campagna.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

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, eco-

conomic 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

### College of Education and Social Services

*Professors Boller, Carlson, Corrigan, Ducharme, Fishell, Fox, Gobin, Hunt, Leggett, McKenzie, Nash, Peterson, Petrusich, Phillips, Rippa; Associate Professors Abruscato, Agne, Burrell, Christensen, Clements, Conrad, Erb, Hanley, Hillman, Lang, Larson, Meyers, Nichols, Rathbone, Saurman, Shiman, Stocker, Thompson, Whittlesey; Assistant Professors Bright, Chase, Cheney, Dunkley, Greig, Griffin, Guzzetta, Holmes, Leean, Letteri, McKay, Nedde, Ponzo, Robie, Ryan, Simberg, Strassburg, York; Lecturers Burdett, Christie, Condon, Corologus, Egner, Farrell, Gryckiewicz, Guerette, Hall, Hayes, Knight, Kusiak, LaCasse, Lange, McEntee, Paolucci, Perelman, Pierson, Reinhardt, Roberts, Royce, Schiller, Slack, Smith, Szabo, Wade, Watson.*

The College of Education and Social Services 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 or appropriate professional certification and satisfactory score on the Graduate Record Examination (Aptitude only). The Education course prerequisites do not apply to the Student Personnel Services in Higher Education Program.

### **MINIMUM DEGREE REQUIREMENTS**

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

## **AREAS OF SPECIALIZATION**

### **I. ORGANIZATIONAL AND HUMAN RESOURCE DEVELOPMENT**

The Organizational and Human Resource Development Area is a result of merging the Administration and Planning, Counseling, and Student Personnel

## EDUCATION

Services in Higher Education Programs. In addition to the three previously mentioned graduate level programs, a fourth option is available which is referred to as an Interdisciplinary Major in Organizational and Human Resource Development. Inquiries regarding this program and the specializations listed below should be addressed to Professor Robert V. Carlson.

### 1. *Administration and Planning*

This program is designed to prepare administrators and planners for public schools, educational agencies, administrative positions in higher education and social agencies. The M.Ed. Program usually requires 30-36 credit hours of courses, seminars, practicums, and research to complete.

The C.A.S. Program usually requires 30-36 credit hours of intensive study beyond the M.Ed. requirements.

Courses in administration include 218, 295, 332, 333, 335, 337, 352, 353, 354, 355, 356, 357, 358, 364, 391, and 397.

### 2. *Counseling*

This degree program provides preparation for the individual who intends to become a school counselor, a director of public personnel services, or a counselor in another setting. The program covers three broad areas including courses to assist the candidate to understand the foundations and dynamics of human behavior within the social context, courses to aid the candidate in understanding the foundations of education and the organizational structures of institutions of learning, and courses which provide understanding of the professional aspects of the work of the counselor and which assist the candidate in the refinement of skills necessary for competence in helping relationships, whether individual or group. There is emphasis upon the implementation of theory in practice with opportunities provided for student-counselors to work in real-life settings with supervision.

Courses in the Counseling program include: 220, 221, 295, 350, 351, 368, 370, 374, 381, 383, 384, 386, 388, 389.

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

3. *Student Personnel Services in Higher Education.* This program area is aimed at providing a general background for the individual who is preparing to work within the broad area of student personnel services in colleges and universities. The program allows flexibility for the student to strengthen his/her major area of interest (i.e., admissions, housing, student activities, financial aid, counseling, placement, and others), while pursuing a strong academic core. Emphasis is on the dynamics of the college student's growth and development, human behavior, and a practical and conceptual understanding of the culture

of higher education and its organizational structure and its impact on the individual student. The student personnel program seeks to link the theoretical and conceptual knowledge of higher education and student development with its most immediate practical applications. To implement this aspect of the program, a comprehensive program of practicums and internships has been developed to provide experiences in a variety of university offices and departments as well as in nearby colleges. The program attempts to prepare student development educators to serve as teachers, counselors, facilitators, administrators. It defines education broadly to consciously reflect a basic understanding of the teaching-learning process and the role of the student development educator in perpetuating this process.

Courses in the student personnel services program include: 220, 295, 319, 360, 362, 374, 383, 385, 387 and 397.

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

4. *Interdisciplinary Major in OHRD.* This degree option is designed primarily for students who wish to pursue a more flexible and self designed route in drawing upon the courses offered in the Administration & Planning, Counseling and Student Personnel Programs, as well as other parts of the College of Education & Social Services and the University. This program is planned in consultation with an assigned faculty advisor and ideally suited for persons whose future professional role may call upon some mixture of administration and counseling competencies.

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

## II. SPECIAL EDUCATION

### 1. *Special Education*

The Graduate Program in the Special Education Area is designed to prepare consulting teachers who specialize in early essential education, elementary education or secondary education. Only those applicants who intend to be full time graduate students will be accepted into the Graduate Program. Although the minimum requirements for this degree are 30 credit hours, including 6 hours of foundations of education, consulting teacher candidates are required to complete 54-60 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 for consulting teachers include: EDSP 298, 310, 312, 316, and 319.

Graduate courses in special education that are open to interested individuals

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other than those in the consulting teacher program include: EDSP 216, 218, 220, 224, 226, 290, 292, 295-297, and 397.

Inquiries regarding the consulting teacher program or other special education coursework at the graduate level should be addressed to the Chairman, Professor Wayne Fox.

### III. TEACHER EDUCATION

In the event of restrictions on enrollment, preference will be given to Vermont residents holding professional positions in education and social services.

#### 1. *Individually Designed Concentration*

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 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 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 and Social Services.

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 to develop strong programs of professional education which include academic offerings in the various teaching fields in elementary and secondary education.

Degree concentrations, in addition for those listed below, can be developed on an interdisciplinary basis responding to student strengths and needs.

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 Dr. Edward R. Ducharme, Chairperson, Teaching and Learning Specialties Program Area.

#### 2. *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) inservice 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, 211, 252, 254, 255, 277, and 313.

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

### 3. *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.

## COURSES OFFERED

### *Organizational and Human Resource Development, Social Work—EDOH, SOSE:*

Any questions concerning instructor and course structure should be addressed to Professor Robert V. Carlson.

**220 PERSONALITY DEVELOPMENT** Approaches to understanding human behavior in applied settings. With emphasis on behavior development as an interpersonal process. *Prerequisite:* Twelve hours in education and psychology.

**221 COUNSELOR-TEACHER-PARENT CONSULTATION** The consultive relationship in educational settings. *Prerequisites:* Education 220 and permission of instructor.

**291 SPECIAL TOPICS IN ORGANIZATIONAL AND HUMAN RESOURCE DEVELOPMENT** Designed to accommodate various special issues

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in counseling, administration and planning, social work, or higher education which are not appropriate to the content of an existing course. Courses will reflect the social services orientation of OHRD. Various hours.

**332 SEMINAR AND SIMULATION TRAINING IN EDUCATIONAL ADMINISTRATION AND PLANNING** Provides an opportunity for the student to experience and apply selected administrative and planning concepts and skills in a simulated setting. Three hours. Staff.

**333 CURRICULUM CONCEPTS, PLANNING & DEVELOPMENT** An overview of conceptions of curriculum for elementary, secondary, or higher education organizations; examination of contemporary curriculum trends and issues; processes for initiating, planning and developing activities. *Prerequisites:* Twelve hours of Education or permission of instructor. Three hours.

**335 STAFF EVALUATION AND DEVELOPMENT** Supervisory roles, behavior, responsibilities, and relationships in educational and social service organizations; methods and processes for evaluating the performance and promoting the personal growth and development of staff in subordinate and superior roles. Attention will be given to evaluation and development practices as factors in organizational health and renewal. Three hours.

**337 POLITICAL PROCESSES IN EDUCATION** Political and operational relationships of social organizations to multiple publics and governmental bodies at the local, state, and national levels. Three hours. Staff.

**350 FOUNDATIONS OF THE HELPING PROCESS** Critical analysis of the various facets of counseling within the current cultural setting. Special emphasis upon goals of the helping process and their justification. *Prerequisite:* Twelve semester hours in education and psychology. Three hours.

**351 UNDERSTANDING INDIVIDUAL DIFFERENCES** Current and traditional techniques used to explore the psychology of individual differences and group assessment. Experience given in taking, administering, interpreting various tests; study project allows for application to any setting. *Prerequisite:* Twelve hours in education. Three hours.

**352 ANALYSIS OF EDUCATIONAL AND SOCIAL SERVICE ORGANIZATIONS** Organizational concepts, variables, and methods of analysis; diagnosing causes of organizational problems; examination of factors promoting organizational health and renewal. Emphasis will be on the pre-planning phase of the planning process. Three hours.

**353 INQUIRY SEMINAR IN ADMINISTRATION AND PLANNING** Administrative roles, functions, and responsibilities in maintaining and chang-



ing organizations; relationships between persons in superior and subordinate positions; leadership styles and behavior appropriate for managing in contemporary and future organizations. Three hours.

**354 GENERAL AND SOCIAL SYSTEMS THEORY** General Systems Theory is analyzed in terms of its utility for examining social systems, macro-systems analysis of research, planning, and interdisciplinary dialogue. Three hours.

**355 SYSTEMS ANALYSIS AND PLANNING** An analysis of and experience with planning theories and techniques that derive from General Systems Theory. Three hours.

**356, 357 SEMINAR IN FUTURISM AND PLANNING** Examination of knowledge, values, and attitudes relating to the concept of the future; ways of looking at the future; alternative futures, trend analysis, and goal setting in the context of the planning process; forecasting techniques and planning processes applied to educational and social service organizations. Six hours (each semester can be taken independently).

**358 SEMINAR IN COMMUNITY EDUCATION** The seminar participants will analyze the Community Education process, relate the process to community development, and develop strategies for the planning and implementation of Community-Education. Three hours.

**360 HIGHER EDUCATION IN AMERICA** A critical, contemporary overview of the American university in crisis. The American university will be examined from the perspectives of differing value positions, and the implications of these conflicting value philosophies for the theory and practice of higher education. Three hours.

**362 THE AMERICAN COLLEGE STUDENT** Study of the American college student within his living-learning environment. Emphasis upon sociological and psychological aspects in relation to student personnel work and counseling. *Prerequisite:* Twelve hours in education, psychology, and sociology or related areas. Three hours.

**364 EDUCATIONAL EVALUATION: CONCEPTS AND APPLICATIONS** This course is designed to acquaint educational personnel with an overview of the state-of-the-art of educational evaluation, emerging concepts, related models and potential applications to settings requiring data to be systematically analysed. Twelve hours in education and/or permission of instructor. Three hours.

**366 SOCIAL WELFARE AND SOCIAL WORK AS SOCIAL INSTITU-**

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**TIONS** 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.

**368 LIFE STYLE APPRAISAL** A specialized technique for developing an understanding of an individual's subjective method of perceiving life events. Applications of the technique in various counseling modalities. Practice in the use of the technique. *Prerequisites:* EDOH 220, 374, and permission of instructor.

**370 ELEMENTARY SCHOOL GUIDANCE** The development of counseling programs in the elementary school. Use of techniques appropriate to elementary school settings: classroom discussions, parent education, teacher consultation, appraisal techniques, etc. Emphasis placed on utilizing the total social milieu to enhance the development of positive self-concept in the child. *Prerequisites:* 220 and 350. Three hours.

**374 COUNSELING THEORY AND PRACTICE** A theoretical and practical approach to understanding the dynamics of the counseling process. Emphasis placed upon the refinement of a personal philosophy and theory of counseling and the implementation of it in practice. *Prerequisites:* Graduate standing, twelve hours in education and/or psychology, and permission of instructor. Three hours.

**381 COUNSELING FOR CAREER DEVELOPMENT** Psychology of career development with emphasis upon counseling for career decision-making within the current cultural context. *Prerequisite:* Graduate standing. Three 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 practice of group dynamics. *Prerequisites:* Twelve hours in education and psychology and permission of the instructor. Three credits.

**384 PRACTICUM IN COUNSELING** Supervised experiences in individual and small-group counseling situations. 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. *Prerequisites:* 374 and permission of the instructor. Three hours.

**385 STUDENT PERSONNEL SERVICES IN HIGHER EDUCATION** Purposes, organization, and administration of student personnel services in higher education. Focus on general practices, current research, and future

trends within a human development framework. The various personnel services will be examined as they assist the student to grow and develop within the unique college culture and environment. An understanding of the role, objectives and philosophical assumptions of student development education will be provided. Three hours.

**386 HUMAN RESOURCE DEVELOPMENT PROGRAMS: A HUMANISTIC PERSPECTIVE ON DESIGN, OPERATION AND EVALUATION** Practical and theoretical work in developing programs designed to increase human well-being. Students will design and implement programs, and increase their self-awareness and their skills in working with others. *Prerequisites:* Introductory courses in guidance and twelve hours in education and psychology. Three hours.

**387 SEMINAR IN HIGHER EDUCATION** Designed for graduate students concentrating in programs in Higher Education. Analysis and discussion of current issues and problems in higher education. *Prerequisite:* Permission of instructor. One to three hours.

**388 PROCEDURES IN FAMILY COUNSELING** Theory and process of counseling with families. Live demonstrations of family counseling with opportunities for student involvement. *Prerequisites:* EDOH 220, EDOH 374, and permission of instructor. Three hours.

**389 COUNSELING PRACTICUM** Supervised practice in family counseling. *Prerequisites:* EDOH 388, permission of instructor.

*Education, Special—EDSP:*

Any questions concerning instructor and course structure should be addressed to Professor Wayne Fox.

**216 INTRODUCTION TO INDIVIDUALIZING INSTRUCTION FOR ELEMENTARY CLASSROOM TEACHERS** Introduction to the individualization of instruction for elementary school children with deficits in language, arithmetic and/or social behaviors. Each student is required to complete a classroom project with an elementary school child determined eligible for special education services. *Prerequisites:* Twelve hours in education and related areas and permission of the instructor. Three hours.

**219 INTRODUCTION TO INDIVIDUALIZING INSTRUCTION FOR SECONDARY CLASSROOM TEACHERS** This course will emphasize the preparation of instructional objectives, the organization and sequencing of learning materials, and the utilization of special procedures to assist adolescents in achieving objectives. Each student will be required to carry out a practicum

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with an adolescent displaying academic or social deficits. *Prerequisites:* Twelve hours in education and related areas and permission of the instructor. Three hours.

**224 INTRODUCTION TO BEHAVIORAL PRINCIPLES OF EDUCATION WITH ELEMENTARY CLASSROOM APPLICATION** An introduction to the application of basic behavioral analysis principles in the elementary classroom setting that will improve the academic and social behaviors of children eligible for special education services. *Prerequisites:* Twelve hours in education and related areas and permission of the instructor. Three hours.

**226 INTRODUCTION TO BEHAVIORAL PRINCIPLES OF EDUCATION WITH SECONDARY CLASSROOM APPLICATION** This course will emphasize the application of behavioral principles in regular class settings to improve the academic and social behaviors of adolescents. *Prerequisites:* Twelve hours in education and related areas and permission of the instructor. Three hours.

**290 DEVELOPMENT OF SCHOOL YEAR MINIMUM OBJECTIVES** This course provides intensive study of that aspect of the math or language curriculum that constitutes the basic (minimum) skills and knowledge to be learned by all students at a given instructional level. The curriculum is specified in terms of instructional objectives and an evaluation system is developed to measure each learner's achievement. *Prerequisite:* Permission of instructor. Three hours.

**295 SPECIAL EDUCATION PRACTICA FOR ELEMENTARY CLASSROOM TEACHERS** Credit as arranged.

**296 SPECIAL EDUCATION PRACTICA FOR SECONDARY CLASSROOM TEACHERS** Credit as arranged.

**297 PRACTICUM FOR THE MEASUREMENT AND IMPLEMENTATION OF MINIMUM OBJECTIVES** Credit as arranged.

**298 CONSULTING TEACHER PRACTICA** Credit as arranged.

**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 for children and youth eligible for special education. Each student will be required to conduct a supervised classroom project. *Prerequisites:* Twelve hours in education and related areas, and permission of the instructor. Three hours.

**312 ANALYSIS OF CLASSROOM BEHAVIOR** This course is a survey of

basic behavioral principles and procedures involved in the analysis of classroom behavior as they apply to the problem of learners with behavioral deficits in the regular classroom setting. *Prerequisite:* EDSP 310. Three hours.

**316 SEMINAR IN SPECIAL EDUCATION FOR CONSULTING TEACHERS** Advanced application of behavioral analysis principles to the language, arithmetic and social behaviors of learners eligible for special education. Emphasis is on the evaluation of research involving teaching/learning procedures, methodology, and materials employed by consulting teachers. *Prerequisite:* EDSP 312. Three hours.

**319 CONSULTING TEACHER INTERNSHIP** Credit as arranged. Staff.

*Education, General—EDSS:*

Any questions concerning instructor and course structure should be addressed to Professor Edward Ducharme.

**202 PHILOSOPHY OF EDUCATION** Educational theory and philosophy past and present; contributions of leading educational philosophers; the interrelationships of education, society, and philosophy. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**204 SEMINAR IN EDUCATIONAL HISTORY: THE STRUGGLE FOR EQUALITY OF OPPORTUNITY** A study of selected topics in the history of education from the "Golden Age" of Greece to the present. Special attention to the nature of education in democratic and authoritarian social orders. Discussions and research will revolve around such topics as the education of women, the plight of American Indians, and the quest of the black people throughout the world for equality and freedom. *Prerequisites:* Twelve hours in education and related areas; permission of instructor. Three hours.

**205 HISTORY OF AMERICAN EDUCATION** History of principles and practices in American education as they relate to social, economic, political, and cultural developments. Discussions will focus on key ideas of historic and contemporary significance. *Prerequisite:* Twelve hours in education and related areas, or permission of instructor. Three hours.

**206 COMPARATIVE EDUCATION** An examination of educational policies and practices in selected countries throughout the world. Specific attention will be paid to those topics that relate to important issues in American Education. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**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:* Twelve hours in education and related areas. Three hours.

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**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:* Twelve hours in education and related areas. Three hours.

**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.

**252 SEMINAR IN AESTHETIC EDUCATION** A critical examination of aesthetic values transmitted in contemporary schools. Consideration of ways to expand aesthetic awareness among children, youth and adults. The aesthetic quality of natural and man-made environments with implications for present and future educational practice will be given special attention. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**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. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**255 THE SCHOOL AS A SOCIAL INSTITUTION** 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:* Twelve hours in education and related areas. Three hours.

**277 SEMINAR IN EDUCATIONAL PSYCHOLOGY** Examination of personal values, attitudes, and beliefs related to learning, psychological research of the teaching-learning process, use of such research in analyzing the process of education, and the creation of applications for educational settings of all kinds. *Prerequisite:* Twelve hours in education and related areas. 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. *Prerequisite:* Twelve hours in Education and related areas. Two to six hours.  
(EDSS, EDEL, EDSC, EDOH, EDSP)

**295, 296, 297, 298 LABORATORY EXPERIENCE IN EDUCATION** Supervised field work designed to give students experience in specialized areas for

their professional development. *Prerequisite:* Permission of instructor in the appropriate program area. Credit as arranged.  
(EDSS, EDEL, EDSC, EDOH, EDSP)

**313 STATISTICAL METHODS IN EDUCATION** Introductory course covering the basic concepts of descriptive and inferential statistics. Topics include frequency distributions, measures of central tendency and hypothesis testing. Special emphasis will be placed upon the application of these concepts to educational situations. Three hours.

**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.  
(EDSS, EDEL, EDSC, EDOH, EDSP)

**333 CURRICULUM CONCEPTS, PLANNING AND DEVELOPMENT**  
See EDOH 333, page 90.

**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 and Social Services. Three to eight hours.

**391 MASTER'S THESIS RESEARCH** Thesis topic must be approved by a faculty committee. Credit as arranged.

**397 PROBLEMS IN EDUCATION** Individual work on a research problem selected by the student in consultation with a staff member. *Prerequisites:* Twelve hours in education and related areas; endorsement by a sponsoring faculty member. Credit as arranged.  
(EDSS, EDEL, EDSC, EDOH, EDSP)

**399 RESEARCH METHODS IN EDUCATION** Seminars and research projects will introduce the students to the methods of historical, descriptive, experimental, quasi-experimental, field studies, and survey research. Three hours.

*Education, Elementary—EDEL:*

Any questions concerning instructor and course structure should be addressed to Professor Edward Ducharme.

**222 IMPROVEMENT OF READING INSTRUCTION IN THE ELEMENTARY SCHOOL** Analysis of philosophies, programs and instructional practices for teaching reading in the elementary school. Examination and evaluation of basal textbook, individual and specialized reading programs. *Prerequisite:*

## EDUCATION

Twelve hours in education and/or related areas including an introductory course in reading or consent of instructor. Three hours.

**234 LITERATURE AND LANGUAGE FOR CHILDREN AND YOUTH** 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 content areas; books for children and youth. *Prerequisite:* Twelve hours in education and related areas or consent of instructor. Three hours.

**241 SCIENCE FOR THE ELEMENTARY SCHOOL** This course will examine a number of elementary school science programs including: Elementary Science Study (ESS), Science Curriculum Improvement Study (SCIS), Science: A Process Approach (AAAS), Environmental Studies (ES). Emphasis will be on the methods and materials relating to the construction and use of science units for children in grades K-6. *Prerequisites:* Twelve hours in education and related areas and permission of instructor. Three hours.

**242 MODERN TRENDS IN ELEMENTARY EDUCATION** Study of modern educational principles and practices in elementary schools. Emphasis will be on communication in the classroom, interaction between students and teachers, materials and emerging trends as they affect the school. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**244 SOCIAL STUDIES IN THE ELEMENTARY SCHOOL** Study of literature, research, and problems in teaching social studies in the elementary school. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**256 METHODS AND MATERIALS IN ELEMENTARY SCHOOL MATHEMATICS** 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:* Twelve hours in education and related areas. Three hours.

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

**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:* Twelve hours in education and related areas. Three hours.



**275 ANALYSIS OF READING AND RELATED LANGUAGE DIFFICULTIES** Analysis and evaluation of learning difficulties with emphasis on reading and writing; nature of difficulties; procedures and materials for assessing reading performance. Involvement with children is required. *Prerequisite:* Twelve hours in education and related areas, including an introductory course in reading or permission of instructor. Three hours.

**276 LABORATORY EXPERIENCES IN READING AND RELATED LANGUAGE INSTRUCTION** Approaches to be used for the prevention and correction of reading and written language difficulties. Supervised teaching of individuals and/or small groups experiencing reading and language problems. Apprenticeships in reading instructional programs. *Prerequisite:* 275 or permission of instructor. Three to six hours.

**378 ADVANCED STUDY AND RESEARCH IN READING AND RELATED LANGUAGE ARTS** Survey of research, comparison and evaluation of emerging programs, design and development of projects in reading. *Prerequisites:* Fifteen hours in education including nine hours in the field of reading and language education, or permission of the instructor. Three hours.

**379 SEMINAR IN READING INSTRUCTION** Study of reading relative to total curriculum. Significant trends and concepts related to specific problems and programs in reading and language arts instruction; role of the supervisor and the reading consultant. *Prerequisites:* Fifteen hours in education including nine hours in the field of reading and language education or permission of the instructor. Three hours.

