

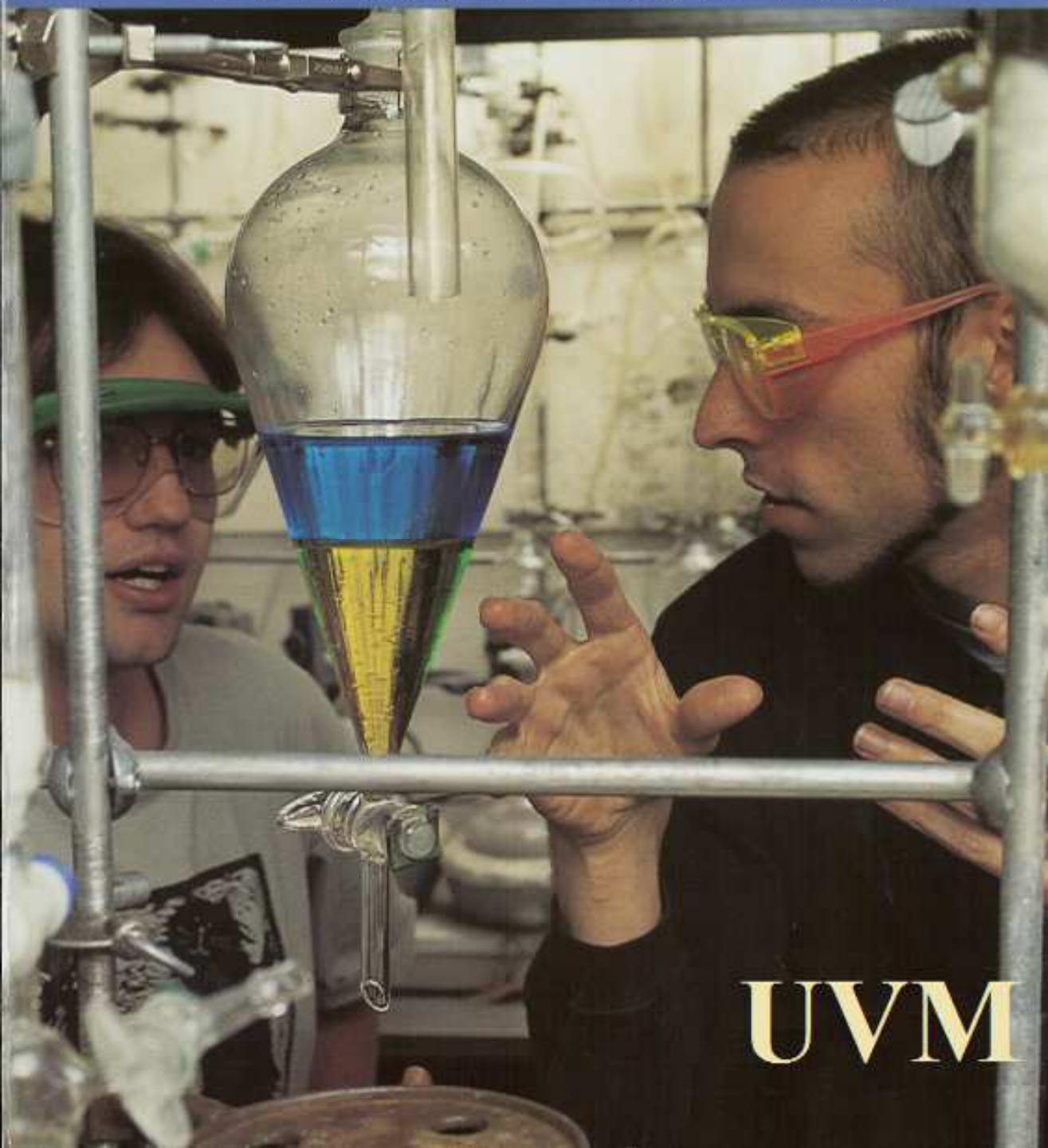
GRADUATE



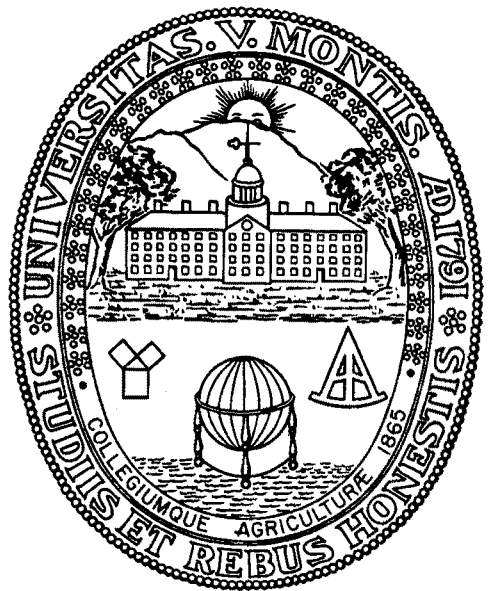
COLLEGE

The UNIVERSITY *of* VERMONT

C A T A L O G U E 1 9 9 8 - 2 0 0 0



UVM



Graduate Catalogue 1998–2000

The University of Vermont
Burlington, Vermont 05405

ACCREDITATIONS

The University of Vermont is accredited by the New England Association of Schools and Colleges, Inc., a nongovernmental, nationally-recognized organization whose affiliated institutes include elementary schools through collegiate institutions offering postgraduate instruction.

Accreditation of an institution by the New England Association indicates that it meets or exceeds criteria for the assessment of institutional quality periodically applied through a peer group review process. An accredited school or college is one which has available the necessary resources to achieve its stated purposes through appropriate educational programs, is substantially doing so, and gives reasonable evidence that it will continue to do so in the foreseeable future. Institutional integrity is also addressed through accreditation.

Accreditation by the New England Association is not partial but applied to the institution as a whole. As such, it is not a guarantee of the quality of every course or program offered or the competence of individual graduates. Rather, it provides reasonable assurance about the quality of opportunities available to students who attend the institution.

Inquiries regarding the status of an institution's accreditation by the New England Association should be directed to the administrative staff of the University. Individuals may also contact the New England Association of Schools and Colleges, The Sanborn House, 15 High Street, Winchester, MA 01890, (617) 729-6762.

Specific academic program accreditations are listed below:

ALLIED HEALTH SCIENCES

- Biomedical Technologies
- Medical Laboratory Science — National Accrediting Agency for Clinical Laboratory Science
- Nuclear Medicine Technology — Joint Review Committee on Educational Programs in Nuclear Medicine Technology
- Radiation Therapy — Joint Review Committee on Education in Radiologic Technology
- Dental Hygiene — American Dental Association
- Physical Therapy — American Physical Therapy Association

ARTS AND SCIENCES

- Chemistry — American Chemical Society
- Speech-Language Pathology — American Speech-Language-Hearing Association
- Clinical Psychology — American Psychological Association