*Education, Secondary—EDSC:*

Any questions concerning instructor and course structure should be addressed to Professor Edward Ducharme.

**217 SECONDARY SCHOOL CURRICULUM** Principles and problems in curriculum development. An analysis of recent curricular innovations in American secondary schools. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**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 permission of instructor. Three hours.

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**225 TEACHING SOCIAL STUDIES IN SECONDARY SCHOOLS** Includes multiple teaching modes, questioning techniques, micro-teaching laboratory, analysis of historical content to determine students prerequisite cognitive skills and processes for construction of historical scenarios. *Prerequisite:* Twelve hours of education and related areas. Three hours.

**227 TEACHING SCIENCE IN SECONDARY SCHOOLS** Consideration of science curricula for grades 7-12. Opportunity for study will be provided in: BSCS, IMB, IME, IET, IPS, PSII, CHEM, CBA, IIS, PSSC, HPP, ECCP, TSM, ESS, ISCS, and locally developed Minicourses. The following is a representative listing of topics to be examined: Teaching science as problem-solving, research in science teaching, evaluation strategies, instructional techniques, and affective education through science. *Prerequisites:* Twelve hours in education and related areas, and permission of instructor. Three hours.

**303-304 PROBLEMS AND RESEARCH IN TEACHING SECONDARY SCHOOL ENGLISH** See English 303-304.

### *Education, Music—EDMU:*

Any questions concerning instructor and course structure should be addressed to Professor William Metcalfe.

**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. *Prerequisite:* An undergraduate major in music education or permission of instructor. Three hours.

**243 RECENT TRENDS IN MUSIC EDUCATION** Study of recent thought and practices in music education. Examination of current trends. *Prerequisite:* an undergraduate major in music education or permission of instructor. Credit variable, one to four hours.

**253 PRACTICUM IN MUSIC EDUCATION** Current methodology in music education for music specialist and classroom teacher. Each year the emphasis will be in a different area of concentration. *Prerequisites:* An undergraduate major in music education or elementary education and teaching experience or permission of instructor. Credit variable. Course may be taken for one to four hours each semester and may be repeated for a maximum of eight hours of credit.

**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.

**390 ORGANIZATION AND ADMINISTRATION OF MUSIC EDUCA-**

**TION** Study of the organization and administration of vocal and instrumental music in the public schools. *Prerequisites:* Graduate standing in music education and teaching experience or consent of instructor. Three hours.

***Education, Physical Education—EDPE:***

Any questions concerning instructor and course structure should be addressed to Associate Professor Charles Christensen.

**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. Includes scheduling, budgeting, management, equipment, policy, and public relations. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**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. *Prerequisite:* Twelve hours in education and related areas. Three hours.

**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. *Prerequisite:* EDPE 116 or equivalent. Three hours.

***Library Science—EDLS:***

Within the Teacher Education Program Area, it is possible to concentrate in school library media. Inquiries should be directed to Professor H. Lang.

**272 PUBLIC AND SCHOOL LIBRARY SERVICES** *Prerequisite:* Twelve hours in education and related areas, or permission of instructor. Three hours.

**273 CATALOGING AND CLASSIFICATION** *Prerequisite:* EDLS 272, or equivalent. Three hours.

**274 REFERENCE MATERIALS AND TEACHING THE USE OF LIBRARIES** *Prerequisite:* EDLS, or equivalent. Three hours.

**275 SELECTION OF BOOKS AND MATERIALS FOR YOUNG ADULTS** *Prerequisite:* EDLS, or equivalent. Three hours.

**276 REFERENCE SOURCES AND SERVICES** *Prerequisite:* EDLS 274. Three hours.

**277 LIBRARY MATERIALS AND SERVICES FOR MEDIA PERSONNEL** *Prerequisites:* EDLS 272, 273. Three hours.

**278 CATALOGING AND ORGANIZATION OF MEDIA MATERIALS** *Prerequisite:* EDLS 273.

**279 SELECTION OF LIBRARY MATERIALS FOR CHILDREN** *Prerequisite:* EDLS 272, or equivalent. Three hours.

## ELECTRICAL ENGINEERING

### • 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 (EDSS, EDEL, EDSC, EDOH, EDSP)	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
373 INDIVIDUAL TESTING	3
380 PROFESSIONAL PROBLEMS IN EDUCATION (EDSS, EDEL, EDSC, EDOH, EDSP)	3

### • ELECTRICAL ENGINEERING

*Professors Evering, Handelsman, Lai, Lambert, Roth and Rush (Chairman); Associate Professors Absher, Mirchandani, Taylor and Williams; Lecturer Hogel.*

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, pattern recognition 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).

Although a thesis is normally required in the program leading to the M.S. in Electrical Engineering, for students having substantial professional level engineering experience or having written high-quality technical reports which can be submitted as evidence, the thesis may be waived, with departmental approval, in favor of additional courses.

### **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 42 credit hours in courses and seminars and 30 credit hours in thesis. Normally, 12 additional credit hours in an area of specialization are found necessary. The language requirement for the Electrical Engineering Ph.D. program is comprised of the following: Satisfactory passing of a reading proficiency examination in one foreign language. The selection typically shall be made from French, German, Japanese or Russian. 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.

## ELECTRICAL ENGINEERING

**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. *Prerequisites:* 171 and Math 124 or equivalent background. Three hours. 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. 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. *Prerequisite:* Math 123 and one year of electrical engineering or physics. Three hours. Staff.

**231 COMPUTER APPLICATIONS TO DESIGN AND MANUFACTURING (3-0)** Computer hardware and software concepts. Basic and advanced APL (Program Language), practical computer applications in information management and process control. *Prerequisite:* Department permission. 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:* Math 123 or departmental permission. Three hours. Taylor.

**234 MINICOMPUTER SYSTEMS AND MICROPROCESSORS (3-0)** Introduction to mini and micro computers; hardware and peripherals; software and programming aspects; operating characteristics and configurations; mini/micro computer systems applications; discussion of system reliability, installation, and maintenance; future trends of minis and micros. *Prerequisite:* Senior standing in Electrical Engineering or Computer Science or departmental permission. Three hours. Staff.

## ELECTRICAL ENGINEERING

**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. *Prerequisites:* College physics and calculus or permission of the instructor. Four hours. Evering.

**236, 237 FUNDAMENTALS OF DIGITAL COMPUTER DESIGN (3-0)** Fundamentals of logic design. Design of combinational and sequential logic circuits. Implementation of arithmetic operations. Memory systems. Instruction codes. Dynamic storage allocation. *Prerequisites:* 32 or equivalent or Math 116; 236 for 237. Three hours. Staff.

**238 COMPUTER ASSISTED DESIGN (2-0)** Circuit design, modeling and analysis via visual display computer terminals. Use of ASTAP system to analyze device characteristics and diffusion parameters. *Prerequisites:* 261 and departmental permission. Two hours. Staff.

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

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

**251 APPLICATIONS OF LINEAR ALGEBRA** Introduction to basic definitions and concepts of linear algebra; formulation and solution of engineering problems. Application to problems of state variable analysis, field theory,

## ELECTRICAL ENGINEERING

mechanics, quantum mechanics and signal theory. *Prerequisite:* Graduate standing in Electrical Engineering or Physics, or departmental permission. Three hours. Rush.

**261 TRANSISTOR ENGINEERING** Analysis of the properties of PN junctions. Theory of transistors as developed from drift and diffusion properties of carriers. Charge control model of transistor switch. *Prerequisite:* Mathematics 123. Three hours. Staff.

**262 TRANSISTORS** 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.

**270, 271 SIGNAL PROCESSING** Signal-space concepts. Processing of analog and digital signals. Representation and analysis of nonrandom and random signals. Signal measurement techniques. Analysis and design of digital filters. Applications to real-world signals such as biosignals and signals in communication and radar systems. *Prerequisite:* Graduate standing in Electrical Engineering or 171; 270 for 271. Three hours. Lai.

**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:* Statistics 151. Three hours. Absher.

**281 SEMINAR** Presentation and discussion of advanced electrical engineering problems and current developments. *Prerequisite:* Graduate engineering enrollment. One hour. Staff.

**285 CREATIVE ENGINEERING** Creative techniques applied to problems in process control, biomedical engineering, communications, circuit design. *Prerequisite:* Graduate standing in Electrical Engineering or departmental permission. Three hours. Roth.

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

**311, 312 INTRODUCTION TO OPTIMUM CONTROL SYSTEMS** Review of conventional s-plane design of linear systems. Introduction to the optimal control problems, parameter optimization, and least-square optimization in the frequency domain. Optimization using the calculus of variations, Pontryagin's maximum principle, Hamilton Jacobi theory, and Dynamic programming. Computational methods for finding optimal controls and trajectories. Examples of optimum systems control. Introduction to stochastic control problems. *Prerequisites:* 111; 311 for 312. Three hours. Absher or Taylor.



314, 315 **NONLINEAR SYSTEM THEORY** Analysis and synthesis of piece-wise 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 systems 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. *Prerequisites:* 270, 312; 317 for 318. Absher or 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. Absher or 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.

345 **ELECTROMAGNETIC ANTENNAS AND PROPAGATION** Fundamentals of radiating systems and antennas. Antenna gain, directivity, receiving area, linear antennas, aperture antennas and phased arrays, transmission line systems and propagation through the atmosphere and ionosphere. *Prerequisite:* 242 or equivalent. Three hours. Handelsman.

363, 364 **INTRODUCTION TO SOLID STATE THEORY** Crystal structures in terms of the Bravais lattice. Band theory and the concept of Brillouin zone. Vibrational, transport, and other fundamental problems associated with ordered solids. *Prerequisites:* Atomic or modern physics; 363 for 364. Three hours. Lambert.

365 **OPTICAL PROPERTIES OF SOLIDS** Interaction of light with a medium. Absorption, dispersion, and reflectivity of light. Interband transitions in solids. Plasmons and dielectric functions in metals. *Prerequisites:* Bachelor's Degree in Engineering or physics or departmental permission. Three hours. Lambert.

366, 367 **SOLID STATE THEORY** Quantum mechanical free electron theory of metals. Quasi-free electron theory for periodic structures. Calculation of

## ENGLISH

energy bands for the most common crystal structures employing the tight binding approximation. Introduction to the Boltzmann transport equation, Onsager Relations, and transport coefficients. *Prerequisites:* 364, 366 for 367. Three hours. Lambert.

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 Electrical Engineering. Three hours. 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. 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. Lai.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

## • ENGLISH

*Professors* Bogorad, Broughton, Clark, Cochran (Chairman), Jones, Long, Orth, Poger, Rothwell and Shepherd; *Associate Professors* Eschholz, Hall, Howe, Huddle and Rosa; *Assistant Professors* Biddle, Bradley, A. I. Dickerson, Edwards, Gutman, Simone, Stanton, Stephany, Sweterlitsch, and Thompson; *Lecturer* M. J. Dickerson.

The research interests of the faculty of the Department of English and library resources permit 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 Aptitude and Advanced Graduate Record Examinations; demonstration of proficiency in writing by a detailed statement concerning the purpose in pursuing graduate study in English.

## **MINIMUM DEGREE REQUIREMENTS**

The department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24.

For MA and MAT: Eighteen hours in English, including 212, 301, and 302, and six additional hours in English or a related field. Also for MA: 371, six hours of thesis research, and reading knowledge of a foreign language, normally French or German.

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

## **COURSES OFFERED**

**200 OLD ENGLISH** The sounds, words, and structure of Old English; simple prose texts. Three hours. Alternate years, 1977-78. Dickerson.

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

**204 MIDDLE ENGLISH** Literary, historical, and linguistic considerations of Middle English texts, excluding Chaucer. Three hours. Alternate years, 1976-77. Dickerson.

**205, 206 ENGLISH DRAMA TO THE CLOSING OF THE THEATRES** First Semester: From the drama in the Middle Ages to Marlowe and Jonson. Second Semester: Jacobean Drama (exclusive of Shakespeare), to include Webster, Tourneur, and Ford, to the closing of the theatres in 1642. Howe, Rothwell.

**209, 210 ELIZABETHAN PROSE AND POETRY** First semester: From More and Wyatt to Spenser and contemporaries; second semester: Donne, Jonson and followers; development of prose from ornateness to simplicity. Three hours. Alternate years, 1977-78. Long.

**212 MILTON** *Paradise Lost*, *Paradise Regained*, *Samson Agonistes*, some of the minor poems, and selected prose works. Three hours. Bogorad.

**217 RESTORATION AND EIGHTEENTH-CENTURY DRAMA** Development of English drama from Dryden to Sheridan. Three hours. Alternate years, 1976-77. Bogorad, Howe.

## ENGLISH

218 RESTORATION AND EIGHTEENTH-CENTURY PROSE AND POETRY Significant writers from Dryden to Johnson. Three hours. Alternate years, 1976-77. Bogorad.

221, 222 THE ROMANTIC PERIOD First semester: Development of the Romantic Movement through Wordsworth and Coleridge; second semester: Byron, Shelley, Keats, and other Romantic poets and prose writers. Three hours. Jones, Stanton.

227, 228 ENGLISH NOVEL English fiction from its origins through the nineteenth century. Three hours. Hall, Stanton.

231, 232 VICTORIAN LITERATURE Significant writers, exclusive of novelists, from 1832 to 1900. Three hours. Alternate years, 1976-77. Long.

235 MODERN BRITISH DRAMA British and continental plays of the late 19th and 20th centuries, including plays by Ibsen, Pinter and Beckett. Three hours. Simone.

236 MODERN AMERICAN DRAMA Recent and contemporary, including plays by O'Neill, Miller and Williams. Three hours. Orth.

239 MODERN BRITISH POETRY A study of selected British poets since World War I, including Eliot, Yeats and Auden. Three hours. Poger.

242 LITERATURE OF THE SOUTHERN RENAISSANCE Selected short stories, novels, and poetry by Glasgow, Faulkner, Warren, Tate, Styron, and others. Three hours. Alternate years, 1977-78. Shepherd.

244 MODERN IRISH LITERATURE Irish literature from 1890 to the present with emphasis on Joyce and Yeats. Three hours. Bradley.

250 THE LITERATURE OF VERMONT An exploration of Vermont writing from the narratives of the Allen brothers to the poetry and fiction of today. Three hours. Biddle, Eschholz.

251, 252 AMERICAN NOVEL OF THE NINETEENTH CENTURY First semester: Hawthorne, Melville, and others; second semester: Twain, Howells, James, and others. Three hours. Biddle, Eschholz, Shepherd.

253 AMERICAN COLONIAL LITERATURE Intellectual and literary origins, in the seventeenth and eighteenth centuries, of American culture. Mather, Taylor, Edwards, Franklin, Jefferson, Freneau and Brown. Three hours. Rosa.

254 EMERSON, THOREAU, AND THEIR CIRCLE Three hours. Alternate years, 1977-78. Orth.

256 REGIONAL WRITING IN AMERICA Selected works by Cooper,

Twain, Faulkner, and others, including units on local color and Southwest humor. Three hours. Alternate years, 1976-77. Cochran.

257 AMERICAN POETRY TO WORLD WAR I Major American poets to 1917, including Poe, Whitman, Dickinson, and others. Three hours. Cochran, Gutman.

258 MODERN AMERICAN POETRY Major American poets from World War I to 1950, including Frost, Stevens and Williams. Three hours. Edwards, Poger.

261 STRUCTURE OF THE ENGLISH LANGUAGE Descriptive study of Modern American English. I, II. Three hours. Clark.

262 HISTORY OF THE ENGLISH LANGUAGE The principles of historical linguistics and their application to English. Three hours. Alternate years, 1976-77. 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. Three hours. Alternate years, 1977-78. Clark.

266 AMERICAN ENGLISH DIALECTS The emergence of American English with special attention to dialectology. *Prerequisites:* 13, Linguistics 101 or by permission of the instructor. Three hours. Eschholz.

273 TECHNIQUE AND CRITICISM OF POETRY Intensive analysis of various kinds of poetry to develop appropriate critical methods and standards. Three hours. Bogorad.

275 HISTORY OF CRITICISM Principles and theories of criticism from Aristotle to the twentieth century. Three hours. Alternate years, 1977-78. Hall, Stanton.

276 CONTEMPORARY CRITICISM A seminar in selected contemporary critical methods and interests. Three hours. Poger.

278 MODERN TRADITION Special topics necessary for the understanding of the critical, intellectual and literary works of the modern period: Symbolism, Realism, Self-consciousness, Nature, the Unconscious, Myth and others. 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. Dickerson.

302 GRADUATE SEMINAR A seminar for graduate students only. The topic varies from semester to semester, depending on the faculty member as-

## EXTRA-DEPARTMENTAL COURSES

signed to the course. One seminar is required of all 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:* Twelve hours of Education; acceptance as qualified to earn graduate credit in English. Three hours. Biddle.

**371 PRINCIPLES OF LITERARY RESEARCH** Methods of literary study, research, and scholarship. Required of all first-year M.A. candidates in English. Three hours. Orth, Stanton.

**383 TEACHING ENGLISH IN THE TWO-YEAR COLLEGE** Consideration of problems, curricular materials, classroom procedures, and research methods in junior and community college English teaching. *Prerequisite:* Permission of instructor. Three hours. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

**397, 398 SPECIAL READINGS AND RESEARCH** Directed individual study of areas not appropriately covered by existing courses. Not to exceed three hours per semester.

## • 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. *Prerequisites:* Permission by the executive committee and Dr. D. Kinnard 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.

**GRADUATE COLLEGE 301 SEMINAR IN COLLEGE TEACHING** Practical assistance to the beginning teacher in developing an effective, individ-

ual teaching style. Activities include analysis of approaches to teaching; discussion with faculty from various departments; micro-teaching exercises. *Prerequisites:* Graduate Teaching Fellowship and selection by department. Three hours. Holmes.

**GRADUATE COLLEGE 395 SPECIAL TOPICS** Workshop in the Social Sciences. Staff.

## • FORESTRY

*Professors Christensen, John (Acting Chairman), McCormack, Reidel, and Whitmore; Associate Professors Armstrong, Donnelly, Hannah, and Newton; Assistant Professor Blakeslee.*

The goal of the Master of Science program is to provide graduate students with initial training as forest scientists, or the opportunity to further their knowledge and proficiency in some specialized aspect of forest resource management. Research in the Department is oriented towards an integrated approach to forest based resource problems. The faculty has research interests which span the broad areas of biometry, economics and management, pathology, policy and administration, silvics, silviculture, and utilization. A student's thesis research is usually an integral part of on-going research projects in the Department.

### **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). No foreign language requirement.

### **COURSES OFFERED**

**205 MINERAL NUTRITION OF PLANTS** See Plant and Soil Science 205.

**207 WATER RELATIONS OF PLANTS** Soil-plant water relations. Absorption, transport, and transpiration by plants. Effects of water excesses and deficits. *Prerequisite:* Permission. Three hours. Alternate years, 1976-77. Donnelly and botany and plant and soil science staff.

**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. Hannah.

## FRENCH

222 **ADVANCED SILVICULTURE** Scientific bases for selected silvicultural practices. *Prerequisite:* Permission. Three hours. McCormack.

242 **ADVANCED FOREST BIOMETRY** Advanced principles of estimation, prediction, inventory and evaluation of forest resources. Use of system analysis techniques in natural resource management. *Prerequisite:* 144 or permission. Three hours. Alternate years, 1976-77. Newton.

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

253 **FOREST MANAGEMENT DECISION THEORY** Operations research procedures in forest management including wildlife, fire control, insect control, construction projects, and management of conservation programs. *Prerequisite:* Calculus. Three hours. Armstrong.

282 **SEMINAR** Review and discussion of selected topics and forestry research. *Prerequisite:* Graduate standing and permission. One hour. Staff.

381 **SELECTED PROBLEMS IN FORESTRY** Advanced readings, or a special investigation dealing with a topic beyond the scope of existing formal courses. *Prerequisite:* Graduate standing, and permission. Credit arranged.

391 **MASTER'S THESIS RESEARCH** Credit as arranged.

## • FRENCH

*Professor Ugalde (Acting Chairman); Associate Professors Julow, T. Geno, Crichfield; Assistant Professors Benoit, Carrard, Whatley, Whitebook and Wiley Sandler; Lecturer M. Geno.*

Opportunities for thesis research in French literature are offered in all areas from the medieval through the 20th century, as well as French-Canadian literature.

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

An undergraduate major in French or equivalent. Satisfactory scores on the Aptitude and Advanced Graduate Record Examinations.

### **MINIMUM DEGREE REQUIREMENTS**

Twenty-four hours in French, which may include six hours in a related field, and in addition:

Plan A: Thesis research (six hours)



Plan B: In lieu of a thesis the candidate may write a series of master's essays with variable credit of up to three credits per paper (six hours).

A program is also offered leading to the degree of Master of Arts in Teaching. Satisfactory scores on the Graduate Record Examinations (Aptitude and Advanced) are prerequisite for acceptance to candidacy for this degree. Cf. p. 24.

### COURSES OFFERED

The following courses are available for graduate credit. They are divided into courses concerned primarily with advanced language study and those which treat literature. In literature, the two-hundred level courses, open to both undergraduates and graduates, cover the history of French literature from its origins to the present time by means of division into centuries and genres. Emphasis is placed on major figures and works, with a view to studying them for their intrinsic value as well as in their historical context. The two courses offered specifically for graduate students are regularly supplemented by special topics given under the rubric of the Graduate Seminar; content may vary from year to year, depending on student and staff interests. For more detailed information on specific courses, consult with department chairman and the course instructor.

### FRENCH LANGUAGE

209 ADVANCED GRAMMAR Designed to help the student progress from an average workable knowledge of French grammar to a much more sophisticated level of speaking and writing French. Written and oral exercises are employed. Three hours. M. Geno.

215 METHODS OF TEXT ANALYSIS An introduction to procedures and terminology used in the analysis of texts of various genres. Three hours. Carrard.

216 STYLISTICS On a comparative basis, study of the main idiomatic difficulties faced by English-speaking people who learn French; translation; analysis of the various "levels of speech" in French, with their stylistic features. Three hours. Carrard.

### FRENCH LITERATURE

225, 226 MEDIEVAL FRENCH LITERATURE (1100-1500) Lectures and readings on aspects of Medieval culture, history, philosophy, and their relation to the literature of the period. *Prerequisites:* 225 for 226. Three hours. Alternate years, 1977-78. Whitebook.

## FRENCH

**235 16TH CENTURY FRANCE: A WORLD IN TRANSITION** The 16th Century as a pivotal era between medieval and modern society, focusing on literary and esthetic movements, related to their historical and social contexts. Texts presented will illustrate the changing attitudes towards man and his place in the world. Three hours. Alternate years, 1976-77. Wiley Sandler.

**236 THE DEVELOPING RENAISSANCE IN FRANCE** The cultural, historical, social and esthetic origins of Renaissance ideals, their development through the years 1530-1560, the breakdown of their influence, and some of their lasting effect in French thought. Among the topics to be covered: Humanism, the Italian influence, classical models and imitation, educational reforms, women writers, Rabelais, Du Bellay, Scève, Ronsard, Montaigne. Three hours. Alternate years, 1976-77. Wiley Sandler.

**245 THE BAROQUE AGE, 1600-1650** A study of the literature after France's religious civil wars, up to the triumph of Classicism. Readings may include religious, lyric and political poetry; idealistic, picaresque and fantastic novels; Corneille and Rotrou; the *Pensées* of Pascal. Three hours. Alternate years, 1976-77. Whatley.

**246 17TH CENTURY** Selected works of the Century with emphasis on Corneille, Racine and Molière. Three hours. Alternate years, 1976-77. Julow.

**255 18TH CENTURY LITERATURE** Readings in writers of the early 18th century such as Bayle, Fontenelle, Montesquieu, Marivaux, Prévost, Voltaire. Topics to be treated might include: the impact of the new science on thought and art; the reflection in literature of new social types; the "pursuit of happiness"; the early evolution of the novel. Three hours. Alternate years, 1977-78. Whatley.

**256 18TH CENTURY LITERATURE** Readings in writers such as Rousseau, Diderot, Laclos, Bernardin de Saint-Pierre, Sade: the literature of the generation before the Revolution. Topics to be treated might include: the attempts to define "natural man"; the relationship between the arts and morality; the relationship between liberty and libertinism. Three hours. Alternate years, 1977-78. Whatley.

**265 THE ROMANTIC PERIOD** Major figures, themes and tenets of the Romantic movement, including Chateaubriand, Madame de Staël, Victor Hugo, Balzac, Stendhal, Constant, Musset, Vigny. Topics may include the revolt against Classicism, the Romantic view of nature, the *roman d'analyse*, *le vague de passions*, among others. Three hours. Alternate years, 1977-78. Crichfield.

**266 THE SECOND EMPIRE THROUGH 1900** The rise of modern literary

Realism, Naturalism, Symbolist poetry, Decadence. Authors will include Flaubert, Zola, Maupassant, Baudelaire, Verlaine, Rimbaud, Mallarmé, Huysmans. Topics may include the image of *la bourgeoisie*, the theme of Paris vs. *la Province*, Symbolism and Impressionist painting and music, the influence of Positivism on the novel, and others. Three hours. Alternate years, 1977-78. Julow.

275, 276 TWENTIETH CENTURY LITERATURE Selected topics, dealing with poetry and/or narrative related either to an historical period or a literary movement. Subjects may include: The Novel in the *Entre-deux-guerres*, Politics and the Novel, World War II and Literature, Surrealism, The Literature of Existentialism, The New Novel, The Development of Modern Poetry (1870-1940), etc. Each may be repeated up to six hours. Three hours. Alternate years, 1976-77. Carrard.

277 TOPICS IN 20TH CENTURY FRENCH THEATRE Subjects may include: 1. le théâtre traditionnel: Claudel, Sartre, Giraudoux, Salacrou, Anouilh; 2. le théâtre "De l'absurde": Ionesco, Beckett, Genet, Arrabal; 3. le théâtre de la marge: Ghelderode, Pinget, Vian, Shéhadé, Audiberti; 4. la vision totale: a combination of all the above. Each may be repeated up to six hours. Three hours. Alternate years, 1976-77. T. Geno.

285 LITERATURE OF THE FRENCH OF NORTH AMERICA An analysis of the French novel of North America as it relates to the socio-cultural and ecological contexts of the French of North America (cultural values, social structures and human aspirations in the rural and urban contexts). Three hours. Alternate years, 1976-77. Benoit.

286 LITERATURE OF THE FRENCH OF NORTH AMERICA A study of the French novel, poetry and theatre of North America in so far as they depict the psychology of the individual in relation to the socio-cultural and ecological contexts. Three hours. Alternate years, 1976-77. Benoit.

291 CIVILIZATION OF FRANCE A study of the geographical, political, social, economic and intellectual development of France from the Middle Ages to the present. Three hours. M. Geno.

295, 296 ADVANCED SPECIAL TOPICS

297, 298 ADVANCED READINGS AND RESEARCH

301 MARCEL PROUST *A la Recherche du Temps Perdu* Three hours. Alternate years, 1977-78. Staff.

302 EMILE ZOLA'S *Rougon-Macquart* Three hours. Alternate years. Julow.

381, 382 GRADUATE SEMINAR Three hours. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.  
For undergraduate courses see the undergraduate catalog.

## GEOGRAPHY

### • GEOGRAPHY

*Professors Miles and VanderMeer (Chairman); Associate Professors Barnum, Gade, Leinbach, Lind and Meeks; Assistant Professor McHenry.*

Faculty research interests include most systematic aspects of geography, especially from an historical perspective. Technique interests are in cartography, remote sensing, and quantitative methods. Regional interests and field experiences are almost world-wide in scope.

### **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. Satisfactory scores on the aptitude portion of the Graduate Record Examination.

### **MINIMUM DEGREE REQUIREMENTS**

Twenty-one hours in approved geography courses including six hours of work on a thesis or two research papers; nine additional hours in geography or related fields; a thesis or two research papers. For additional information, please write to The Graduate Program Coordinator, Department of Geography.

The Department also offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24.

### **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:* a course in U.S. history plus three additional hours in geography, history, or other social science. Three hours. Miles.

**202, 203 HISTORICAL GEOGRAPHY OF EUROPE** (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:* Six hours in geography or history. Three hours. Barnum.

**211 FIELD GEOGRAPHY** Field studies using the state and local area as an outdoor laboratory to indicate lines of geographic inquiry and demonstrate methods and techniques of investigation into the human use of the earth. *Prerequisite:* Six 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. *Prerequisite:* Nine hours in geography or biology. Three hours. Gade.

220 SEMINAR IN ENVIRONMENTAL GEOLOGY See Geology 220.

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

231 RESOURCE GEOGRAPHY OF THE UNITED STATES Identification and analysis of natural regions of the U.S. as they reflect the elements of the physical environment; emphasis on distributional patterns and resource significance. *Prerequisite:* Six hours in geography including Geography 12. Three hours. Meeks.

233 REGIONAL PLANNING See Resource Economics 233.

241 ADVANCED PHYSICAL GEOGRAPHY Patterns and processes in the interactions between the earth, atmosphere, hydrosphere and biosphere; effects of human intervention in environmental systems. *Prerequisites:* 12 or 151, and advanced courses in geography, geology, or biological sciences, or permission of the instructor. Three hours. Lind.

243 SPATIAL ANALYSIS I (Same as Resource Economics 243) Analysis of spatial pattern and interaction through quantitative models; introduction to measurement, sampling and covariation in a spatial framework. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Leinbach.

244 SPATIAL ANALYSIS II Probabilistic, normative and multivariate models in analyzing problems of spatial structure and process; emphasis upon spatial diffusion, regional classification, spatial forecasting. *Prerequisite:* 243. Three hours. Leinbach.

246 URBAN GEOGRAPHY Analysis of the morphology and function of cities. Consideration of urban growth and development, methods of classification, distribution, and theories of location. *Prerequisites:* 11; three additional hours in the social sciences. Three hours. Barnum.

247 TRANSPORTATION FLOWS AND NETWORKS Growth, location, and structure of transportation networks; study of spatial flows and linkage patterns, development, and connectivity through analytical, descriptive, and theoretical models. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Leinbach.

## GEOGRAPHY

### 248 INDUSTRIAL LOCATION AND REGIONAL DEVELOPMENT

Classical and contemporary theories of location and measurement of spatial change; locational planning in developed and developing areas; emphasis on problems of regional disequilibrium and growth strategies. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Leinbach.

249 AGRICULTURAL GEOGRAPHY World, national, and local rural land use patterns; landscape elements as they reflect prevailing and historic agricultural patterns; ecologic and social problems of agriculture. *Prerequisite:* Six hours in geography or other social sciences. Three hours. Meeks, Vander-Meer.

251 ADVANCED CLIMATOLOGY Analysis of regional and local climatic data with special reference to climatic controls; special laboratory projects. *Prerequisites:* 151 and permission. Three hours. Lind.

257 POLITICAL GEOGRAPHY (same as Political Science 257) The political unit as a geographic area; location, resources, and the distributional relationships of the variety of human factors as they bear on the structure and functioning of the modern political unit; the relationship between geopolitics and political geography. *Prerequisites:* Six hours in geography and political science. Three hours. Miles.

261 REMOTE SENSING AND ENVIRONMENTAL PROBLEMS (same as Geology 219) Research projects in remote sensing; application of multi-spectral data for environmental studies. *Prerequisite:* 161 or permission of instructor. Three hours. Lind.

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

264 MAN, SPACE AND COMMUNITY Social geography; the social nature of place and the spatial character of social phenomena and groups; distributions, boundaries, and territoriality at community, regional and national scales. *Prerequisite:* Six hours in geography or other social sciences. Three hours. McHenry.

271 ADVANCED CARTOGRAPHY *Prerequisites:* 171 and permission. Three hours. Barnum.

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

295, 296 SEMINAR Selected topics in geography. *Prerequisite:* Six hours in geography. Three hours. Staff.

297, 298 SPECIAL TOPICS

381 ADVANCED READINGS AND RESEARCH Credit as arranged. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged.

## • GEOLOGY

*Professors Hunt, Stanley (Chairman); Associate Professors Drake and Wagner; Assistant Professors Bucke, Doolan and Rhodes.*

Research programs are oriented in the following areas: Selected problems in mineralogy; crystal chemistry of amphiboles; petrogenesis of mafic schists and ultramafic intrusions in Vermont; metamorphic and structural evolution of Vermont, with emphasis on Northern Vermont; structural geology of sedimentary and metamorphic 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; field and laboratory studies in fluvial and mass wasting processes. Interdisciplinary studies are available. Thesis topics should be in accord with faculty interests.

### **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 are encouraged and may be substituted for some selected Geology courses on approval by the departmental advisor. All students must complete successfully a course in field geology before

## GEOLOGY

graduation. This can be satisfied by Geology 238, a comparable course at another institution, recognized experience with a state survey, U.S. Geological Survey, an oceanographic institute, a geolimnological group or industry. Satisfactory completion will be determined by the Departmental Studies Committee.

### **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 or oral examination.

A program is also offered leading to the degree of Master of Arts in Teaching, Cf. p. 24.

### **COURSES OFFERED**

**211, 212 SEMINAR IN SEDIMENTARY PROCESSES** Selected readings on the origin and interpretation of sedimentary deposits. Topics will include mechanics of transportation and deposition, interpretation of surface textures, methods of statistical analysis, geomorphology of sedimentary environments. *Prerequisite:* 115, 155. Three hours. Bucke, Hunt, and Rhodes.

**216 GLACIAL GEOLOGY** Quaternary history of the world with emphasis on the origin, mechanics and effects of past and present glaciations. *Prerequisite:* 51 or permission of instructor. Three hours. Alternate years. Wagner.

**218 HYDROGEOLOGY** The origin, occurrence, movement, and character of ground water in various geologic environments; principles and practices of development, utilization, and management of ground water supplies. *Prerequisite:* 51, 216, or permission of instructor. Three hours. Alternate years. Rhodes.

**219 SPECIAL TOPICS IN REMOTE SENSING OF THE ENVIRONMENT** See Geography 261. Three hours. Lind.

**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. *Prerequisite:* 51, 132, or permission of instructor. Three hours. Staff.



221 SOIL CLASSIFICATION AND LAND USE See Plant and Soil Science 261. Three hours. Bartlett.

223 ENVIRONMENTAL GEOLOGY ACTION STUDIES Study of environmental problems. Emphasis is given to project selection, investigation methods, actual investigation, and constructive implementation of findings for maximum social benefit. *Prerequisite:* Permission of instructor. Offered during summers. Three to six hours. Wagner.

235 ADVANCED STRUCTURAL GEOLOGY Dynamic and kinematic origin of earth structures with emphasis on field studies, rock mechanics and other laboratory experiments. *Prerequisite:* 166. Three hours. Stanley.

237 STRUCTURAL PETROLOGY Elastic and ductile behavior of rocks. Fracture phenomena and analysis. Stress and strain interpretation of deformational features in minerals. Laboratory includes orientation and universal stage procedures, use of computers in data presentation, methods of interpretation. *Prerequisite:* 166 and 145. Three hours. Stanley.

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 August. *Prerequisite:* 166 or departmental permission. Four hours. Stanley.

240 PLATE TECTONICS Development and current status of plate-tectonic concepts with applications to selected parts of the globe. *Prerequisite:* 156 or 166, permission of instructor. Three hours. Stanley.

242 REGIONAL GEOLOGY Geology of selected parts of North America; course includes a four week summer field trip that illustrates the salient features of the region in question. *Prerequisite:* Junior standing in geology. Four hours. Staff.

245 NEW ENGLAND GEOLOGY 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 and the concept of plate tectonics. *Prerequisite:* 166, 156, or 224. Three hours. Stanley.

250 ADVANCED MINERALOGY Selected topics in mineralogy including crystal chemistry, experimental mineralogy, and current problems in mineralogy. *Prerequisite:* Permission of instructor. Three hours. Alternate years. Drake.

252 CLAY MINERALOGY The structure, composition, properties, occurrence, origin, distribution, environmental significance of the various clay minerals. Laboratory techniques in identification of clay minerals and measurement

## GERMAN

of their physical and chemical parameters. *Prerequisite:* Permission of instructor. Three hours. Bucke.

**253 PHASE EQUILIBRIUM** The application of thermodynamics and graphical methods to the analysis of multicomponent, polyphase systems of mineralogical interest. *Prerequisite:* 111 or permission of instructor. Three hours. 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. *Prerequisite:* 155 or 156 or permission of instructor. Three hours. Drake.

**262, 263 SEMINAR IN PETROLOGY** Modern concepts of the evolution of igneous and metamorphic rocks. Emphasis directed toward application of petrologic concepts to interpretations of earth history and tectonophysics. *Prerequisite:* 156 or equivalent. Three hours. Doolan.

**270 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. Hunt.

**272 RECENT SEDIMENTATION** Investigation of recent sedimentary environments using geolimnological and oceanographic techniques. Group and individual projects. Field oriented with use of the University research boats. *Prerequisite:* 155 or 42 and permission of instructor. Three hours. Hunt.

**277 STRATIGRAPHY** The sequential development and distribution of the sedimentary rocks. *Prerequisite:* 156 or permission of instructor. Three hours. Alternate years. Bucke.

**291 SEMINAR IN GEOLOGY** Selected topics of current interest. *Prerequisite:* Senior or graduate standing. One to three hours. Staff.

**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** Credit as arranged.

## • GERMAN

*Professor Kahn (Acting Chairman); Associate Professors Mieder and Richel; Assistant Professors Allen and Scrase.*

Current research interests include East German literature; history of the German language; medieval literature; literature of the eighteenth, nineteenth and twentieth centuries; and folklore.

### **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**

Thirty hours of graduate level courses including German 281, 282; 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. 24. Satisfactory scores on the Graduate Record Examination are prerequisite to acceptance to candidacy for this degree.

### **COURSES OFFERED**

**201 PROSEMINAR: METHODS OF RESEARCH AND BIBLIOGRAPHY** An introduction to tools and methods of research. *Prerequisites:* 101, 102 or the equivalent. One hour. Mieder.

**203 DEVELOPMENT OF GERMAN INTELLECTUAL MOVEMENTS** A comprehensive survey of the history of ideas as a framework for the study of German literature. *Prerequisites:* 101, 102 or the equivalent. Three hours. Alternate years, 1976-77. Allen.

**204 COURTLY EPIC AND MINNESANG** Cultural background and major works of medieval classicism. *Prerequisite:* 101, 102 or the equivalent. Three hours. Alternate years, 1976-77. Mieder.

**205, 206 GOETHE AND SCHILLER AND THEIR TIME** Origin, development, characteristics and criticism of German Classicism. *Prerequisites:* 101, 102 or the equivalent. Three hours. Alternate years, 1977-78. Richel and Scrase.

**207 NINETEENTH CENTURY PROSE** Masterpieces of narrative prose by representative authors such as Kleist, Droste-Hülshoff, Stifter, Storm and Keller. *Prerequisite:* 101, 102 or the equivalent. Three hours. Alternate years, 1976-77. Mieder.

**208 NINETEENTH CENTURY DRAMA** Works by Kleist, Büchner, Grillparzer, Hebbel, Wagner and the early Hauptmann. *Prerequisite:* 101, 102 or the equivalent. Three hours. Alternate years, 1976-77. Kahn.

## HISTORY

209, 210 **THE TWENTIETH CENTURY** Selected works in poetry, prose and drama by Brecht, George, Hauptmann, Hofmannsthal, Kafka, Thomas Mann, Rilke, and others. *Prerequisites:* 101, 102 or the equivalent. Three hours. Alternate years, 1977-78. Allen and Scrase.

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. *Prerequisite:* 121, 122 or equivalent. Three hours. 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. *Prerequisites:* 121, 122 or the equivalent. Three hours. Alternate years, 1977-78. Mieder.

281, 282 **SEMINAR** Special readings and research. Three hours. Staff.

391 **MASTER'S THESIS RESEARCH** Credit as arranged.

## • HISTORY

*Professors Bliss, Daniels, Davison, Evans (Emeritus), J. Felt, Hand, Metcalfe, Muller, Schmokel, Schultz, Spinner (Director of Graduate Studies), and Stout; Associate Professors Andrea, Hutton, Overfield, Seybolt, Steffens, Stoler, and True; Assistant Professors Jackson and Baskerville; Instructors K. Felt and Kulczycki; Lecturers Engroff and Liebs; Adjunct Professor Morrissey.*

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; 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; East European nationalism; Canadian history (including French Canada); Latin American history; African history; music history; history of science; and historic preservation. Three scholarly journals (*Oral History Review*, *The American Review of Canadian Studies*, and *Chinese Education*) are edited by members of the History Department. 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**

Plan A: Twenty-four hours in History, including thesis research (six hours), and History 301; six additional hours in History or a related field.

Plan B: Historic Preservation or Cultural History/Museology options offered by the departments of History and Art, leading to an M.A. in History. Each consists of a two year, thirty-six hour program, with the student usually electing an internship instead of writing a thesis.

The Department also offers a program leading to the degree of Master of Arts in Teaching (Cf. p. 24). 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 Same as Geography 201.

202 HISTORICAL GEOGRAPHY OF EUROPE Same as 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. Alternate years, spring semester. True.

205 HISTORY OF MEXICO Reading knowledge of Spanish strongly recommended. Three hours. Alternate years, spring semester. True.

207 THE EARLY MIDDLE AGES Western Europe from the late Roman Empire to the death of Otto III (A.D. 1002). Three hours. Andrea.

208 THE HIGH MIDDLE AGES Western Europe, 1000-1300. Three hours. Andrea.

211 THE RENAISSANCE European society from the fourteenth to early sixteenth century, emphasizing the transition from medieval to "modern" society and the roots of Renaissance Italy's cultural and artistic brilliance. Three hours. Overfield.

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212 THE REFORMATION European society from the Renaissance to mid-seventeenth century. Emphasis on the religious struggles growing out of the Protestant Reformation and their impact on the social, political, economic and cultural movements of the era. Three hours. Overfield.

216 FRENCH CANADA A history of the French experience in North America from 1867 to the present. Ability to read in French a decided asset. *Prerequisite:* 213, 214, or concurrent enrollment in same. Three hours. Baskerville.

221 THE AMERICAN COLONIES 1607-1763 Three hours. Stout.

222 THE AMERICAN REVOLUTION 1763-1790 Three hours. Stout.

223 ARCHITECTURE AND THE ENVIRONMENT An introduction to the basic skills necessary to preserve, document, and re-use America's visible past, its architectural heritage. Students will do projects in actual preservation problems in Vermont. Three hours. Liebs.

230 PHILOSOPHY OF HISTORY Same as Philosophy 230. An investigation of the theories of history from the perspectives of both historians and philosophers. Three hours. Steffens.

231, 232 FRENCH HISTORY First semester: seventeenth century to 1815; second semester: 1815 to the present. Three hours. Alternate years, 1976-77. Hutton.

233, 234 GERMAN HISTORY First semester: seventeenth century to 1850; second semester: 1850 to the present. Three hours. Alternate years, 1977-78. 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 Modern Era. Three hours. Hutton, 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. Schultz.

243 SOVIET RUSSIA The USSR from the Revolution of 1917 to the present. Three hours. Daniels.

244 IMPERIAL RUSSIA History of Russia from the Middle Ages to the Revolution of 1917. Three hours. Daniels.

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 Hen-

## HISTORY

rician Reformation to the Revolution). Three hours. Alternate years, 1976-77. Metcalfe.

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. Three hours. Alternate years, 1976-77. Spinner.

257, 258 AMERICAN STATESMEN Thought and practical politics of American statesmen. First semester: 1783-1865; second semester: since 1865. Three hours. 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. Schultz.

261 TOPICS IN VERMONT HISTORY A topical approach to the Vermont experience through original research utilizing primary sources available at the University of Vermont, the Vermont Historical Society and the Vermont State Library. *Prerequisite:* History 161, or permission of the instructor. Three hours. Muller and Staff.

263, 264 SOCIAL HISTORY OF THE U.S. Selected topics in the history of American society, including social movements, rural history, or urban history. Three hours. Jackson.

265, 266 INTELLECTUAL HISTORY OF THE U.S. Three hours. Felt.

267, 268 HISTORY OF U.S. FOREIGN RELATIONS First semester: 1763-1900; second semester: 1900-present. Three hours. Stoler.

271 MODERN CHINA An examination of Chinese history from 1800 to 1949 including a discussion of Western imperialism, the breakdown of the Confucian order, and the 20th century struggle to find a viable alternative, culminating in the Communist victory of 1949. Three hours. Seybolt.

272 PEOPLE'S REPUBLIC OF CHINA An examination of the domestic and foreign affairs of China from 1949 to the present. Three hours. Seybolt.

277 SOVIET POLITICS (Same as Political Science 277) 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:* Six hours of appropriate work in history, political science, or economics. Three hours. Daniels.

278 FOREIGN POLICY OF THE USSR Same as Political Science 278.

## HISTORY

**280 SCIENCE AND CULTURE** A study of science as an integral part of the culture of our age with emphasis on the published works of leading scientists, mathematicians and "humanists" of the 20th century. Three hours. Steffens.

**281 SCIENTIFIC REVOLUTIONS AND SOCIETY** An evaluation of the relationship between scientific activity and conditions of society during the "Scientific Revolution" of the 17th century, the rapid development of science and technology in the 19th century and the "new science" of the 20th century. Three hours. 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:* Statistics 111 or permission of the instructor. Three hours. Jackson.

**295, 296 SPECIAL TOPICS** Staff.

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

**351 PROSEMINAR IN AMERICAN CULTURAL HISTORY** Intended primarily for students in Cultural History/Museology or Historic Preservation, but open to other graduate students by permission. Three hours. Stout.

**352 HISTORIC PRESERVATION CONTEMPORARY PRACTICE** A detailed study of current historic preservation methodology through field trips and seminars with practicing professionals. *Prerequisites:* 223 and permission of the instructor. Six hours. Liebs.