BUSINESS ADMINISTRATION

- American Assembly of Collegiate Schools of Business

EDUCATION

- National Council for Accreditation of Teacher Education
- Social Work — Council on Social Work Education
- Teacher Education — Vermont Department of Education

ENGINEERING AND MATHEMATICS

- Engineering Programs (Mechanical, Electrical, Civil) — Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc.

MEDICINE

- Liaison Committee on Medical Education, American Medical Association-Association of American Medical Colleges

NATURAL RESOURCES

- Forestry — Society of American Foresters

NURSING

- National League for Nursing

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The University of Vermont Equal Opportunity in Educational Programs and Activities Policy

The University of Vermont and State Agricultural College is committed to a policy of equal educational opportunity. The University therefore prohibits discrimination on the basis of unlawful criteria, such as race, color, religion, national or ethnic origin, age, sex, sexual orientation, marital status, or disability, as those terms are defined under applicable law, in admitting students to its programs and facilities and in administering its admissions policies, educational policies, scholarships and loan programs, athletic and other institutionally administered programs or activities made available to students at the University. The University also prohibits unlawful harassment defined in 16 V.S.A. §11 (a) (26) as verbal or physical conduct based on a student's race, creed, color, national origin, sex, sexual orientation, marital status, or disability and which has the purpose or effect of substantially interfering with a student's educational performance or creating an intimidating, hostile, or offensive environment.

Questions regarding this policy statement or compliance with its provisions may be directed to Dean Batt, Vice President for Student Affairs, University of Vermont, 41-43 South Prospect Street, Burlington, VT 05405 (802-656-3380) or Wanda Heading-Grant, Executive Director, Office of Affirmative Action and Equal Opportunity, University of Vermont, 428 Waterman Building, Burlington, VT 05405 (802-656-3368). Questions may also be directed to government agencies having oversight and enforcement authority with respect to the referenced laws. A complete listing of those agencies may be obtained from the Office of Affirmative Action and Equal Opportunity.