**354 PRESERVATION ADVOCACY PROJECT** Application of historic preservation skills to a team project in a Vermont community or region. *Prerequisites:* 223, 352, and 353. Three hours. Liebs.

**377 SPECIAL TOPICS** Staff.

**379 INTERPRETATIONS OF AMERICAN HISTORY** An intensive reading course covering the major periods and events in America from the Revolution to the Cold War. Three hours. Hand and Staff.

**380 INTERPRETATIONS OF EUROPEAN HISTORY** An intensive reading course covering the major periods and events in Europe from the Renaissance to the Cold War. Three hours. Overfield and Staff.



**391 MASTER'S THESIS RESEARCH** Required of all candidates for the M.A. Normally arranged for two semesters at three hours each.

**393 INTERNSHIP** For students in the Cultural History/Museology and Historic Preservation programs who opt for "Plan B", the non-thesis option for the M.A. in History. Students will devote a semester to working in a museum, library, historical agency, planning commission, or other agency appropriate to their career plans. Three or six hours. Liebs and Stout.

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

## • HOME ECONOMICS

*Professors Betsinger (Director), Grams; Associate Professors Atwood, Caldwell, Knowles, \*Livak, Powell, Webster; Assistant Professors Barbour, J. Emanuel, Goldhaber, Jameson, Schlenker, Shelton, Soule, and Tyzbir; Instructor F. Emanuel; Lecturers Brower, Lawler, Lawton, Miller, Osborn, Peterson, Schiller; Adjunct Associate Professor Merrow; Affiliated Faculty: Assistant Professor Rathbone.*

The School offers the Master of Science degree in Home Economics with a concentration in Human Nutrition and Foods. The degree of Doctor of Philosophy in the field of Nutrition is offered in cooperation with the Department of Animal Sciences.

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

An undergraduate major in Human Nutrition and Foods or a related field.

### **MINIMUM DEGREE REQUIREMENTS**

Thirty hours, of which twenty-one hours of graduate credit including thesis research (6-15 hours) must be earned in the field of specialization and may include courses in foods, nutrition, and related sciences; nine hours may be selected from minor subjects of which a course in statistics is recommended.

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

See Department of Animal Sciences page 45.

\* On leave Fall 1976.

### **COURSES OFFERED**

**217 AMERICAN TEXTILES AND FASHION: TWO CENTURIES—18th CENTURY TO 1910** Study of home production of textiles, needle art and clothing in collections at Shelburne Museum. Lectures, demonstrations and

## HOME ECONOMICS

laboratory experience. *Prerequisite:* six hours in design and/or textiles, or permission of instructors. Three hours. Atwood and Caldwell.

**221 COSTUME DESIGN AND DRAPING** Draping techniques in creative fashion design. Handling of fabrics in relation to line in dress. Original projects. *Prerequisites:* 15, 122. Three hours. Webster.

**229 CLOTHING, TEXTILES AND RELATED ART SEMINAR** Theory and research in Clothing, Textiles and Related Art, analysis of current problems; review and discussion of recent publications; individual studies. *Prerequisites:* 117, 253 or 221. Three hours. Staff.

**235 RECENT ADVANCES IN FOODS AND NUTRITION** Interpretation, application and communication of trends in foods and nutrition as evidenced through literature and research. *Prerequisites:* Twelve hours in foods and nutrition and related areas. 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. Staff.

**237 READINGS IN FOODS** Critical survey of the literature on the recent developments in food research. *Prerequisites:* Senior standing; 135. Two or three hours. Staff.

**238 WORLD DIETARY PROBLEMS** A background for understanding the causes of undernutrition, the magnitude of the problem, and the programs seeking workable solutions. *Prerequisites:* 135, 144, or departmental permission. Three hours. Staff.

**239 INSTITUTIONAL ORGANIZATION AND MANAGEMENT** Institutional organization and management; personnel policies; laws and regulations; promotion and advertising. *Prerequisites:* 138, 139, or equivalent. Three hours. F. Emanuel.

**240 METHODS IN NUTRITION EDUCATION** Problems common to nutrition educators in schools, hospitals, and community. Individual investigations selected to meet special needs. *Prerequisite:* 43 or 140 or 141. Three hours. Soule.

**242 ADVANCED NUTRITION** A study of nutrients and their specific functions in metabolic processes. *Prerequisites:* 43 or equivalent, and a course in biochemistry and physiology. Three hours. Tyzbir.

**247 DIET THERAPY** Adaptations of the normal diet in conditions affected by or affecting the utilization of food. *Prerequisites:* 242 and permission of instructor. Four hours. Powell.

## HOME ECONOMICS

**248 READINGS IN NUTRITION** Critical survey of the literature on recent developments in nutrition. *Prerequisite:* 242, or departmental permission. Two or three hours. Staff.

**249 NUTRITION SEMINAR** A review of recent developments in nutrition research. *Prerequisite:* Advanced nutrition courses and permission of instructor. 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. Knowles.

**253 INTERIOR DESIGN II** Interior design; period furnishing, its present use and influence upon modern furnishing. *Prerequisite:* 159. Three hours. Caldwell.

**258 PERSONAL AND FAMILY FINANCE** The role of money and its management in planning, controlling and evaluating income, expenditures, investments and debts. Alternatives in relation to goals. *Prerequisites:* 56, Economics 11. Three hours. Schiller.

**259 FIELD EXPERIENCE IN PERSONAL RESOURCE MANAGEMENT** Application of economic, sociological, and efficiency principles to better manage personal and/or family resources, including time, energy, money, and talents, in the home and community. *Prerequisites:* 56, 158, 258 or permission of instructor. Three hours. Schiller.

**264 CONTEMPORARY ISSUES IN PARENTING** Contemporary cultural factors that influence adult life-styles and their relationship to successful parenting. *Prerequisite:* Nine hours in human development or permission of instructor. Three hours. Jameson and Goldhaber.

**265 FAMILY LIFE EDUCATION IN SCHOOL AND COMMUNITY** Methods, materials, and philosophy of family life and sex education in the schools. *Prerequisites:* 65, Senior standing and permission of instructor. Three hours. Grams.

**266 SEMINAR IN HUMAN DEVELOPMENT** Intensive study of specific issues in human development and their application in a wide variety of professional areas. May be taken more than once up to a maximum of 12 credits. *Prerequisites:* Junior standing; nine hours of human development or equivalent. Three hours. Staff.

**272 TEACHING ADULTS** Organization and teaching of classes in home economics to meet the needs of adults; supervised experience in teaching adults. *Prerequisite:* 171, or permission of instructor. Two hours. Staff.

## HOME ECONOMICS

**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. Osborn.

**274 HOME ECONOMICS IN ELEMENTARY AND MIDDLE SCHOOLS** Home Economics, an integral part of curriculum, grades one through eight. Observations of children in these grades. *Prerequisites:* 63, 71. Three hours. Osborn.

**290 INTRODUCTION TO RESEARCH** Research procedures with lectures and discussions of problem selection, objectives, bibliographical techniques, and analysis of data. Two hours. Tyzbir.

**291 SPECIAL PROBLEMS** Reading, discussion, and special field and/or laboratory investigations. *Prerequisite:* Departmental permission. Students may enroll more than once for a maximum of twelve hours. One-six hours. Staff.

**294 HISTORY OF NUTRITION** Foremost investigators and methods involved in the development of present day nutritional knowledge. *Prerequisite:* Three hours of nutrition. One hour. Staff.

**295 SPECIAL TOPICS** Lectures, laboratories, readings or projects relating to contemporary areas of study. Enrollment may be more than once; accumulation up to twelve hours. *Prerequisite:* Departmental permission.

**296 FIELD EXPERIENCE** Professionally oriented field experience under joint supervision by faculty and business or community representative. Credit arranged up to fifteen hours. *Prerequisite:* Departmental permission.

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

**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. Staff.

## MATHEMATICS

**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** Credit as arranged.

**397 PROBLEMS IN EDUCATION** See Education 397. Credit to be arranged. Staff.

### • MATHEMATICS

*Professors Brock, Chamberlain, Izzo, Meserve, Moser, Riggs, Schoonmaker (Chairman), Sylwester and Wright; Associate Professors Burgmeier, Cooke, Dwork and Hill; Assistant Professors Aggarwal and Ashikaga; Instructors Burns, Kost, Lawlor and Morency; Lecturers Aleong, Hatcher and Puterbaugh.*

Current research interests include algebra, real and complex analysis, differential equations, probability and statistics, computer science, numerical analysis and computational linear algebra.

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 Academic Computing Center.

## MATHEMATICS

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

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 semester hours of acceptable graduate credits in advanced Mathematics courses; six semester hours in thesis research.

**Plan B:** Thirty semester hours of acceptable graduate credits in advanced Mathematics courses; no thesis required.

Under both Plan A and Plan B students must already have, or must acquire a knowledge of the content of the following courses: Mathematics 231, 233, 251 and 252.

### **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

## MATHEMATICS

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. A program is also offered leading to the degree of Master of Arts in Teaching, Cf. p. 24.

### COURSES OFFERED

207 PROBABILITY THEORY See Statistics 251.

216 SYSTEMS PROGRAMMING See Computer Science 241.

218 AUTOMATA THEORY Capabilities and limitations of finite state automata. Minimization, control and identification of machines. Structure and loop-free decomposition of machines. State-identification and fault-detection experiments. Finite state recognizers and regular expressions. *Prerequisite:* 104. Three hours. Aggarwal.

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 104; 219 for 220. Three hours. Cooke.

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:* 124; 121 desirable. Three hours. Brock.

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:* 151 or 207; 221. Three hours. Staff.

**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. *Prerequisites:* 242; 231 for 232. Three hours. Staff.

**233, 234 THEORY OF FUNCTIONS OF REAL VARIABLES** Functions of real variables, including: point sets and measure, transfinite numbers, Riemann and Lebesgue integrals, and sequences of functions. Considerable outside reading is assigned. *Prerequisites:* 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, 124 and knowledge of computer programming. Three hours. Staff.

**238 NUMERICAL METHODS II** Finite differences, differentiation and integration, ordinary and partial differential equations, linear programming. *Prerequisite:* 237. Three hours. Staff.

**240 OPERATIONAL MATHEMATICS** Orthogonal functions, transforms and boundary value problems. *Prerequisite:* 230 or 271. Three hours. Staff.

**241 ADVANCED CALCULUS I** Calculus of several variables, Euclidean spaces, open and closed sets, limits, continuity, differentiation (emphasizing the linearity), maxima and minima, Lagrange multipliers and integration of functions of several variables. *Prerequisites:* 121 and 124. Three hours. Staff.

**242 ADVANCED CALCULUS II** Jacobians, change of variables in a multiple integral, line and surface integrals, Green's, Gauss' and Stokes' Theorems, Fourier Series, Fourier and Laplace transforms. *Prerequisite:* 241. Three hours. Staff.

## MATHEMATICS

**251 MODERN ALGEBRA** Fundamental concepts of Abstract Algebra. Sets, mappings, groups, rings, integral domains, fields, homomorphisms and isomorphisms. *Prerequisites:* 22; 102 or 104 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. *Prerequisites:* 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; 253 for 254. Three hours. Staff.

**255 ELEMENTARY NUMBER THEORY** Divisibility, prime numbers, Diophantine equations, congruence of numbers, and methods of solving congruences. *Prerequisite:* One year of calculus. Three hours. Staff.

**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:* One year of calculus. Three hours. Izzo, Meserve and Riggs.

**261 THE DEVELOPMENT OF MATHEMATICS** The historical development of the mathematical sciences is considered with an emphasis upon the interrelations among these sciences. Individual students are expected to emphasize the specific aspects of mathematics that are of interest to them and the level of abstraction that is compatible with their previous experience. *Prerequisite:* Nine hours of college mathematics. Three hours. Staff.

**262 GEOMETRY FOR ELEMENTARY SCHOOL TEACHERS** An informal approach to geometry is considered with an emphasis upon the use of intuitive geometric concepts in the introduction or clarification of most topics of elementary school mathematics. Not open to mathematics majors. *Prerequisite:* 125 or a teaching certificate. Three hours. Staff.

**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. Meserve.



**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.

**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. No credit for mathematics majors. For a mathematics concentration, a sequence beginning with 230 is advised. *Prerequisite:* 121. 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.

**273 INTRODUCTION TO COMBINATORICS** Combinatorial relations, elementary problems of existence, enumerative combinatorics; generating functions and graphs. Applications to problems in probability, mathematics of computers, graph theory and number theory. No graduate credit for mathematics majors. *Prerequisite:* 104. Three hours. Staff.

**274 COMPUTATIONAL LINEAR ALGEBRA** Implementation on digital computers is stressed. Topics include examples of "real" problems leading to formulation of linear computational problems; efficient algorithms for Gauss elimination, Householder upper triangular and tridiagonal reduction, stable least-squares computations, eigenvalue computations, determination of conditioning and stability, solution of under and over-determined systems. *Prerequisites:* 124 or 271, modest experience with digital computer programming. Three hours. Staff.

**276 MATHEMATICS OF SPACE FLIGHT** Topics include orbit determination and prediction of natural and artificial satellites and projectiles. Astrodynamic coordinate systems and their transformations. Integration schemes and perturbation theory. Attitude determination. *Prerequisites:* 237 and modest experience with digital computer programming. Three hours. Riggs.

**279, 280 SENIOR PROBLEM** Investigation of some area or problem, under the direction of an assigned staff member, culminating in a report. This course is available only to candidates for the Bachelor of Science degree in Mathematics. *Prerequisite:* Departmental permission. Three hours. Staff.

## MATHEMATICS

281, 283, 287, 289, 291, 293 **SPECIAL TOPICS** For advanced students in the indicated fields. Lectures, reports and directed readings on advanced topics. *Prerequisite:* Permission of instructor. Credit as arranged. Offered as occasion warrants. Staff.

281 Special Topics in Applied Mathematics

283 Special Topics in Computer Science

287 Special Topics in Algebra

289 Special Topics in Topology

291 Special Topics in Geometry

293 Special Topics in Analysis

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. Staff.

325 **ADVANCED AUTOMATA THEORY** Algebraic structure theory of automata, monoids, semigroups and semiautomata; homomorphisms, simulation and realization. Decomposition theory, including permutation and reset machines. Topics of current interest in complexity of automata. *Prerequisite:* 218. Three hours. Aggarwal.

330 **ADVANCED ORDINARY DIFFERENTIAL EQUATIONS** Linear and non-linear systems, approximate solutions, existence, uniqueness, dependence on initial conditions, stability, asymptotic behavior, singularities, self-adjoint problems. *Prerequisite:* 230. Three hours. Wright.

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.

335, 336 **ADVANCED REAL 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. Dwork.

351, 352 **ABSTRACT ALGEBRA** Groups, rings, integral domains, extensions of rings and fields, factorization theory, groups with operators (Jordan-

Holder 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. Wright.

391 MASTER'S THESIS RESEARCH Credit as arranged.

491 DOCTORAL THESIS RESEARCH Credit as arranged.

## • MECHANICAL ENGINEERING

*Professors von Turkovich (Chairman), Gaden, Martinek, McLay (on leave), Outwater and Tuthill; Associate Professors Carpenter, Duchacek, Hundal and Marshall; Research Associate Professor Pope; Adjunct Professors Gardiner and Liu.*

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; shell structural analysis; non-linear vibrations; biomechanics; stability of fluid jets; radiative heat transfer; matrix methods in structural mechanics; continuum mechanics; physical and mechanical metallurgy; solidification; mechanical and thermal processing of metals.

### **PREREQUISITE FOR ACCEPTANCE TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE**

An accredited Bachelor's Degree in Mechanical Engineering or its equivalent. Satisfactory scores on the Graduate Record Examination.

### **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**

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

## MECHANICAL ENGINEERING

least 40 credit hours must be earned in courses and seminars and a minimum of 25 credit hours must be earned in thesis research. Each candidate must be 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. *Prerequisite:* 133. Three hours. 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. Hundal.

**206 APPLICATION OF COMPUTERS IN ENGINEERING** Utilization of analog, digital and hybrid computers as an engineering tool for the solution of complex engineering problems. Three hours. Hundal.

**211 ADVANCED MECHANICAL STRUCTURES I** Energy methods; topics in solid mechanics, introduction to elasticity. Three hours. McLay.

**222 ADVANCED MECHANICAL STRUCTURES II** Elasticity; matrix methods. Three hours. McLay.

**231 MATERIALS PROCESSING II** Fundamental theory of selected mechanical and thermal processing techniques with applications. *Prerequisites:* 131 or equivalent. Three hours. von Turkovich.

**243 ADVANCED FLUID MECHANICS** Foundations of fluid dynamics; thermodynamics and concepts of compressible flow; isentropic flow; normal shock waves; flow in ducts with friction and with heating or cooling; generalized solution of combined effects. *Prerequisites:* 142 and Mathematics 271. Three hours. 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. Duchacek.

## MECHANICAL ENGINEERING

**251 TECHNOLOGY AND SOCIETY SEMINAR** Current views on the influence of technology on society through extensive study of contemporary writings and involvement in seminars, discussion and project assignments. *Prerequisite:* Senior or Graduate standing. Three hours. von Turkovich.

**252 ENGINEERING DESIGN II** Application of the principles of engineering mechanics, material science, and thermal science to the design of mechanical systems and their components; optimization, fracture mechanics, product design. Group projects from industry. *Prerequisite:* 135. Three hours. Carpenter.

**262 THERMAL SYSTEMS** Application of engineering thermodynamics to the analysis of thermodynamic machines and processes; problems on gas turbine, jet propulsion, nuclear power plants, energy conversion devices and other areas of current interest. *Prerequisite:* 261. Three hours. 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. Duchacek.

**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. Outwater.

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

**297 NUCLEAR ENGINEERING** Fission and fusion chain reactions; criticality; neutron diffusion; fast and breeder reactors; design considerations and accident delineation; high pressure and boiling heat transfer; liquid metals; fuel-coolant interaction; transient phenomena; safety. *Prerequisite:* Senior or graduate standing. Three hours. von Turkovich.

**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 decision-making processes to the design, analysis and synthesis of complex engineering systems. *Prerequisite:* Graduate standing in ME. Four hours. von Turkovich.

**302 ENGINEERING ELASTICITY** Tensors, complex variables, variational methods. Four hours. McLay.

**303 STRESS ANALYSIS (THEORY AND EXPERIMENT)** Theory and

## MECHANICAL ENGINEERING

experimental method of 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. McLay.

306 CONTINUUM MECHANICS Tensors, conservation laws, field equations for solids and fluids. Three hours. McLay.

307 ADVANCED FLUID DYNAMICS Stress in continuum; kinematics and dynamics; potential fields; Wing theory; Navier-Stokes equation; hydrodynamic stability; turbulence; laminar and turbulent boundary layer theory; transient flows; free laminar and turbulent flows; mixing. *Prerequisite:* Graduate standing in M.E. Four hours. Martinek.

308 ADVANCED DYNAMICS Application of Lagrange's equation and Hamilton's principle to mechanical systems. Systems with constraints. Matrix formulation of problems in kinematics and dynamics. Stability of linear and non-linear systems. *Prerequisite:* 202. Three hours. Hundal.

309 ADVANCED ENGINEERING THERMODYNAMICS Microscopic thermodynamics; Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac statistics; kinetic theory of gases; transport properties, compressed gases, liquids and solid states; chemical systems; irreversible processes; fluctuations. *Prerequisite:* Graduate standing in M.E. Three hours. Martinek.

310 ADVANCED HEAT TRANSFER Generalized equation of heat conduction; classical, integral transforms and approximate solutions; thermal boundary layers; forced and free convection; condensation, boiling and ablative cooling; radiation, statistical theory; mass transfer. *Prerequisite:* Graduate standing in M.E. Three hours. Martinek.

311 ADVANCED GAS DYNAMICS Compressible flow in ducts; friction and heat transfer; shock waves; small perturbation theory; similarity in high speed flows; transonic, supersonic and hypersonic flows; methods of characteristics. Aerodynamic heating; rarified gas flows. *Prerequisite:* Graduate standing in M.E. Three hours. 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 M.E. 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 M.E. Three hours. Staff.

## MEDICAL MICROBIOLOGY

**322 SPECIAL PROBLEMS IN DYNAMICS** Advanced topics in dynamics in which there is a particular student and staff interest. *Prerequisite:* Graduate standing in M.E. 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 M.E. 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 M.E. 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 M.E. Three hours. Outwater and von Turkovich.

**330 MATRIX METHODS IN STRUCTURAL DYNAMICS** Matrices, eigenvalue problems, forced vibration, wave propagation. *Prerequisite:* 203. Three hours. McLay.

**391 MASTER'S THESIS RESEARCH** Credit as arranged. Staff.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged. Staff.

## • MEDICAL MICROBIOLOGY

*Professors Johnstone, Schaeffer, and Stinebring (Chairman); Associate Professors Boraker, T. Moehring, Novotny, and Phillips; Assistant Professors Albertini, Fives-Taylor, Gump, Jakob, and J. Moehring.*

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 cellular aging; transplantation immunity and immunogenetics; mechanisms of transmission of bacterial DNA; studies of rubella, respiratory syncytial, infectious hepatitis and other viruses; studies of *in vitro* carcinogenesis; mechanisms involved in assembly of bacterial surface structures; the role of bacteria, fungi and viruses in pulmonary hypersensitivity diseases and chronic bronchitis; genetic mutation studies in cultures, diploid human fibroblasts, and studies of immunocompetence and tumor immunity in cancer bearing patients.

## 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 15 and 16

## MEDICAL MICROBIOLOGY

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 381-384, Thesis Research; approved selected courses from among Medical Microbiology 203, 205, 211, 223, 302, 325; Biochemistry 301-302, 303; passage of a comprehensive examination in Medical Microbiology and related subjects. Twenty-four hours of course credits and six hours of research credits are required. Chemistry 140 (Physical Chemistry for Biological Science Students) would be helpful but is not required.

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

Two years of biology; chemistry through physical chemistry (equivalent to Chemistry 1, 2, 123, 131, 132, 140 or 141, 142) mathematics through calculus; one year of physics (Physics 15 and 16 equivalent); additional courses required by the Department depending on the aims of the student.

### MINIMUM DEGREE REQUIREMENTS

Participation in seminars offered by the Department during residency of students; Biochemistry 301-302, 303; approved selected courses from programs in medical microbiology, biochemistry, microbiology and 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. *Prerequisite:* Permission of the instructors. Four hours. T. Moehring, Schaeffer.

**205 PATHOGENIC BACTERIOLOGY** Studies of major species of pathogenic bacteria with emphasis on mechanisms of disease production, epidemi-



ology, control measures, and diagnosis. Designed for advanced undergraduate or graduate students interested in phenomenon of parasitism. *Prerequisite:* Permission of the instructor. Three hours. Stinebring.

**211 GENETICS OF MICROORGANISMS** Studies of organization and replication of genetic material, the expression of genetic information, and gene transfer in bacteria and bacterial viruses. *Prerequisite:* Permission of the instructor. Three hours. Novotny.

**223 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. *Prerequisite:* Permission of the instructor. Four hours. Boraker.

**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. Primarily for medical students. *Prerequisite:* Permission of the Department. Four hours. Staff.

**303 SPECIAL PROBLEMS IN MEDICAL MICROBIOLOGY** Supervised investigations in microbiology. Credit as arranged. Staff.

**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. *Prerequisite:* Permission of Department Chairman. Four hours. Alternate years. Staff.

**381 SEMINAR** Current problems in medical microbiology. One hour. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

## • MEDICAL TECHNOLOGY

*Associate Professors Breen, Lachapelle (Chairman); Assistant Professors Reed, Sullivan; Instructors Czerniawski, Fike, Page and Russell.*

The Department of Medical Technology offers a Master of Science degree with emphasis in the preparation of medical technology educators. The student may also concentrate in Administration, Clinical Chemistry, Clinical Microbiology or the student may design a program which fulfills his/her needs.

## MICROBIOLOGY AND BIOCHEMISTRY

Areas of research and interest: Mycological techniques for yeast identification; pathogenic factors of *C. albicans*; correlation of evaluation and job competency; medical technology admission criteria; curriculum design; education; coagulation; cellular enzymology; lymphocytes; antibiotic susceptibility; anaerobes; complement; immunogenetics.

In addition, various facilities and departments, e.g. the MCHV and Department of Pathology, offer other opportunities for research.

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

Undergraduate major in Medical Technology; certification as MT (ASCP) (or equivalent), minimum of one year's experience as a medical technologist. GRE Aptitude Score required.

### **MINIMUM DEGREE REQUIREMENTS**

Medical Technology 381 (2 credits), 351, 352; Thesis research (6-15 credits); six credits biochemistry lecture, such as Biochemistry 301, 302; six credits clinically related sciences; additional approved courses. In addition, a non-credit teaching practicum is required.

### **COURSES OFFERED**

381 SPECIAL TOPICS Review and discussion of current areas of importance to students in Medical Technology. The seminar will emphasize Administration, Clinical Pathophysiology and Education. Selected topics are presented by the student with occasional supplemental discussions led by faculty members or guests. One hour per semester. Staff.

391 MASTER'S THESIS RESEARCH Credit as arranged. Staff.

## **• MICROBIOLOGY AND BIOCHEMISTRY**

*Professors Little and Racusen (Chairman); Associate Professors Foote and Sjogren; Teaching Associate Husted.*

Research currently involves the identification and metabolism of plant 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

## MICROBIOLOGY AND BIOCHEMISTRY

in organic chemistry, quantitative analysis and biochemistry. A course in physical chemistry is strongly recommended.

### 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, 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. This program is co-sponsored with Biochemistry (College of Medicine).

### MINIMUM DEGREE REQUIREMENTS

Biochemistry 301, 302, 303; satisfactory participation in biochemistry seminars during residency; advanced courses in chemistry (9 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 biological science, including an undergraduate course in microbiology, and Chemistry 131-132.

### MINIMUM DEGREE REQUIREMENTS

Medical Microbiology 205, Microbiology and Biochemistry 381-384; thesis research (10-15 hours).

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

One year of organic chemistry and biology and sufficient mathematics and physics to provide background for the candidate's program, 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 205; 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. This program is co-sponsored with Medical Microbiology.

## MUSIC

### COURSES OFFERED

**201 GENERAL BIOCHEMISTRY** Broad coverage of biochemistry including principles of analytical biochemistry. *Prerequisite:* Chemistry 16 or 131. Four hours. Also offered each spring. Foote.

**202 ADVANCED BIOCHEMISTRY** A study of metabolic cycles with emphasis on research methods involving radioisotopes and chromatography. *Prerequisite:* 201 or 203 or permission of the instructor. Four hours. Racusen.

**203 MOLECULAR BIOLOGY** The structure and biological function of nucleic acids, proteins, and enzymes. Emphasis is on optical, electrophoretic, and ultracentrifugal methods. *Prerequisite:* Chemistry 140 or 142 or permission of instructor. Four hours. Staff.

**220 ENVIRONMENTAL MICROBIOLOGY** The activities of microorganisms, primarily bacteria, in air, soil, and water. *Prerequisite:* A previous course in microbiology. Four hours. Alternate years, 1977-78. Sjogren.

**254 MICROBIAL BIOCHEMISTRY** The chemical composition and metabolism of microbial cells. *Prerequisites:* 55, 201, or permission of instructor. Four hours. Alternate years, 1978-79. Sjogren.

**295 SPECIAL TOPICS** Lectures, readings, laboratory studies, or field trips. Format and subject matter at the instructor's discretion. Spring, summer, and fall. *Prerequisite:* Permission of the department. Credit to be arranged. Staff.

**301 SPECIAL PROBLEMS** *Prerequisite:* Permission of the department. Credit as arranged. Staff.

**381 SEMINAR** A topical seminar with discussion of assigned and collateral reading. Required of graduate students. One hour.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

**491 DOCTOR'S THESIS RESEARCH** Credit as arranged.

### • MUSIC

*Professors Chapman, Lidral, W. Metcalfe (Acting Chairman), T. Read and Papoutsakis (Emeritus); Associate Professors D. Kinsey, Schultz and Wigness; Assistant Professors Ambrose and Weinrich; Instructors Boyer, Dahl, Davis, Dorsam, Fleming, Karstens, E. Metcalfe, Ranney, E. Read, Rhineland, Scoones, Storandt and M. Vogelmann; Lecturer Bemis.*

## No graduate degree program offered

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.

**COURSES OFFERED**

203, 204 ORCHESTRATION Instrumental characteristics, arranging for orchestra; second semester: advanced orchestral scoring. *Prerequisites:* 105-106, 203 for 204. Three hours. Staff.

205, 206 COUNTERPOINT First semester: Tonal counterpoint; second semester: canon and fugue. *Prerequisite:* 105-106. Three hours. Staff.

208, 209 FORM AND ANALYSIS Creative approach to aural and sight analysis of musical construction. *Prerequisites:* 105-106; 205 recommended. Three hours. Staff.

211, 212 CONDUCTING Baton technique, score reading, laboratory practice; second semester: preparation and performance of selected scores, including score reading at the piano and rehearsal procedures. *Prerequisites:* 5-6; 211 for 212. Three hours. Staff.

215, 216 COMPOSITION Creative work in free composition according to the needs and capabilities of the individual student. *Prerequisites:* 205 and 208 or permission of instructor. May be repeated for credit. Three hours. 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. Chapman.

245, 246 CHAMBER MUSIC LITERATURE Study through analysis and performance of masterworks for small groups leading to public performance. *Prerequisites:* Twelve hours or the equivalent in performance field and permission of instructor. May be repeated for credit. One hour. Staff.

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. Chapman.

## NATURAL RESOURCE PLANNING

**302 SEMINAR IN MUSICOLOGY** The major areas of historical musicology; problems in musical research; introduction to musical paleography. *Prerequisite:* 301. Three hours. 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 to four hours. Staff.

**381 SEMINAR** Study of special topics appropriate to student needs. Credit as arranged. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged. Students may write a traditional long thesis or offer a somewhat shorter thesis accompanied by and related to a recital/lecture-demonstration. Student may substitute 3 hours of 351, 352 with permission. Staff.

## • NATURAL RESOURCE PLANNING

*Professors Cassell, Haugen, John (Director), Reidel and Sargent; Associate Professors Gilbert, Lind, Lindsay and Meeks; Lecturer Flinn.*

This interdisciplinary program of studies leading to the degree of Master of Science is offered in the School of Natural Resources and prepares students for professional careers with public and private planning organizations. Theoretical and practical education is offered in planning the location, development, and coordination of services, facilities, and land uses. The scope of the program ranges from rural areas to river basins and multistate regions. The professorial staff's diverse backgrounds permit specialization in various planning fields.

For additional information concerning the program in Natural Resource Planning, contact the Director, School of Natural Resources, The University of Vermont, Burlington, Vermont 05401.

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

Undergraduate degree in an appropriate field and satisfactory scores on the Graduate Record Examination. Transcripts are evaluated on an individual basis.

## **MINIMUM DEGREE REQUIREMENTS**

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

## NATURAL RESOURCE PLANNING

**Plan A:** At least 24 hours in courses numbered above the 200 level. Thesis research, at least 6 hours for a total of 30 hours.

**Plan B:** Completion of 36 hours of advanced courses and independent study prescribed by the candidate's faculty studies committee. A planning project which must be defended must be included in the 36 hours.

### **COURSES AVAILABLE**

Other courses may be included in individual programs in Natural Resource Planning where appropriate.

**205 RURAL COMMUNITIES IN MODERN SOCIETY** See Sociology 205, page 180.

**210 AIRPHOTO INTERPRETATION** See Civil Engineering 210, page 70.

**218 COMMUNITY ORGANIZATION AND DEVELOPMENT** See Sociology 207, page 180.

**222 NATURAL RESOURCE EVALUATION** See Agri. and Res. Econ. 222, page 41.

**224 ECONOMICS OF OUTDOOR RECREATION** See Agri. and Res. Econ. 224, page 42.

**230 URBAN PLANNING TECHNIQUES** See Civil Engineering 230, page 70.

**231 URBAN PLANNING ANALYSIS** See Civil Engineering 231, page 70.

**232 COMMUNITY DESIGN** See Civil Engineering 232, page 71.

**233 REGIONAL PLANNING** See Agri. and Res. Econ. 233, page 42.

**234 ADVANCED REGIONAL PLANNING** See Agri. and Res. Econ. 234, page 42.

**235 LEGAL ASPECTS OF PLANNING AND ZONING** See Agri. and Res. Econ. 235, page 42.

**243 SPATIAL ANALYSIS** See Geography 243, page 119.

**255, 256 SPECIAL TOPICS IN AGRICULTURAL AND RESOURCE ECONOMICS** See Agri. and Res. Econ. 255, 256, page 42.

**322 ADVANCED AGRICULTURAL AND RESOURCE ECONOMICS** See Agri. and Res. Econ. 322, page 42.

**381 PLANNING SEMINAR** See Agri. and Res. Econ. 381, page 43.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

## **PATHOLOGY**

### **• PATHOLOGY**

*Professors Clemmons, Craighead (Chairman), Korson, Stark, and Trainer; Associate Professors Harris, Howard, Kanich, Perl and Taylor; Assistant Professors Glavin, Little, MacPherson and Whitcomb; Clinical Instructor Wlodarski.*

Research interests are in the fields of anatomic, clinical, and experimental pathology. Current studies include histochemistry, connective tissue pathology and biochemistry, electron microscopy, neoplasia, teratology, immunopathology, virology, and lung diseases.

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

Anatomy 301, 311; Physiology and Biophysics 301; Biochemistry 301, 302.

### **MINIMUM DEGREE REQUIREMENTS**

Pathology 301, 302 (11 hours), Medical Microbiology 302 (4 hours), additional approved courses; thesis research (6-15 hours).

### **COURSES OFFERED**

**201 HISTOCHEMISTRY** A survey of techniques used for chemical identification of cellular and tissue components, including discussion of underlying theories. *Prerequisites:* An acceptable course in cell structure (e.g., Anatomy 311, Botany 256); Chemistry 131-132; permission of the department. A course in biochemistry is required. Three hours credit. By arrangement with instructor. Brody, Korson, Val.

**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. *Prerequisites:* 301-302; permission of department. 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.



## • PHARMACOLOGY

*Professors Gans, Jaffe, Robinson, and Soyka (Chairman); Associate Professors Doremus, McCormack, Reit; Assistant Professor (part-time) Scollins; 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 cholesterol and steroid metabolism; synthesis, physico-chemical properties and structure-activity relationships of biologically-active nitrogen heterocyclic compounds; effect of narcotic drugs on male rats and their progeny; biochemical aspects of chemical carcinogenesis; functions of neurohumoral substances in synaptic transmission and microcirculatory regulation. A postdoctoral program in clinical pharmacology is operated in cooperation with the Departments of Medicine and Pediatrics: pharmacotherapy of developmental and endocrine disorders, 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 or no foreign language, 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, 302, 303, 372, 381, 391; supporting courses in Biochemistry and Physiology.

### **MINIMUM REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE**

Physiology and Biophysics 301; Biochemistry 301, 302. Pharmacology 301, 302, 303, 328, 372, 381, 491; Biometrics and Applied Statistics 308.

### **COURSES OFFERED**

**272 TOXICOLOGY** The biology of environmental intoxicants and of drug abuse. Ecologic and physiologic consequences of the dissemination of agricultural, industrial and medicinal chemicals. *Prerequisites:* Organic chemistry and background in biology. Open to undergraduates. Three hours. Gans.

**301 MEDICAL PHARMACOLOGY** The chemical and biological properties of drugs. *Prerequisite:* Permission of the department. Six hours. Staff.

## PHILOSOPHY

**302, 303 PHARMACOLOGICAL TECHNIQUES** Experiments conducted under supervision in the areas of drug metabolism, modes of drug action, physicochemical properties of drugs, bioassay, and toxicology. *Prerequisite:* Permission of the department. Two hours, by arrangement. Staff.

**328 INTRODUCTION TO MEDICINAL CHEMISTRY** Important classes of drugs are surveyed. Emphasis is placed on relationships between physicochemical properties and pharmacologic activity; synthetic aspects are considered. *Prerequisites:* Chemistry 131-132. Open to undergraduates with permission of the instructor. Three hours. McCormack.

**372 SPECIAL TOPICS** Topics of current interest and importance in pharmacology are considered in depth through presentations by staff, students and visiting scientists. *Prerequisite:* Permission of the department. Credit variable one to three hours. Staff.

**373 READINGS IN PHARMACOLOGY** Intensive directed reading in one area of pharmacology. Students in the department must choose a topic outside their area of thesis research. A term paper and a seminar on the selected topic are required. *Prerequisite:* Permission of the department. Two hours, by arrangement. Staff.

**381 SEMINAR** Current developments in pharmacology are presented for discussion by students. *Prerequisite:* Permission of the department. One hour. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

## • PHILOSOPHY

*Professors Cahn (Chairman) and Hall; Associate Professors Mann, Moneta, and Sher; Assistant Professors Beckett, Hinman, Kitcher, Kitcher, Miller, and Swanson.*

Research interests of the Department include virtually every period in the history of philosophy and every major area of philosophical inquiry. No graduate program is offered.

## COURSES OFFERED

**201 THEORY OF KNOWLEDGE** A critical examination of the nature and sources of knowledge: belief, truth, evidence, perception, memory, and induction. *Prerequisites:* 101 and 102. Three hours. P. S. Kitcher, P. W. Kitcher, Sher.

**202 METAPHYSICS** A critical examination of such topics as the nature of space and time, the concept of change, the identity of the self, the nature

of the world and man's place in it. *Prerequisites:* 101 and 102. Three hours. Cahn, Mann, Moneta, and Sher.

**210 PHILOSOPHY OF MIND** Major philosophical theories of the mind and its relation to the physical world, the nature of sensation, desire, and belief, and the relation between thought and action. *Prerequisites:* 102 or 110. Three hours. P. W. Kitcher and Sher.

**212 PHILOSOPHY OF SCIENCE** A thorough investigation of one or two problems in the philosophy of science. There will be emphasis on modern attempts to solve them. *Prerequisite:* 112 or extensive study in the sciences. Three hours. P. S. Kitcher.

**214 MATHEMATICAL LOGIC** A survey of the basic material of mathematical logic: the propositional calculus, the predicate calculus, first-order theories, formal number theory and the elementary parts of axiomatic set theory, metalogical results including completeness theorems and Gödel's first incompleteness theorem. *Prerequisite:* 3 or Mathematics 102 or Mathematics 104. Three hours. P. S. Kitcher.

**215 PHILOSOPHY OF MATHEMATICS** A study of the philosophical problems connected with mathematics. The course will attempt to answer the following questions. What (if anything) is mathematics about? How do we acquire our mathematical knowledge? Is there an important difference between mathematics and natural science? Could all our mathematical beliefs be false? *Prerequisite:* 3 or 214 or extensive background in mathematics. Three hours. P. S. Kitcher.

**217 PHILOSOPHY OF LANGUAGE** A philosophical study of the nature of language. *Prerequisite:* 3 or 214 or background in linguistics. Three hours. P. S. Kitcher and Sher.

**221 TAO TE CHING** A systematic study of one of the most important texts of Taoism and of the English translation of the text. *Prerequisites:* 101, 102, and 121. Three hours. Swanson.

**222 I CHING OR BOOK OF CHANGES** A systematic study of one of the most difficult and most important texts in the Oriental tradition. *Prerequisites:* 101, 102, and 121. Three hours. Swanson.

**230 PHILOSOPHY OF HISTORY** An investigation of theories of history from the perspectives of both historians and philosophers. *Prerequisites:* Two advanced courses in philosophy or six hours in history. Three hours. P. W. Kitcher and Mann.

## PHYSICS

**240 CONTEMPORARY ETHICAL THEORY** An analysis of the ideas of contemporary moral philosophers in normative ethics and metaethics. *Prerequisites:* 4, 140, or 142. Three hours. Hinman and Sher.

**260 PHENOMENOLOGY II** A critical and intensive investigation of the thought of a major twentieth century phenomenologist, e.g. Husserl, Heidegger, or Merleau-Ponty. *Prerequisite:* 160. Three hours. Moneta.

**262 EXISTENTIALISM** A study of existentialism as a philosophy, and an examination of its background, as displayed in the literary and philosophical writings of Pascal, Kierkegaard, Camus, Heidegger, and Sartre. *Prerequisites:* Any two of 101, 102, and 107. Three hours. Hall and P.W. Kitcher.

**265 AMERICAN PHILOSOPHY** The thought of such leading American philosophers as Peirce, James, Royce, Santayana, Dewey and Whitehead. *Prerequisites:* 101 and 102. Three hours. Miller.

**271, 272 SEMINAR: MAJOR PHILOSOPHICAL AUTHOR** A study of the major philosophical texts by a single author. May be repeated for credit when different authors are studied. *Prerequisite:* An appropriate 100-level course in philosophy. Three hours. Staff.

**273, 274 SEMINAR: MAJOR PHILOSOPHICAL PERIOD OR SCHOOL** A study of the philosophical texts of a specific period or school of philosophy. May be repeated for credit when different periods or schools are studied. *Prerequisite:* An appropriate 100-level course in philosophy. Three hours. Staff.

**281, 282 SEMINAR** Selected topics in philosophy. *Prerequisite:* An appropriate 200-level course in philosophy. Three hours. Staff.

**297, 298 READINGS AND RESEARCH** Independent study with an instructor on a specific philosopher or philosophical problem. *Prerequisite:* An appropriate 200-level course in philosophy. Staff.

**391 MASTER'S THESIS RESEARCH** Credit as arranged. Staff.

## • PHYSICS

*Professors Crowell (Chairman), Detenbeck, Juenker, Krizan, Nyborg and Scarfone; Associate Professors Brown and Cohen; Assistant Professor Sachs.*

The Department of Physics offers opportunities for both experimental and theoretical research in the fields of biological physics and the physics of materials. In the former field the experimental projects are mostly concerned with the applications of nonlinear ultrasonic techniques to the study of structures and processes in biological materials. Investigations are carried out both *in vivo*

and *in vitro* and the specimens range from plant cells to human tissue of medical interest. There are theoretical research programs devoted to both the interpretation of the ultrasonic work and to the applications of statistical mechanics and quantum mechanics to fundamental properties of biomacromolecules and biomembranes.

In the field of the physics of materials there are experimental programs concerned with the interaction of gas molecules with metal surfaces using ultra high vacuum, radiotracer, photoelectron emission, and thin film techniques. The mechanisms of photoelectron emission and the general area of electromagnetic interactions in metals are being investigated using vector photoelectric methods in near and far ultraviolet regions of the spectrum. The properties of superfluids, including liquid helium and a class of superconductors, are being explored both experimentally and theoretically. Other theoretical work in metal physics is concerned with lattice dynamics and electron densities of states in liquid metals, alloys, and other disordered systems. Other research in the physics of materials includes the scattering of laser light by microscopic particles and other inhomogeneities in fluids, a project of particular interest to those concerned with the pollution of air and water.

Some of the above projects are carried out with the active cooperation of faculty in other science departments and many opportunities exist for collaborative research with such other departments and groups of the University as Chemistry, Physiology and Biophysics, Cell Biology, Electrical and Mechanical Engineering, Medical Radiology and the Academic Computer Center.

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

An undergraduate major in Science, Engineering or Mathematics; Physics 211, 213 and 273; 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. 24.

#### **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

## PHYSICS

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 education. (Credit in education courses is limited to six semester hours.) (2) Successful completion of a comprehensive examination administered by the Joint Advisory Committee.

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.

### COURSES OFFERED

201, 202 EXPERIMENTAL PHYSICS Experiments in classical and modern physics. Each student selects laboratory experiments appropriate to his background and interests. *Prerequisites:* 16 or 128, Mathematics 121 or 123; junior standing. Three hours per semester, four semesters maximum. Staff.

211 MECHANICS Newtonian dynamics of particles and systems of particles. Extensive use is made of descriptive, analytical, and approximations techniques. *Prerequisites:* 16 or 24; Mathematics 121 or 123. Three hours. Brown.

213 ELECTRICITY AND MAGNETISM 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. *Prerequisites:* 16 or 25; Mathematics 121 or 123. Three hours. Brown.

214 ELECTROMAGNETISM An introduction to time dependent electromagnetic fields. Maxwell's equations in space and matter. Electromagnetic waves and radiation. *Prerequisite:* 213. Three hours. Brown.

220 BIOLOGICAL PHYSICS Physical laws, concepts and methods discussed with respect to their reference to biology. Mechanics of solids, liquids and

non-ideal media. Transport of dissolved gases and ions. Properties of macromolecules, radiation biophysics. *Prerequisites:* 16; Chemistry 2; Mathematics 12. Four hours. 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. *Prerequisites:* Chemistry 2; Mathematics 121 or 123; experience in applying differential equations. Departmental permission required. Four hours. Nyborg.

**242 INTRODUCTION TO SOLID STATE PHYSICS** Introduction to crystal structures, reciprocal lattices, lattice vibrations. Thermal properties of solids and free electron theory of metals and semi-conductors. Elementary band theory. *Prerequisite:* 128. Three hours. Alternate years, 1977-78. Scarfone.

**254 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. *Prerequisite:* 211. Three hours. Alternate years, 1976-77. Crowell.

**255 ACOUSTICS AND OPTICS** Introduction to two important areas of classical wave phenomena. Use of rays and waves in describing propagation and superposition of sound and light; geometric and physical optics, physical acoustics. *Prerequisite:* 128. Three hours. Alternate years, 1977-78. Detenbeck.

**265 THERMAL PHYSICS** Basic concepts of thermodynamics including equilibrium conditions in homogeneous and heterogeneous systems. Introduction to kinetic theory and statistical mechanics. *Prerequisites:* 128 and Mathematics 121 or 123. Three hours. Alternate years, 1976-77. Juenker.

**273 INTRODUCTORY QUANTUM MECHANICS** Introduction to non-relativistic quantum mechanics. Schroedinger equation and applications to simple systems. *Prerequisites:* 128 and 211. Three hours. Scarfone.

**301 MATHEMATICAL PHYSICS** Introduction to basic mathematical methods of theoretical physics; vector and tensor analysis, partial differential equations, orthogonal functions, complex variables and variational techniques. *Prerequisites:* 211, 214 and 216. Four hours. Alternate years, 1977-78. Krizan.

**311 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. *Prerequisites:* 211. Four hours. Alternate years, 1977-78. Krizan.

## PHYSICS

**313 ELECTROMAGNETIC THEORY** Development of Maxwell's theory of electromagnetism with emphasis on its physical basis and the modes of mathematical description. *Prerequisites:* 214 and 216. Four hours. Alternate years, 1976-77. Cohen.

**314 CLASSICAL ELECTRODYNAMICS** Plane electromagnetic waves, wave guides and resonant cavities, simple radiating systems and diffraction, magnetohydrodynamics and plasma physics, special theory of relativity, multipole fields. *Prerequisite:* 313. Four hours. Alternate years, 1976-77. Cohen.

**321 SEMINAR IN THEORETICAL PHYSICS** For research students interested in pursuing topics of general and departmental research interest in theoretical physics. *Prerequisite:* Permission of instructor. Offered as occasion warrants. Credit as arranged. Theoretical Physics Staff.

**323 SEMINAR IN CONTEMPORARY PHYSICS** Topics of current interest in physics to be offered as student and faculty interest warrant. May be repeated for credit with departmental approval. *Prerequisite:* Permission of instructor. Credit as arranged. Staff.

**331 SEMINAR IN BIOLOGICAL PHYSICS** For research students in the field of biological physics. Lectures, reports and directed readings related to the research of the department and the field generally. May be repeated for credit with departmental approval. *Prerequisite:* Permission of the instructor. Credit as arranged. Offered as occasion warrants. 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. *Prerequisites:* 214, 265, and 273 or their equivalents; consent of instructor. Equivalent to and alternates with E.E. 363, 364. Three hours. Alternate years, 1977-78. Scarfone.

**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. *Prerequisites:* 342 (or E.E. 364), 362 and 375. Three hours. Offered as occasion warrants. Brown.

**351 SEMINAR IN PHYSICS OF MATERIALS** For research students in the field of the physics of materials. Lectures, reports and directed readings related to the research of the department and the field generally. May be repeated for credit with departmental approval. *Prerequisite:* Consent of the instructor. Credit as arranged. Offered as occasion warrants. Staff.



## PHYSIOLOGY AND BIOPHYSICS

**362 QUANTUM MECHANICS** Mathematical and physical foundations of non-relativistic quantum mechanics from the unifying point of view of Dirac. Symmetry operations and the algebraic structure of quantum mechanics are emphasized. *Prerequisite:* 273. Four hours. Alternate years, 1976-77. Scarfone.

**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. Offered as occasion warrants. Scarfone.

**364 ADVANCED QUANTUM THEORY** Quantization of free and interacting fields. Symmetry properties of fields and particles. The S-matrix and Feynman graphs. The elements of Dispersion Theory. *Prerequisite:* 363. Three hours. Offered as occasion warrants. Scarfone.

**366, 367 SOLID STATE THEORY** See Electrical Engineering 366, 367.

**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, 273. Four hours. Alternate years, 1976-77. 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. Offered as occasion warrants. Krizan.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

## • PHYSIOLOGY AND BIOPHYSICS

*Professors Alpert (Chairman), Chambers, McCrorey, Parsons, Patterson; Associate Professors Gibbons, Hendley, Low, Webb, Whitehorn; Assistant Professor Hamrell; Lecturer Halpern.*

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 coup-

## PHYSIOLOGY AND BIOPHYSICS

ling; 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 admission and awarding financial support will be given to Ph.D. applicants.

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

Year courses in Biology, Organic 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; Neuroscience 302; 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, Neuroscience 302; additional approved courses amounting to at least 40 hours, 16 of which must be in the Department; thesis research, minimum 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. Same course as Anatomy 302. *Prerequisite:* 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. *Prerequisites:* 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. The course includes a biometrics laboratory. Course limited to twelve students. *Prerequisites:* Math 110 or equivalent, and permission of instructor. Five hours. 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:* 301 and 302, Biochemistry 301, 302, permission of the instructor. Three hours. Alternate years, 1977-78. 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. Lectures and conferences. *Prerequisites:* 301, 302, Biochemistry 301, 302, permission of the instructor. Three hours. Alternate years, 1976-77. Alpert.

**313 SEMINAR ON ENDOCRINE PHYSIOLOGY** The course will be devoted to a study of current problems in endocrine research with major emphasis on the molecular mechanism of action of hormones. *Prerequisites:* 301 or Endocrinology 271; Biochemistry 301-302; permission of the instructor. Three hours. Low.

**317 PHYSIOLOGY OF THE CENTRAL NERVOUS SYSTEM** The course will cover electrophysiological studies of the central nervous systems of mammals and invertebrates with particular emphasis on concepts dealing with information processing. Behavioral, neurochemical and clinical observations will also be used. *Prerequisite:* 301 or permission of instructor. Three hours. Whitehorn.

**323 PRINCIPLES AND ELEMENTS OF BIOMEDICAL INSTRUMENTATION** This course is designed for the biologically trained researcher to provide a firm understanding of instrument methodology. Topics include basic electrophysics; transducers; the concepts and manipulation of bioelectric and other signals; physiological instrument systems. A laboratory supports these theoretical ideas. *Prerequisite:* Permission of the instructor. Five hours. 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** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

## PLANT AND SOIL SCIENCE

### • PLANT AND SOIL SCIENCE

*Professors Wiggans (Chairman), Bartlett, Boyce, Hopp (Emeritus), and MacCollom; Associate Professors Evert, Parker, Pellett, and Wood; Assistant Professor Magdoff; Lecturers Flinn, Watson, and Whipkey; Adjunct Professor Calahan; Teaching Associate Bruckel.*

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 productivity; soil chemistry of the rhizosphere; behavior of nitrogen in the soil; nutrient availability to plants; agricultural waste management; temperature effects on soil water retention and transmission. 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, a written comprehensive examination, and satisfactory scores on the Graduate Record Exam.

#### **MINIMUM DEGREE REQUIREMENTS**

18-22 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 and satisfactory scores on the Graduate Record Exam.

A reading knowledge of a modern foreign language appropriate to the student's specialty. Proficiency in other areas appropriate to the student's specialty may be substituted for the language requirement with the approval of the Studies Committee. This proficiency does not count toward course requirements for the degree.

#### **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** Theoretical and practical considerations of the micrometeorological factors that affect plant growth and agricultural practices. *Prerequisite:* 11. Three hours. Staff. Alternate years, 1977-78.

204 **PLANT RESEARCH TECHNIQUES** Methods of conducting research with plants including the organizing and planning of experiments. *Prerequisites:* 11, Botany 104. Three hours. Alternate years, 1976-77. Wiggans.

205 **MINERAL NUTRITION OF PLANTS** Role of essential elements for plant growth including classical and modern approaches to the study of ion availability and transport. *Prerequisite:* Botany 104. Three hours. Alternate years, 1976-77. Bartlett and botany, forestry, and plant and soil science staff.

207 **WATER RELATIONS OF PLANTS** See Forestry 207. Alternate years, 1976-77.

221 **ADVANCED TREE FRUIT CULTURE** Theory and practice of modern commercial fruit science. Nutrition and cultural responses to various management practices. *Prerequisites:* 11, and 61. Three hours. Calahan.

232 **BIOLOGICAL CONTROL OF INSECT PESTS** A survey of the biological agents used in controlling insects and related arthropods, and their application and limitations. *Prerequisite:* An intermediate course in entomology. Three hours. Alternate years, 1977-78. MacCollom.

234 **MEDICAL ENTOMOLOGY** The relationships of insects and related arthropods to the causation of pathological conditions in man and animals. *Prerequisite:* An intermediate course in entomology. Three hours. Alternate years, 1976-77. Nielsen and Staff.

261 **SOIL CLASSIFICATION AND LAND USE** Classification of soils throughout the world as they relate to soil development and land use. Three Saturday field trips. *Prerequisite:* 61 or a total of six hours in ecology, geography, or geology. Three hours. Alternate years, 1976-77. Bartlett, Watson.

264 **SOIL CHEMISTRY** Chemistry and biology of soils affecting plant growth including the properties of clays and organic matter. *Prerequisites:* 61, two semesters chemistry. Four hours. Alternate years, 1977-78. Bartlett.

## POLITICAL SCIENCE

**266 SOIL PHYSICS** Mathematical and physical principles of the soil-water-plant interaction and its relationship to production and management. *Prerequisites:* 61, Physics 5-6 or Chemistry 1-2. Three hours. Alternate years, 1976-77. Bartlett.

**281 SEMINAR** Presentation and discussion of papers on selected topics of current interest by students and staff. *Prerequisite:* Senior standing. One hour. Staff.

**301 PLANT SCIENCE COLLOQUIUM** Graduate student and staff discussion of current research topics in plant science. One hour. Staff.

**302 SOIL SCIENCE COLLOQUIUM** Graduate student and staff discussion of current research topics in soil science. 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** Credit as arranged. Staff.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged. Staff.

## • POLITICAL SCIENCE

*Professors Dellin, Gould, Haugen, Hilberg, G. T. Little, and Staron (Chairman); Associate Professors Kinnard, Nelson, Pacy, Rosenbloom, Simon, and Wertheimer; Assistant Professors Brewer, Flannery, Frankovic, and Grabosky.*

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; political 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: political thought from Plato to Burke. Second semester: Political thought of the 19th and 20th centuries with emphasis on socialist ideologies from Marx to Marcuse. *Prerequisite:* Six hours in political science. Three hours. Staron.

**213 CONTEMPORARY POLITICAL THOUGHT** Writings of several twentieth-century political thinkers, including works in related fields such as psychology and economics. *Prerequisite:* Six hours in political science. Three hours. Wertheimer.

**216 AMERICAN POLITICAL THOUGHT** American political thought from the colonial period to recent times. *Prerequisite:* Six hours in political science. Three hours. 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:* Junior standing. Three hours. Gould.

**226 ADMINISTRATIVE LAW** The politics of federal regulation, regulatory agencies and processes, and leading constitutional cases in administrative law. *Prerequisite:* Six hours in political science. Three hours. Alternate years. Rosenbloom.

**227, 228 INTERNATIONAL LAW** Principles and applications of public international law. *Prerequisite:* Six hours in political science. Three hours. Little.

**231 THE LEGISLATIVE PROCESS** Congressional and parliamentary organization and procedure. *Prerequisite:* Six hours in political science. Three hours. 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. Haugen.

**233 THE NATIONAL EXECUTIVE** Functions and organization of the Presidency and the bureaucracy in American national government. *Prerequisite:* Six hours in political science. Three hours. Rosenbloom.

**235 DEFENSE POLITICS** Civil-military relations, strategic policy, arms control, defense-industrial complex, defense budget in the post-Vietnam environment. *Prerequisite:* Six hours in political science. Three hours. Kinnard.

**239 AMERICAN POLITICS** The politics of decision-making in the American political system. *Prerequisite:* Six hours in political science. Three hours. Simon.

## POLITICAL SCIENCE

241 PUBLIC ADMINISTRATION The Federal government in action. *Prerequisite:* Six hours in political science. Three hours. Rosenbloom.

242 PROBLEMS OF BUREAUCRACY Bureaucracy and bureau pathology, scientific management, human relations, decision making, and leadership in the context of public organization. *Prerequisite:* Six hours in political science. Three hours. Rosenbloom.

250 THE CRAFT OF DIPLOMACY Emphasis on experiences and reflections of diplomatic personalities, supplemented by studies of specialists. *Prerequisite:* Six hours in political science. Three hours. 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. Kinnard and Hilberg.

256 INTERNATIONAL ORGANIZATION Theory and practice in supranational institutions. *Prerequisite:* Six hours in political science. Three hours. Pacy.

257 POLITICAL GEOGRAPHY See Geography 257. Three hours. Miles.

258 PROBLEMS OF COMMUNISM See Economics 258. Three hours. Dellin.

261 URBAN GOVERNMENT AND POLITICS An analysis of metropolitan areas in terms of their governments, problems and roles. *Prerequisite:* Six hours of political science. Three hours. Grabosky.

262 URBAN PUBLIC ORDER Urban crime as a political issue. Institutions of crime control. Urban police systems and law enforcement. *Prerequisite:* Six hours in political science. Three hours. Grabosky.

264 STATE ADMINISTRATION Problems in planning, policy development, and program coordination. *Prerequisite:* Six hours in political science. Three hours. 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. Haugen.

273 COMPARATIVE POLITICAL ANALYSIS An intensive examination of selected topics in comparative politics. *Prerequisite:* Sophomore standing. Three hours. Flannery.



- 274 **ETHNIC POLITICS** Theories of ethnic group identification, ethnic roots of political behavior, impact of ethnicity on the political structure. *Prerequisite:* Six hours in political science. Three hours. Frankovic.
- 276 **MASSES AND ELITES** Structural and attitudinal linkages between governors and governed. Modern as well as more traditional societies. *Prerequisite:* Permission of the instructor. Three hours. Brewer.
- 277 **SOVIET POLITICS** See History 277. Three hours. Daniels.
- 278 **FOREIGN POLICY OF THE U.S.S.R.** Emphasizing post 1960 developments. *Prerequisite:* Junior standing or consent of instructor. Three hours. Flannery.
- 281 **POLITICAL PARTIES** Political parties with emphasis upon voting behavior and campaign techniques. *Prerequisite:* Six hours in political science. Three hours. Nelson.
- 283 **SCOPE AND METHODS OF POLITICAL SCIENCE** Approaches, sources of information, research methods and systematization in the study of political phenomena. *Prerequisite:* Graduate student or permission of the instructor. Three hours. Grabosky.
- 291 through 293 **READING AND RESEARCH** For advanced undergraduates and graduate students. Three hours. Staff.
- 295, 296 **SEMINAR** Selected topics in political science. Three hours. Staff.
- 391 through 393 **MASTER'S THESIS RESEARCH** Credit as arranged.

## • PSYCHOLOGY

*Professors Albee, Ansbacher, Burchard, Forgays, Joffe, Lawson, and Leitenberg; Associate Professors Hasazi, Howell, Kapp, and Musty (Chairperson); Assistant Professors Dunn, Gordon, Kent, Kessler, Leff, Rolf, and Rosen; Adjunct Professor Grams; Adjunct Associate Professors Conquest and McKenzie; Adjunct Assistant Professors Damkot, Dietzel, Does, Fox, Thomson, and Whitmore.*

The Ph.D. program in Experimental Psychology began in 1964, and now includes ongoing research in a variety of areas. Details of ongoing research are available on request from the Chairperson, Department of Psychology. Students in this program are involved early in independent research projects.

The Ph.D. program in Clinical Psychology began in 1969. It stresses early placement in a variety of clinical facilities and emphasizes the development of research and service techniques relevant to clinical problems encountered in those settings. The clinical program is fully accredited by the American Psychological Association. Further information on the types of clinical facilities

## PSYCHOLOGY

and the research interests of the clinical faculty can be obtained from the Chairperson, Department of Psychology.

While requirements for both the Master of Arts degree and the Doctor of Philosophy degree are described below, this does not imply that it is necessary to take the first degree before one can study for the second. All students in the clinical program and many in the experimental program are encouraged to study directly for the Ph.D. degree and the training program reflects this, accordingly. Students whose goal is a terminal Master's degree are seldom accepted.

In 1974, a small number of students were admitted to the Ph.D. programs on a part-time basis. The intention is to serve neglected Vermont constituencies such as full-time mental health workers with families, and persons with responsibilities at home. The part-time program of study is thus open only to Vermont residents for whom full-time graduate work is not otherwise possible. A justification of the necessity to attend part-time must accompany the candidate's application. To be eligible for acceptance, applicants must have fulfilled prerequisites and minimum requirements listed below.

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

Undergraduate courses in statistics, experimental psychology and usually a major or its equivalent in undergraduate psychology; satisfactory scores on the Graduate Record Examination, including the Advanced Psychology sub-test, 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. 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 Ph.D. comprehensive examination.

### **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. There is no foreign language requirement.

**COURSES OFFERED**

**200 BEHAVIOR MODIFICATION** A survey of techniques used to modify human behavior, and evaluation of their effectiveness. *Prerequisites:* 100, 152. Three hours. Burchard, Hasazi, and Leitenberg.

**205 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. *Prerequisites:* 110, 119. Three hours. Howell.

**206 MOTIVATION AND EMOTION** The nature and development of motives, emotions and their relation to other psychological processes. *Prerequisites:* 110, 119. Three hours. Joffe.

**210 PERCEPTION AND COGNITION** The course focuses upon basic perceptual and cognitive mechanisms that support the acquisition, storage, and retrieval of information relative to the environments of animals and humans. Topics include perceptual development, constancies, attention, memory, and object perception. Three hours. Lawson.

**220 COMPARATIVE PSYCHOLOGY** Behavior of animals at various levels of the phyletic scale from lower forms to man under controlled experimental conditions and in their natural environments. *Prerequisites:* 110, 119. Three hours. Joffe and Kapp.

**230 EXPERIMENTAL SOCIAL PSYCHOLOGY (2-2)** A laboratory course in the experimental methods and techniques typically used in social psychological research. *Prerequisites:* 110, 119. Three hours. Kent and Leff.

**231 SOCIAL PERCEPTION** Experimental and theoretical study of the phenomena of the human perceptual process; with emphasis on the role of social, motivational, and learning factors. *Prerequisites:* 110, 119. Three hours. Staff.

**234 ENVIRONMENTAL PSYCHOLOGY** An exploration of the interaction of natural and man-made environments with human behavior, cognition, and emotion. Special emphasis on how man may increase his ecological awareness and environmental enjoyment, both by changing himself and by working constructively with his environment. *Prerequisites:* 110, strong background in environmental studies, or permission of the instructor. Three hours. Leff.

**236 THINKING** A critical review of the experimental investigation of thought processes, including concept formation, rule learning, plans and strate-

## PSYCHOLOGY

gies, and decision making. *Prerequisites:* 110, 119. Three hours. Gordon and Howell.

**251 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. *Prerequisites:* 1 and 151 or 122. Three hours. Hasazi and Rolf.

**252 INTRODUCTION TO CLINICAL PSYCHOLOGY** Examination of some of the critical issues in clinical psychology; its scientific status, problems of research; and probable future trends. *Prerequisites:* 110, 119, 152. Three hours. Hasazi and Kessler.

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 PROSEMINAR** 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. Three hours. Staff.

**305 SEMINAR IN LEARNING THEORY** An examination of selected contemporary theoretical approaches and recent research contributions to such problem areas as social learning, emotional learning, the physiology of learning, etc. Three hours. 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. Leitenberg.

**310 SEMINAR IN PERCEPTION** The course covers theoretical and empirical developments related to visual perception of objects and events. Topics include visual masking, visual storage mechanisms, and the development of visual perception. Three hours. 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. Three hours. Staff.

**320 COMPARATIVE PSYCHOLOGY OF BEHAVIORAL DEVELOPMENT** An examination of the general principles underlying the development of behavior from prenatal to adult responding. Three hours. Joffe and Kapp.

**321 SENSORY PROCESS: 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. 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. Staff.

**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. Three hours. Musty.

**331 INTERPERSONAL PROCESSES: MODES OF INTERACTING** Examination of interpersonal conflict, cooperation, power relations, information transfer, and persuasion. *Prerequisite:* Permission of the instructor. Three hours. 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. *Prerequisite:* Permission of the instructor. Three hours. 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). *Prerequisite:* Permission of the instructor. Three hours. Leff.

**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. Howell.

**341 ADVANCED STATISTICAL METHODS II** A continuation of 340 with in depth study of regression and nonparametric theory and method. Further study of problems in the analysis and interpretation of data from the behavioral sciences. *Prerequisite:* 340. Three hours. Howell.

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**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. 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. 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. 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. *Prerequisites:* 340 and 342. Three hours. 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:* Permission of the instructor. Three hours. 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:* Permission of the instructor. Three hours. Hasazi and 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. *Prerequisites:* 221, 222 or equivalent. Three hours. Musty and Staff.

**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. McKenzie.

**356 MENTAL RETARDATION** Study of abnormal behavioral development in the intellectual area. Etiology, assessment, and modification of mental retardation. *Prerequisite:* Permission of instructor. Three hours. 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. Rolf.

**358 ANTISOCIAL BEHAVIOR** A review of the literature related to the development and modification of anti-social behavior. 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. Burchard.

**359 PSYCHOTHERAPY RESEARCH** Review of research methodology and findings on the process and outcome of different schools of psychotherapy. *Prerequisite:* Admission to graduate program in psychology or permission of the instructor. Three hours. Leitenberg.

**360 METHODS AND MODELS OF CLINICAL PREDICTION** An in depth 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. Kessler and Rolf.

**361 ADVANCED PERSONALITY THEORY** A survey of present-day personality theories according to issues involved and explanatory demands made on a theory. With emphasis on usefulness to psychotherapy, an organism-operational-Adlerian type theory is favored. *Prerequisite:* Permission of instructor. Three hours. 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 psy-

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chology and community mental health. 3. Research problems in community psychology. *Prerequisite:* Permission of instructor. Three hours. Kessler.

**365 GROUP PROCESSES** A comprehensive treatment of research in small group process, with emphasis on the theoretical and research literature concerning encounter, training, and psychotherapy group issues. Discussions focused on group composition, leadership styles, group stages, dealing with group problems, ethical/social questions, and research design/instrumentation. *Prerequisites:* Graduate standing or permission of the instructor. Three hours. Dietzel.

**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 behavior therapy. The facilities of the University of Vermont Counseling and Testing Center, the Psychology Service of the Medical Center Hospital of Vermont and the Behavior Therapy Center will be utilized as part of the training. *Prerequisites:* 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; Community Mental Health Facilities; Youth Service Bureau; Behavior Therapy Center; Counselling Center. *Prerequisites:* Graduate standing in psychology and permission of the instructor. Three hours. 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. Recent topics include: Animal Behavior, Anxiety and Behavior, Behavioral Pharmacology, Biological Bases of Memory, Depression, Ethics and Professional Affairs, Group Processes, Psycholinguistics, Psychotherapy Research, Primate Behavior. 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** Credit as arranged. Staff.

**491 DOCTORAL THESIS RESEARCH.** Credit as arranged. Staff.



## • RELIGION

*Associate Professors Andrews, Martin and Paden (Chairman); Assistant Professors Brennenman, Gussner, Sugarman, and Yarian.*

No Master's Degree Program offered

**291, 292 PROBLEMS IN THE HISTORY AND PHENOMENOLOGY OF RELIGION** Topics of special concern to historians of religions. *Prerequisites:* Nine hours in religion; junior standing. Three hours. Staff.

## • SOCIOLOGY

*Professors Folta, Lewis, Mabry (Epidemiology and Environmental Health), Sampson (Chairman), Stanfield; Associate Professors Finney, Loewen, Nixon, Steffenhagen, Waitzkin, Underhill; Assistant Professors Danigelis, Deming, McCann, Payne, Schmidt, Waterman.*

Emphasis of the Department is on the development of sociological theory and research methods for application toward the resolution of major social problems. Current research activities include studies of population change, modernization and social structure; complex organizations and inter-organizational relations; changes in sex role relations and family values and structure; rural and urban community development; social inequality, poverty and cooperatives; drug use and abuse; criminal deviance and corrections; race and ethnic relations; school desegregation; the social impact of death and dying; political mobilization and community social networks; the deinstitutionalization of human service delivery systems; medical sociology; small group processes; the role of leisure and sports in modern society; and methodological problems in applied sociology, theory construction and quantitative research methods. No graduate program offered.

## COURSES OFFERED

Courses numbered 200 to 299 generally require graduate standing or six hours of sociology. Sociology 100, Fundamentals of Social Research, or its equivalent is required as a prerequisite for many 200 level courses.

**202 POPULATION DYNAMICS** Analysis of the factors affecting human population growth and distribution, migration patterns, and the relationship between economic activity and population trends. *Prerequisites:* Six hours of sociology or 10 and an introductory course in biology, economics, geography or zoology. Three hours. Deming, McCann and Payne.

**203 HUMAN ECOLOGY** Analysis of the relationships between forms of social organization and their environments. Special attention will be given to

## SOCIOLOGY

the causes and consequences of the differential location of socio-economic, racial and cultural groups and the major institutional facilities of society in contemporary urban communities. Three hours. Deming and Mabry.

**205 RURAL COMMUNITIES IN MODERN SOCIETY** The changing structure and dynamics of rural social organization in the context of modernization, and urbanization. Emphasis on rural communities in America. Three hours. Finney and Schmidt.

**206 URBAN COMMUNITIES IN MODERN SOCIETY** The changing structure and dynamics of urban social organization in the context of modernization and urbanization. Emphasis upon cities and metropolitan areas in America. Three hours. Deming, Lewis, and Loewen.

**207 COMMUNITY ORGANIZATION AND DEVELOPMENT** Community as a changing complex of organization within modern society. Special attention will be given to problems of the formulation and implementation of alternative change strategies. Three hours. Schmidt.

**209 SMALL GROUPS** An examination of the structure and dynamics of interpersonal relations and informal interactions in small groups. Three hours. Nixon and Steffenhagen.

**210 COLLECTIVE BEHAVIOR** Analysis of the nature and types of emergent, noninstitutional behavior, especially responses to shared stressful or crisis situations. Includes the examination, social origins, development and consequences of crowd, riot, disaster and craze behavior. Three hours. Finney, Stanfield, and Waterman.

**211 SOCIAL MOVEMENTS** Analysis of the nature and types of relatively organized collective action to promote social or cultural change. Special attention will be given to the genesis, structure and social consequences of political and religious movements. Three hours. Finney, Foltz, Stanfield, and Waterman.

**212 CULTURE AND PERSONALITY** The cross-cultural comparison of personality development; the problem of delineating modal personality types. *Prerequisites:* 10, Anthropology 21 and one 100 level course in sociology or anthropology. Three hours. Mabry, Magnarella (Anthropology), and Steffenhagen.

**214 DELINQUENCY** Analysis of the nature and types of juvenile behavior that violates law, the mechanisms for defining such behavior as delinquent, and the relationships between delinquency and the social situations of juvenile offenders. Three hours. Foltz, McCann and Payne.

**215 CRIME** Analysis of the nature and types of adult behavior that violate

law, the mechanism for defining such behavior as criminal, and the relationships between crime and the social situation of adult offenders. Three hours. Folta, McCann, Payne and Stanfield.

**216 CRIMINAL JUSTICE** Analysis of the social structures and processes involved in the specification of behavior as being legally deviant and the labeling of individuals as delinquent or criminal offenders. Criminal law, its enforcement and the courts. Three hours. Folta, Payne and Stanfield.

**217 CORRECTIONS** Analysis of the social structures and processes involved in dealing with individuals who have been designated as offenders of criminal law. Probation, prison, parole, programs of prevention and rehabilitation. Three hours. Stanfield.

**219 RACE RELATIONS** Examination of racial subordination in social and historical context. Special attention will be given to the analysis of the forms of interracial contact, racial sub-cultures and social structures, social psychological and protest responses to racial prejudice and discrimination. Emphasis on American experience. Three hours. Danigelis, Loewen and Payne.

**225 BUREAUCRACY IN SOCIETY** Analysis of the structure and dynamics of large, formal organizations. Special attention will be given to the analysis of the forms of complex organization and their external relationships, and the role of bureaucracy in contemporary society. Three hours. Finney, Nixon and Sampson.

**226 SMALL GROUPS IN COMPLEX ORGANIZATION** Analysis of the emergence, structure and consequences of informal interaction in large, formal organizations. Special attention will be given to the reciprocal effects of small groups and their complex organizational environments. Three hours. Nixon and Steffenhagen.

**229 THE FAMILY AS A SOCIAL INSTITUTION** Description and analysis of the family as one of the society's major social institutions; the varying theoretical perspectives used in studying the family; the family in cross-cultural perspective; the role of social values in understanding continuity and change in the American family institution. *Prerequisite:* 129 or six hours in sociology. Three hours. Lewis and Mabry.

**230 SOCIAL VALUE PATTERNS IN AMERICAN FAMILY LIFE** A detailed examination of both the similarities and differences in social value patterns characteristic of the different segments of American family life and the relation of each to the larger American society. Attention will be given to both continuity and change in value patterns, including radical alternatives, and their significance for future developments in the family and society. Three hours. Fox and Lewis.

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**232 SOCIAL CLASS AND MOBILITY** Comparative analysis of the social causes, structures and consequences of the differential ranking of individuals and groups in society. Special attention will be given to the criteria for social ranking, their measurement and association, and intergenerational social mobility. Three hours. Danigelis, Finney, Lewis, Nixon, Schmidt and Underhill.

**237 OCCUPATIONS AND PROFESSIONS** Analysis of the social organization of economic roles and associations in industrial society. Special attention will be given to an examination of the impact of the structure of work on the individual and the relationship of occupations and professions to other institutions in society. Three hours. Mabry, Underhill, and Waterman.

**240 POLITICAL SOCIOLOGY** Analysis of the social organization of political roles and associations in modern society. Special attention will be given to an examination of the changing structure of the political institution and its relationship to other institutions in society. Three hours. Danigelis, Loewen, Nixon and Waitzkin.

**241 PUBLIC OPINION** Analysis of the factors affecting social attitude formation and change. Special attention will be given to political and social ideology. Three hours. Underhill.

**248 SOCIAL ORGANIZATION OF SCIENCE** Examination of science as a social institution, its social structure and its relationship with other institutions in society. Topics will include organization of research, stratification, social control, communication, and the relationship to such other institutions as educational, economic and political structures. *Prerequisites:* Six hours of social science, or, three hours of social science and six hours of natural science. Three hours. McCann.

**249 SOCIOLOGY OF KNOWLEDGE** Reviews the development and present state of sociological theory and research on the emergence and role of belief and normative systems in society. Special attention will be given to systematic attempts to understand the causes and consequences of shared constructions of social reality. Three hours. Loewen, McCann and Sampson.

**251 SOCIOLOGY OF RELIGION** Analysis of the social organization of religious roles and associations in modern society. Special attention will be given to the changing structure of the religious institution and its relationship to other institutions in society. Three hours. Sampson.

**254 SOCIOLOGY OF HEALTH AND MEDICINE** The socio-cultural environment of physical well-being and illness. Special attention will be given to the role of socio-cultural factors in the etiology, identification, definition and treatment of illness in society. Three hours. Folta, Mabry and Steffenhagen, Waitzkin and Waterman.

**255 SOCIOLOGY OF MENTAL HEALTH** The socio-cultural environment of mental well-being and illness. Special attention will be given to the role of socio-cultural factors in the etiology, identification, definition and treatment of mental illness in society. Three hours. Folta, Mabry, Steffenhagen, Waitzkin and Waterman.

**258 SOCIOLOGY OF LAW** Analysis of the social organization of legal roles and associations in modern society. Special attention will be given to the changing structure of the legal institution and its relationship to other institutions in society. Three hours. Folta and Stanfield.

**273 METHODOLOGY OF SOCIAL RESEARCH** Basic issues in the construction and empirical testing of sociological descriptions, predictions and explanations. Consideration will be given to the philosophy and logic of social research and the socio-cultural nature of scientific inquiry; theoretical frames of reference; concept formation, measurement and validation; socio-cultural causation and measures of association; models, theories and verification; and the formalization of theories. Three hours. Danigelis, McCann and Sampson.

**274 METHODS OF DATA GATHERING IN SOCIAL RESEARCH** An examination of the methods available for studying social phenomena including laboratory and field experiments, observational techniques, social surveys, content analysis, cross-cultural comparisons and others. Basic problems in research design, sampling methods, and measurement and scaling will be investigated. Three hours. Danigelis, Deming, Loewen, Mabry, McCann, Schmidt, Waterman and Underhill.

**275 METHODS OF DATA ANALYSIS IN SOCIAL RESEARCH** An examination of approaches to the quantitative analysis of sociological data, including table analysis, regression and path analysis, scaling and factor analysis, and the analysis of variance with emphasis on the multivariate techniques. Three hours. Danigelis, McCann, Payne and Underhill.

**278 THE DEVELOPMENT OF SOCIOLOGICAL THEORY** An examination of the major classical traditions in social theory and their contemporary research relevance. Detailed critical attention will be given, but not necessarily confined to, the theoretical and methodological contributions of Marx, Durkheim and Weber. Three hours. Danigelis, Loewen, McCann, Payne, Sampson and Schmidt.

**279 CONTEMPORARY SOCIOLOGICAL THEORY** A detailed examination of selected major theoretical approaches and issues in modern sociology. *Prerequisite:* 278. Three hours. Loewen, McCann, Sampson, Schmidt and Stanfield.

## SPANISH

281, 282 SEMINAR Presentation and discussion of advanced problems in contemporary sociological analysis. *Prerequisites:* Twelve hours in sociology and permission of the department. Three hours. Staff.

288, 289 SEMINAR: RESEARCH AND METHODS OF TEACHING SOCIOLOGY The development and evaluation of teaching strategies in sociology. Open only to graduate students and advanced undergraduate sociology majors who are serving concurrently as teaching assistants in the Department. *Prerequisites:* Twelve hours in sociology and permission of the department. Three hours. Danigelis, Finney, Loewen, McCann, Nixon and Underhill.

295, 296 SPECIAL TOPICS

297, 298 READINGS AND RESEARCH

354 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. McAree (psychiatry), Folta, Mabry, Steffenhagen, Waitzkin, and Waterman.

355, 356 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 instructors. McAree (psychiatry), Folta, Mabry, Steffenhagen, Waitzkin, and Waterman.

## • SPANISH

*Professors Ugalde (Acting Chairman), Weiger; Associate Professor Zárte; Assistant Professors Murad and Wesseling.*

### No Graduate Program Offered

Opportunities for research exist in Spanish literature of the 16th, 17th, 19th and 20th centuries and in Spanish-American literature of the 20th century.

### COURSES OFFERED

The following courses are available for graduate credit. In literature, the two-hundred level courses, open to both undergraduates and graduates, cover the history of Spanish literature from the Golden Age to the present time, by means of division into centuries and genres. Emphasis is placed on major

figures and works, with a view to studying them for their intrinsic value as well as in their historical context. For more detailed information on specific courses, consult with department chairman and the course instructor.

For undergraduate courses see the undergraduate catalogue.

### SPANISH LANGUAGE

209 ADVANCED GRAMMAR An in-depth study of Spanish grammar, its rules and practices, going beyond conventional good usage into the reasons and theories for same. Three hours. Ugalde.

### SPANISH LITERATURE

235, 236 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. Three hours each course. Alternate years. Weiger.

245, 246 CERVANTES *Don Quijote*, the *Novelas Ejemplares*, and the theatre of Cervantes. Three hours each course. Alternate years, 1977-78. Weiger.

265 19th CENTURY SPANISH LITERATURE Romanticism and realism: 1. Romantic theater, prose, poetry; 2. the realist and naturalist novelists: Galdós and Leopoldo Alas. Three hours. Alternate years, 1977-78. Wesseling.

276 THE REAWAKENING IN THE 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. Three hours. Alternate years, 1977-78. Ugalde.

285, 286 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. Reading of major works by genre and by period, following the various directions of social protest against a) the Spanish political system, b) local governments, c) imperialism. The second half of the course will stress the contemporary scene. Three hours each course. Alternate years, 1976-77. Zárate, Murad.

291 CIVILIZATION OF SPAIN Topical approach to the study of Spanish civilization. Uneven years: emphasis on art, literature and music (Ugalde). Even years: modern Spanish institutions and social, political and cultural problems with emphasis on the Civil War and its antecedents (Wesseling). Lectures in Spanish, texts both in English and in Spanish. Three hours. Ugalde, Wesseling.

293 LATIN AMERICAN CIVILIZATION A study of history and culture of Latin American people from the formation of the Indian civilization to the

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present ideals and problems. The periods studied will be the following, Pre-Hispanic civilization, colonization and modern states. Artistic, literary and musical manifestations of these periods will be covered. Three hours. Alternate years, 1977-78. Zárate.

### 295, 296 ADVANCED SPECIAL TOPICS

### 297, 298 ADVANCED READINGS

301, 302 GENERATION OF 1898 Three hours each course. Ugalde.

305 REGIONAL NOVEL OF SPANISH AMERICA Three hours. Zárate.

306 PSYCHOLOGICAL NOVEL OF SPANISH AMERICA Three hours. Zárate.

313 THE SPANISH COMEDIA Three hours. Weiger.

314 SPANISH THEATER Three hours. Weiger.

## • STATISTICS

*Steering Committee Members: Professors McCrorey, Sylwester (Director); Associate Professors Howell, Newton; Assistant Professors Ashikaga, Fritz, Gordon, Haugh, Tashman; Adjunct Assistant Professor Dorsey; Lecturer Aleong.*

The Statistics Program was established July 1, 1973 and is responsible for offering statistics courses and degree programs to meet the needs of the University. The Director reports to the Dean of the College of Engineering, Mathematics and Business Administration. The Program Steering Committee is composed of professional statisticians plus other faculty with extensive training in statistics so that students have substantial opportunities to see and participate in the interaction between statistics and its applications. Departments represented are Mathematics, Psychology, Business Administration, Physiology, Epidemiology and Environmental Health, Forestry, Animal Sciences, and the Agricultural Experiment Station.

The Program offers the Master of Science Degree in Statistics with emphasis in experimental statistics. The degree program is designed primarily for students who plan to work as statisticians in business, industry and government and for students who wish a graduate degree in statistics prior to advanced training in other disciplines. The Biostatistics Program (described elsewhere in this catalogue) is a separate but related program.

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

A baccalaureate degree. One semester of advanced calculus, a course in linear



algebra and one semester of statistics. Provisional acceptance can be given prior to the completion of all these requirements. Satisfactory scores on the aptitude portion of the Graduate Record Examination are required.

### MINIMUM DEGREE REQUIREMENTS

**Plan A:** Twenty-four semester hours of acceptable graduate credits in statistics, mathematics and allied fields and six semester hours of thesis research.

**Plan B:** Thirty semester hours of acceptable graduate credits in statistics, mathematics and allied fields with no thesis required.

Under Plan A and Plan B students must already have, or must acquire, a knowledge of the content of the following courses in statistics: Statistics 211, 221 (Statistical Methods I, II), 231 (Experimental Design), 241-242 (Statistical Theory) and 251 (Probability Theory). The student is expected to participate in the Statistics Seminar series throughout his graduate studies. Under Plan B students must carry out a comprehensive data analysis culminating in both an oral and written report. This project may be done independently or by enrolling in 281 (Statistics Practicum).

### COURSES OFFERED

**211 STATISTICAL METHODS I** Fundamental ideas and techniques of statistics, with applications, used in experimental design and data analysis; descriptive and inferential statistics, especially parameter estimation and hypothesis testing. Introduction to correlation, regression, and analysis of variance. One section of 211 is crosslisted as Psychology 340. *Prerequisite:* College algebra. Three hours. Staff.

**221 STATISTICAL METHODS II** Continuation of 211 concentrating on linear and multiple regression, analysis of variance, chi-square tests, and non-parametric methods. *Prerequisite:* Any one of 141, 211 or 241. Three hours. Staff.

**225 APPLIED REGRESSION ANALYSIS** The nature and applications of basic regression-correlation models in investigating relationships, testing hypotheses and making predictions. Emphasis on the art of developing appropriate models and evaluating existing research. *Prerequisite:* Any one of 111, 141 or 211. Three hours. Tashman.

**227 STATISTICAL METHODS FOR THE BEHAVIORAL SCIENCES** See Psychology 341 for course description.

**229 STATISTICAL METHODS FOR THE ENGINEERING SCIENCES** Multiple regression modelling, factorial design of experiments with analysis of variance. Statistical quality control, attribute and variable inspection schemes,

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control charts. Probability distributions used in queuing, reliability, life testing. *Prerequisite:* Any one of 141, 211, or 241. 111 with instructor permission. Three hours. Haugh.

**231 EXPERIMENTAL DESIGN** Experimental design techniques, survey of basic experimental designs, factorial designs; fixed and random effects models; multiple comparisons. *Prerequisites:* Any one of 221, 227, 229, 242 or 313; 225 with instructor permission. Three hours. Haugh.

**233 SAMPLE SURVEY METHODS** Presentation of implementing and estimating parameters for various sampling schemes including simple random, stratified random, systematic, and cluster sampling. Relative efficiencies of designs. *Prerequisites:* Any one of 141, 211, 241 or 313. *Corequisite:* 151 or 251. Three hours. Alternate years, 1977-78. Ashikaga.

**235 MULTIVARIATE METHODS** Properties and statistical methods, with applications, for the multivariate normal distribution: multiple regression, non-linear regression, discriminant functions, principal components and factor analysis. Experience in data analysis using computer programs. *Prerequisites:* 241 and any one of 221, 225, 227, 229 and 313. Three hours. Alternate years, 1977-78. Ashikaga.

**237 NONPARAMETRIC METHODS** Nonparametric procedures for hypothesis tests and confidence intervals, including rank procedures and those based on the binomial distribution. Selecting the optimum procedure for a particular problem. *Prerequisite:* Any one of 141, 211, or 241. Three hours. Alternate years, 1976-77. Sylwester.

**241, 242 STATISTICAL THEORY I, II** Introduction to the fundamental concepts and procedures of modern statistics: sampling distributions, decision theory, point and interval estimation, hypothesis testing, non-parametric procedures, sequential procedures, linear models, and multivariate procedures. Selected applications. *Prerequisites:* 141 or 211 recommended but not required; 151 or 251 for 241; 241 for 242. Three hours. Offered in spring (241) and fall (242). Staff.

**251 PROBABILITY THEORY** Non-measure-theoretic course in probability with some applications. Axioms of probability, random variables, generating functions, laws of large numbers and central limit theorems, introduction to stochastic processes. A strong working knowledge of calculus including infinite series and multiple integration is needed. *Prerequisite:* Mathematics 121. 51 recommended for undergraduates. Three hours. Sylwester.

**252 STOCHASTIC PROCESSES** Discrete and continuous stochastic processes: the random walk, branching, Poisson, birth and death, Brownian

## VOCATIONAL EDUCATION AND TECHNOLOGY

and diffusion processes. Analysis of times series in both the time and frequency domains. *Prerequisite:* 151 with permission of instructor or 251. Three hours. Alternate years, 1976-77. Sylwester.

**281 STATISTICS PRACTICUM** Intensive experience in carrying out a complete statistical analysis for a specific research project in a substantive area with close consultation with the project investigator. 1-4 credit hours. *Prerequisite:* One year of statistics and elementary computer programming ability. Staff.

**285 SPECIAL TOPICS** For advanced students. Lectures, reports and directed readings on advanced topics. *Prerequisite:* Permission of instructor. Credit as arranged. Offered as occasion warrants. Staff.

**313 BIOMETRICS** See Physiology 308 for course description.

**331 THEORY OF LINEAR STATISTICAL MODELS** Non-central chi-square and F distribution, Markoff theorem, general linear hypothesis of full rank and less than full rank, experimental design models, variance components. *Prerequisites:* 231, 242. Three hours. Haugh.

**391 MASTER'S THESIS RESEARCH** Credit as arranged.

## • VOCATIONAL EDUCATION AND TECHNOLOGY

*Professors Fuller (Chairman), Schneider; Associate Professor Kelly; Assistant Professors Bloom, Ferreira, Jensen, Lampe, Wells. Adjunct faculty: Assistant Professor Moore.*

The department offers two areas of concentration:

- (a) Occupational and Practical Arts Education—which leads to either an M.A.T. or an M.Ed. degree, and
- (b) Extension Education—which leads to a Master of Extension Education degree

Individuals seeking a maximum amount of flexibility in a program based upon both undergraduate and graduate courses are encouraged to consider the Fifth Year Certificate in Education. (See page 12 of this bulletin.)

## OCCUPATIONAL AND PRACTICAL ARTS EDUCATION

*The Master of Arts in Teaching Degree Program*

The goal of this program is to strengthen an individual's background in a teaching field. The specialized areas of interest include agriculture and natural resource education, industrial arts and industrial education.

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

An undergraduate degree in an appropriate field of specialization. Completion of the necessary courses to meet the minimum requirements for a teaching certificate. Acceptable scores on the aptitude portion of the Graduate Record Examination.

Candidates who do not qualify for a teaching certificate, but have satisfactory teaching field preparation and Graduate Record Examination scores may be admitted. A professional field experience will need to be completed in addition to the minimum degree requirements.

### **MINIMUM DEGREE REQUIREMENTS**

See pages 24 and 25 for regulations of the Graduate College

The Department expects a candidate to complete at least eighteen semester hours in professional education in his or her combined undergraduate and graduate programs, which includes preparation in the areas of Foundations of Education, methods for teaching, and learning and human development. Usually not more than six hours of independent study is allowed. A candidate is expected to complete at least one semester or two summers in residence on the University of Vermont campus in Burlington. Inquiries should be directed to Professor Gerald R. Fuller.

#### *The Master of Education Degree Program*

The goal of this program is to prepare the individual for professional leadership in occupational and practical arts education. Programs are planned jointly with the College of Education and Social Services in guidance and counseling, occupational education for the mentally retarded, or to meet individual goals as they relate to occupational and practical arts education.

The department expects each candidate to include study in one or more of the following areas as they relate to occupational and practical arts education; improvement of instruction, principles and problems involved in curriculum development, planning and managing educational programs, and/or research.

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

An undergraduate degree in an appropriate area. Eighteen hours of education courses or appropriate certification. Acceptable scores on the aptitude portion of the Graduate Record Examination.

### **MINIMUM DEGREE REQUIREMENTS**

See pages 25 and 26 for regulations of the Graduate College.

A candidate is expected to complete at least one semester or two summer sessions in residence on the University of Vermont campus in Burlington.

## VOCATIONAL EDUCATION AND TECHNOLOGY

Additional information on this degree program may be found on pages 83-87 of this bulletin. Inquiries should be directed to Associate Professor Edward Ducharme, College of Education and Social Services, or Professor Gerald R. Fuller, College of Agriculture.

### EXTENSION EDUCATION

The goal of this program is to improve the knowledge and competencies of the student in a career field coupled with preparation for educational leadership functions. Programs of study may be designed for educational responsibilities in one of the following specializations in the non-school based setting: agricultural or related agencies and organizations, business and industry, and youth programs and organizations.

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

An undergraduate degree with an acceptable major area of specialization. An acceptable score on the Miller Analogies Test. One year of satisfactory professional experience. A person may be admitted who does not have one year of appropriate professional experience but it will be necessary to complete a field experience in addition to the minimum degree requirements.

### MINIMUM DEGREE REQUIREMENTS

See page 28 for regulations of the Graduate College. A candidate is expected to complete at least six semester hours in the Vocational Education and Technology Department. Usually courses in political science, sociology, and/or research will be taken. Not more than six hours of independent study is allowed in a candidate's program. A candidate is expected to complete at least one semester or two summers in residence on the University of Vermont campus, Burlington, Vermont. Inquiries should be directed to Professor Gerald R. Fuller.

### COURSES OFFERED

**251 METHODS FOR TEACHING OCCUPATIONALLY ORIENTED SUBJECTS** Study of advanced techniques in teaching and program management. *Prerequisite:* Concurrent enrollment in 153 or 155, or departmental permission. Three hours. Fuller.

**253 TEACHING ADULTS** Needs, problems, and objectives for the education of adults. *Prerequisite:* Senior standing, or permission of the department. Three hours. Jensen.

**273 TECHNICAL REPORTING** Study of communication of information through research and technical operations reports and articles in professional journals. Three hours. Not offered, 1976-77.

## WILDLIFE BIOLOGY

**275 DEVELOPING VOCATIONAL INSTRUCTION FOR STUDENTS WITH SPECIAL NEEDS II (Life-Relevant Academics)** Planning, development and implementation of life-relevant academic curricula and learning experiences appropriate for students with special needs at the secondary school level. Implementation of career education concept with handicapped students. *Prerequisite:* 106 or 170 or equivalent and permission of instructor. Variable credit: two for lecture and discussion; one for practicum; three for combination. Lampe.

**276 RESOURCES AND PROCEDURES FOR INSTRUCTING STUDENTS WITH SPECIAL NEEDS** Considers materials, media, and instructional approaches appropriate for educating students with special needs in the secondary and vocational schools. *Prerequisite:* 170 and 275 or equivalent and permission of instructor. Variable credit: two for lecture and discussion; one for practicum; three for combination. Lampe.

**282 SEMINAR** Evaluation of student teaching experiences. *Prerequisite:* 155. Bloom.

**295 SPECIAL TOPICS** Lectures, laboratories and/or readings and reports, 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** 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.

## • WILDLIFE BIOLOGY

*Professor John; Assistant Professor Hoekstra; Lecturer Fuller.*

Refer to the listings for the Department of Forestry for additional information on research interests and course offerings.

### COURSES OFFERED

**271 WETLANDS WILDLIFE ECOLOGY** Emphasis on waterfowl and fur-bearer resources; integration of aesthetic, recreational, socio-economic values. *Prerequisite:* 174; avian and mammalian biology. Four hours. Fuller.

**272 UPLAND WILDLIFE ECOLOGY** Integration of ecological principles, wildlife biology, land use and human dimensions in wildlife biology. Emphasis on development and maintenance of habitat requirements and population regulation in upland habitats. *Prerequisite:* Animal Science 158 and Wildlife Biology 174 and 175. Four hours. Hoekstra.

**276 DYNAMICS OF EXPLOITED WILDLIFE POPULATIONS** Analysis of natural and manipulated wildlife populations parameters through simulation techniques. Emphasis on population management for commensurate benefit to wildlife and humans. *Prerequisite:* Wildlife Biology 271 or 272. Three hours. Hoekstra.

## • ZOOLOGY

*Professors Bell, Glade, Henson, Potash, and Rothstein; Associate Professors Brammer, Davison, Landesman, Stevens, and Woods; Assistant Professor Kilpatrick; Visiting Assistant Professors Elvin, O'Mahoney, and Oswood.*

Faculty research interests fall within the general areas of environmental biology, developmental biology, genetics, and cell biology. Current on-going projects include research in insect taxonomy and ecology, especially of the Carabidae; aquatic ecology; chemical and developmental biology of amphibians and invertebrates; insect vision; mechanisms of cell division; the synthesis of macromolecules during mitosis; comparative anatomy; evolutionary genetics. 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. Satisfactory scores on the Graduate Record Examination. Acceptability to the faculty member with whom the candidate wishes to do his thesis research.

### **MINIMUM DEGREE REQUIREMENTS**

Zoology Graduate Colloquia, 2 hours; 13-20 additional hours in zoology and related fields; thesis research (8-15 hours). Each candidate must participate in the teaching of at least one undergraduate course.

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

The department offers a program leading to the degree of Master of Arts in Teaching: Cf. p. 24. 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.

## ZOOLOGY

### MINIMUM DEGREE REQUIREMENTS

Thirty hours of course work to include a selection of courses in the Departments 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 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

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, or one foreign language and an adjunct area of special competency as determined by the studies committee. Students whose programs are to include physical chemistry should have had, or should take, mathematics through Mathematics 121 or its equivalent. Satisfactory scores on the Graduate Record Examination. 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 and must include 4 hours of Graduate Colloquia. The selection of courses will 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. Each candidate must participate in the teaching of at least one undergraduate course.

### COURSES OFFERED

**201 CONTROL OF GROWTH AND DIFFERENTIATION** Three hours.  
*Prerequisites:* Biology 101, and Chemistry 131, 132. Davison.

**202 QUANTITATIVE BIOLOGY** Mathematical concepts applied to biological problems such as growth, metabolism, temperature effects, kinetics, and graphic interpretation of data. Statistics will not be treated. *Prerequisite:* An intermediate level course in biology, Mathematics 9, or permission of the instructor. Three hours. Davison.



**203 POPULATION ECOLOGY** Analysis of growth, regulation, and inter-relations of biological populations in theoretical, laboratory, and natural systems. *Prerequisite:* Biology 102. Three hours. Oswood.

**204 BIOLOGICAL ASPECTS OF WATER QUALITY MANAGEMENT** Designed to meet the needs of students who are developing careers in any of the various aspects of water resources. The biological and limnological viewpoints of the aquatic systems (lakes and streams); practical experience in methodology and interpretation in the field and laboratory. Credit will not be given for both Zoology 236 and this course. *Prerequisite:* Upperclass or graduate standing, a year of chemistry, two advanced courses in a related area, and permission of the instructor. Four hours. Henson.

**205 NATURAL HISTORY OF BIRDS AND MAMMALS** History, identification, evolution, ecology, behavior, zoogeography, conservation and aesthetics. *Prerequisite:* 104 or Biology 102. Four hours. Alternate years, 1976-77. Woods.

**207 NATURAL HISTORY OF THE LOWER VERTEBRATES** Classification, ecology, behavior, evolution, and distribution of fish, amphibians, and reptiles. *Prerequisite:* 104. Three hours. Alternate years, 1976-77. Bell.

**208 GENERAL ENTOMOLOGY** Morphology, physiology, and evolution of insects. *Prerequisite:* 104 or Biology 102. Four hours. Alternate years, 1977-78. Bell.

**209 FIELD ZOOLOGY** Collection and identification; study of local habitats, their nature, and adaptations to them; factors governing distribution methods of preparing study specimens. *Prerequisite:* 104 or Biology 102. Four hours. Bell.

**211 EMBRYOLOGY** Principles exemplified by typical invertebrate and vertebrate embryos. *Prerequisite:* 104. Four hours. Glade.

**212 COMPARATIVE HISTOLOGY** Anatomy of tissues, chiefly vertebrate. Tissue similarities and specializations of organs among the various groups of animals in relation to function. *Prerequisite:* 104. Four hours. Glade.

**216 HUMAN GENETICS** Inheritance; population genetics; interaction of heredity and environment; application to human problems. *Prerequisite:* Biology 101. Three hours. Kilpatrick.

**219 COMPARATIVE AND FUNCTIONAL VERTEBRATE ANATOMY** Structure, function, and phylogeny; evolutionary and functional trends; investigation of the structure of all chordate groups. *Prerequisite:* 104. Four hours. Woods.

## ZOOLOGY

**220 MECHANISMS OF CELL DIVISION** Fine structure and physiology of normal and abnormal cell division; emphasis on mechanisms. *Prerequisites:* Biology 103, a course in biochemistry, and the consent of the instructor. Three hours. Alternate years, 1977-78. Stevens.

**222 EXPERIMENTAL EMBRYOLOGY** Theoretical approach based on research in embryology, genetics, physiology, bacteriology, and related fields. *Prerequisites:* 211 and permission of the instructor. Four hours. Alternate years, 1976-77. Glade.

**223 BIOCHEMICAL EMBRYOLOGY** Biochemical and structural differentiation of cells and tissues during oogenesis and embryogenesis. *Prerequisites:* Biology 101, 211; a course in biochemistry is recommended. Three hours. Landesman.

**225 ENVIRONMENTAL PHYSIOLOGY** Processes by which animals cope with moderate, changing, and extreme environments. *Prerequisites:* Biology 102 and 104. Four hours. Alternate years, 1977-78. Woods.

**231 CELL PHYSIOLOGY** Experimental techniques used to elucidate chemical and physical mechanisms within living cells. *Prerequisites:* Biology 103; Chemistry 131, 132 and permission of the instructor. Four hours. Rothstein.

**236 LIMNOLOGY** The ecology of standing waters: the biota of lakes as related to the geological, physical, and chemical conditions of lakes. *Prerequisites:* Biology 102, inorganic chemistry. Four hours. Henson.

**237 ECOLOGY OF RUNNING WATERS** Stream and river environments, adaptations of organisms to varying physical, chemical, and biotic conditions. *Prerequisites:* Biology 102, inorganic chemistry. Four hours. Potash.

**240 INVERTEBRATE ECOLOGY OF THE MOUNTAINS** An intensive study of the invertebrate fauna of Camel's Hump and vicinity. *Prerequisite:* Biology 102 or a course in invertebrate or insect taxonomy. Four hours. Bell.

**242 VERTEBRATE EVOLUTION** Theoretical and paleontological evidence for origin, evolution, and classification of vertebrates. Several optional weekend field trips to see fossil vertebrates in collections and nearby area museums. *Prerequisite:* Biology 1, 2; Zoology 104 or Geology 121, or permission of instructor. Three hours. Alternate years, 1976-77. Woods.

**250 INVERTEBRATE ZOOLOGY** Anatomy, physiology, and life histories of representatives of the more important phyla. *Prerequisite:* 104. Four hours. Elvin.

**251 INSECT STRUCTURE AND FUNCTION** Anatomy and physiology

with emphasis upon growth, reproduction, and sensory physiology. *Prerequisite:* 104 or permission of instructor. Four hours. Alternate years, 1977-78. Brammer.

**255 COMPARATIVE ANIMAL PHYSIOLOGY** General principles of function in invertebrates and vertebrates. *Prerequisites:* 104; Chemistry 131, 132; and permission of the instructor. Four hours. O'Mahoney.

**258 PHYSIOLOGICAL INTEGRATION** Principles of integration which apply to the functioning of cells, tissues, and organs, chiefly in vertebrate organisms. *Prerequisites:* Physics, organic chemistry, Biology 103, 104. Three hours. Rothstein.

**262 BIOLOGICAL BASIS OF BEHAVIOR** The structure and function of neural and hormonal mechanisms involved in animal behavior with emphasis on phylogeny. *Prerequisite:* Biology 103 or permission of the instructor. Three hours. Stevens.

**270 MODERN EVOLUTIONARY THEORY** Contributions of modern research in genetics, systematics, distribution, experimental embryology, serology, and related fields to problems of evolutionary change. *Prerequisite:* Biology 101 (102 recommended). Three hours. Kilpatrick.

**271 ADVANCED LIMNOLOGY** Analysis of current concepts and problems. *Prerequisite:* 236. Four hours. Henson.

**281 SEMINAR** Review and discussion of current zoological research. Graduate students and seniors in zoological research programs may enroll. Without credit. Staff.

## **295 SPECIAL TOPICS**

**371 GRADUATE COLLOQUIA** Topics of current faculty and graduate student interest presented in a seminar-discussion format. Specific titles for colloquia will be listed in the course schedule. One hour. 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** Credit as arranged.

**491 DOCTORAL THESIS RESEARCH** Credit as arranged.

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# THE GRADUATE FACULTY

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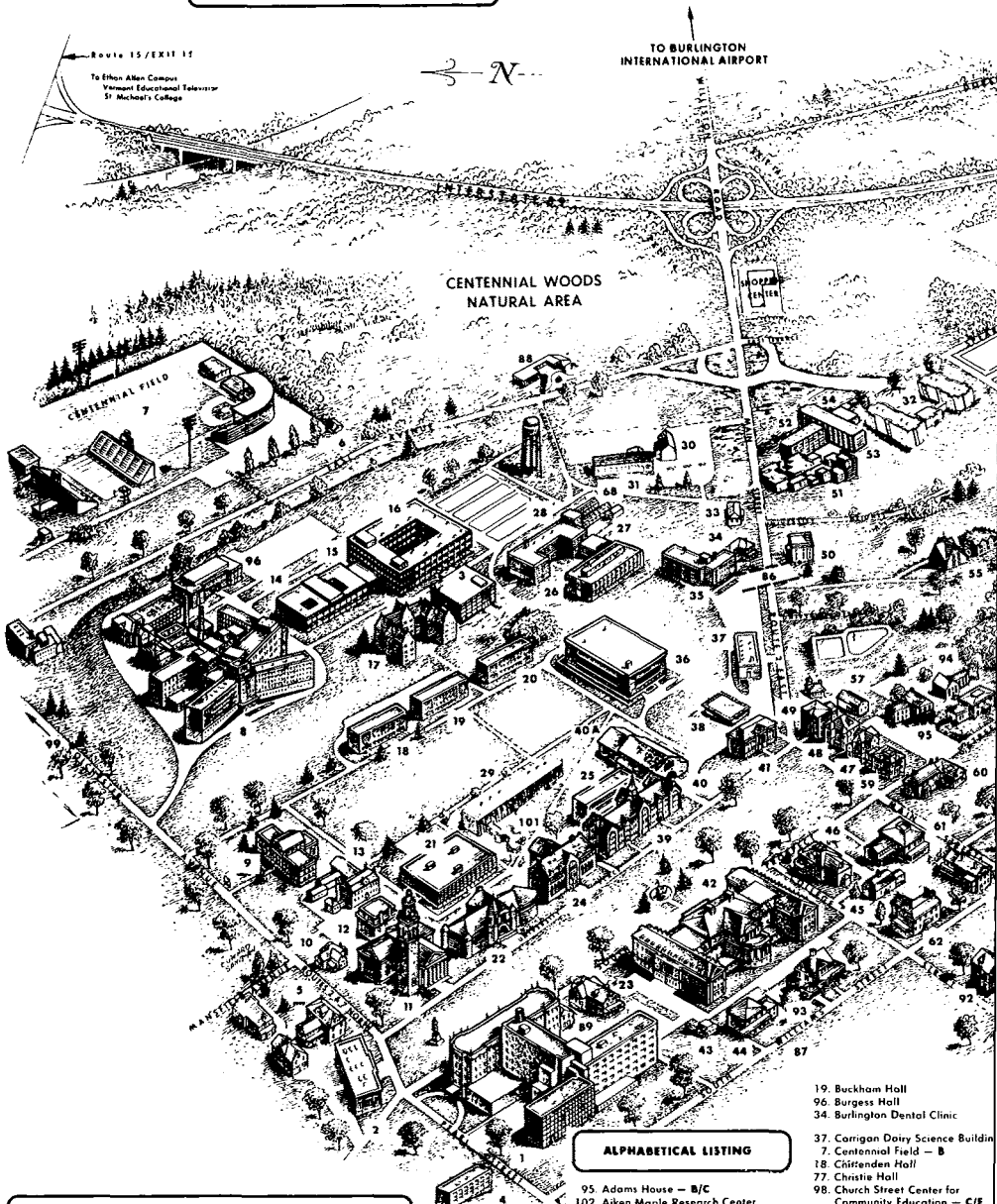
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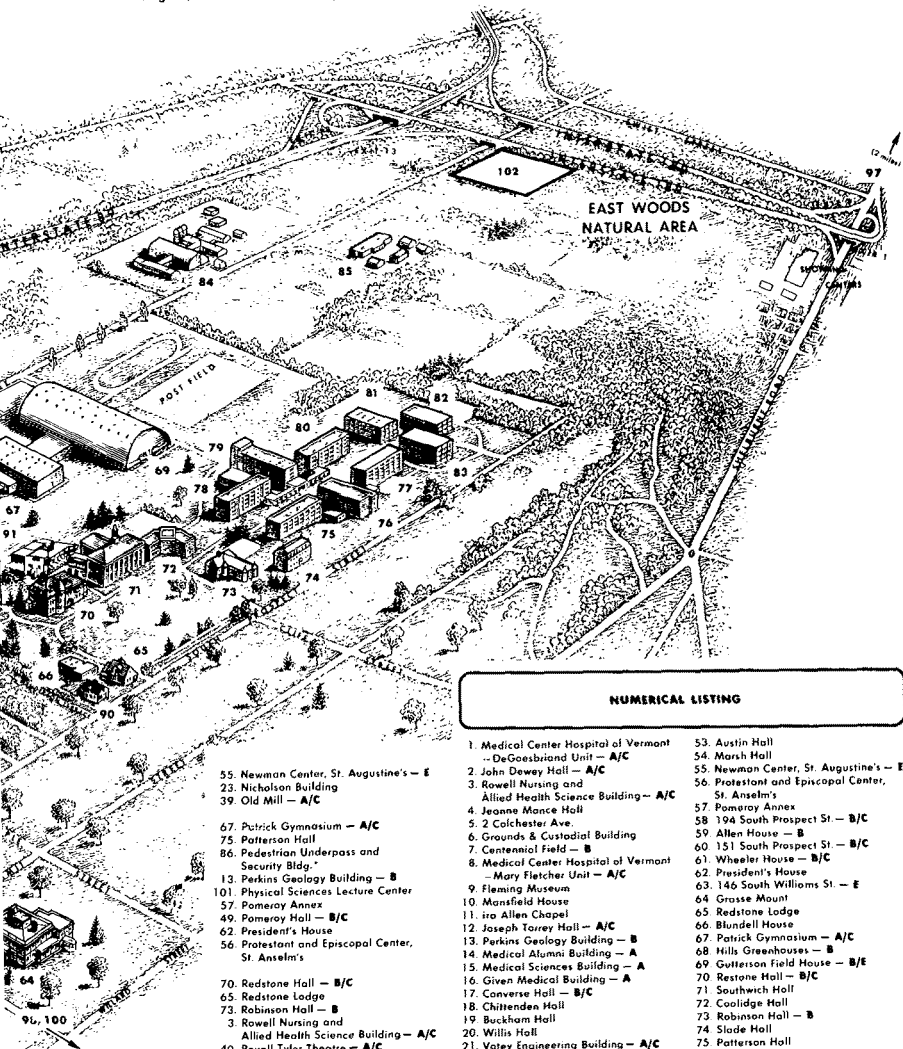
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**ALPHABETICAL LISTING**

- 95. Adams House — B/C
- 102. Aiken Maple Research Center (U.S. Forest Service)
- 30. Agricultural Engineering Barn — A
- 31. Agricultural Engineering Bldg. — A/C
- 59. Allen House — B
- 93. Alumni House
- 53. Austin Hall
- 36. Bailey Library — A/C
- 27. Benedict Auditorium — B
- 22. Billings Student Center — B
- 85. Bio-Research Complex — B
- 97. Blasberg Horticultural Complex — E
- 66. Blundell House
- 19. Buckham Hall
- 96. Burgess Hall
- 34. Burlington Dental Clinic
- 37. Carrigan Dairy Science Building
- 7. Centennial Field — B
- 18. Christenden Hall
- 77. Christie Hall
- 98. Church Street Center for Community Education — C/E
- 5. 2 Colchester Ave.
- 17. Converse Hall — B/C
- 29. Cook Physical Sciences Bldg.
- 72. Coolidge Hall
- 82. Davis Hall
- 9. Fleming Museum
- 100. Gates Hall, 381 Main Street
- 16. Given Medical Building — A
- 64. Grasse Mount
- 6. Grounds & Custodial Building
- 69. Gutterson Field House — B/E





# NUMERICAL LISTING

1. Medical Center Hospital of Vermont  
--DeGoesbriand Unit -- A/C
2. John Dewey Hall -- A/C
3. Rowell Nursing and Allied Health Science Building -- A/C
4. Jeanne Mance Hall
5. 2 Colchester Ave.
6. Grounds & Custodial Building
7. Centennial Field -- B
8. Medical Center Hospital of Vermont  
--Mary Fletcher Unit -- A/C
9. Fleming Museum
10. Mansfield House
11. Ira Allen Chapel
12. Joseph Torrey Hall -- A/C
13. Perkins Geology Building -- B
14. Medical Alumni Building -- A
15. Medical Sciences Building -- A
16. Given Medical Building -- A
17. Converse Hall -- B/C
18. Chittenden Hall
19. Buckham Hall
20. Willis Hall
21. Votey Engineering Building -- A/C
22. Billings Student Center -- B
23. Nicholson Building
24. Williams Hall -- A/C
25. Lafayette Hall -- B
26. Marsh Life Sciences Building -- A
27. Benedict Auditorium -- B
28. Mills Agricultural Sciences Bldg -- A
29. Cook Physical Sciences Bldg -- A/C
30. Agricultural Engineering Barn -- A
31. Agricultural Engineering Bldg. -- A/C
32. Harris-Millis Complex -- A/C
33. 622 Main Street
34. Burlington Dental Clinic
35. Terrill Home Economics Building -- A
36. Bailey Library -- A/C
37. Corrigan Dairy Sciences Building
38. University Store -- A
39. Old Mill -- A/C
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41. Morrill Hall
42. Waterman Building -- A/C
43. 70 South Williams Annex
44. 70 South Williams St.
45. 109 South Prospect Annex
46. 109 South Prospect St.
47. 475-479 Main St.
48. 481 Main St.
49. Pomeroy Hall -- B/C
50. 601 Main St.
51. Living/Learning Complex -- A/C
52. Tupper Hall
53. Austin Hall
54. Marsh Hall
55. Newman Center, St. Augustine's -- E
56. Protestant and Episcopal Center, St. Anselm's
57. Pomeroy Annex
58. 194 South Prospect St. -- B/C
59. Allen House -- B
60. 151 South Prospect St. -- B/C
61. Wheeler House -- B/C
62. President's House
63. 146 South Williams St. -- E
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65. Redstone Lodge
66. Blundell House
67. Patrick Gymnasium -- A/C
68. Hills Greenhouses -- B
69. Gutterson Field House -- B/E
70. Restone Hall -- B/C
71. Southwick Hall
72. Coolidge Hall
73. Robinson Hall -- B
74. Slade Hall
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