Sources: Title VI of the Civil Rights Act of 1964; Title IX of the Education Amendments of 1972; the Age Discrimination Act of 1975; Section 504 of the Rehabilitation Act of 1973; the Americans with Disabilities Act of 1990; the Vermont Public Accommodations Act; and such other federal, state and, local nondiscrimination laws as may apply.

Equal Employment Opportunity and Affirmative Action Policy

The University of Vermont and State Agricultural College is committed to a policy of equal employment opportunity and to a program of affirmative action in order to fulfill that policy. The University will accordingly recruit and hire into all positions the most qualified persons in light of job-related requirements, and applicants and employees shall be treated in employment matters without regard to unlawful criteria including race, color, religion, national origin, sex, sexual orientation, disability, age, or status as a disabled or Vietnam-Era Veteran, as these terms are defined under applicable law. In addition, The University of Vermont recognizes that sexual harassment is a form of unlawful sex discrimination, and it is therefore the policy of the University that sexual harassment will not be tolerated.

Questions regarding this policy statement or compliance with its provisions may be directed to Wanda Heading-Grant, Executive Director, Office of Affirmative Action and Equal Opportunity, University of Vermont, 428 Waterman Building, Burlington, VT 05405 (802) 656-3368. Questions may also be directed to government agencies having oversight and enforcement authority with respect to the referenced laws. A complete listing of such agencies may be obtained from the Office of Affirmative Action and Equal Opportunity.

Sources: Titles VI and VII of the Civil Rights Act of 1964; Title IX of the Education Amendments of 1972; the Equal Pay Act of 1963; the Age Discrimination Act of 1975; Sections 503 and 504 of the Rehabilitation Act of 1973; the Americans with Disabilities Act; Section 402 of the Vietnam-Era Veterans Readjustment Assistance Act of 1974; Executive Order 11246 as amended; the Vermont Fair Employment Practices Act; and such other federal, state, and local non-discrimination laws as may apply.

Note: These Policy Statements are official University of Vermont Equal Employment Opportunity/Affirmative Action and Equal Opportunity in Educational Programs and Activities Policy Statements and supersede all prior policy statements regarding their subject matter. They may be modified only by written statement issued by the President as Chief Executive Officer of the University or formal action by the University of Vermont and State Agricultural College Board of Trustees. These Policy Statements are designed to express the University's intent and commitment to comply with the requirements of federal, state, and local nondiscrimination laws. They shall be applied co-extensively with such laws, and shall not be interpreted as creating any rights, contractual or otherwise, greater or lesser than exist under such nondiscrimination laws. Persons seeking to participate in educational and employment opportunities offered by the University must consult position and program descriptions to determine criteria for eligibility. All such criteria shall be established in a manner consistent with the legal requirements herein referenced.

Students at The University of Vermont are responsible for knowing and complying with all requirements for their respective degrees as stated in the catalogue.

The University of Vermont reserves the right to make changes in the course offerings, degree requirements, charges, and regulations, and procedures contained herein as educational and financial considerations require, subject to and consistent with established procedures and authorizations for making such changes.

Although its legal title is The University of Vermont and State Agricultural College, the University is known to its students and alumni as UVM. This popular abbreviation is derived from the Latin *Universitas Viridis Montis*, University of the Green Mountain.

The colors of the University are green and gold.
The mascot is the catamount.

Correspondence

Please address all inquiries and correspondence concerning applications and admission to the Graduate College Admissions Office, The University of Vermont, Burlington, Vermont 05405-0160; telephone (802) 656-2699; E-mail: graduate.admissions@uvm.edu; FAX (802) 656-0519. For other matters concerning the Dean, telephone (802) 656-3160.

Address requests for transcripts from The University of Vermont to the Registrar, The University of Vermont, Burlington, Vermont 05405-0160; telephone (802) 656-2045.

Address requests for Summer Session and Evening Division information to the Office of Continuing Education, The University of Vermont, Burlington, Vermont 05405-3525; telephone (802) 656-2085.

Information on graduate programs at the University is also available on the World Wide Web at <http://www.uvm.edu/~gradcoll/home.html>. The University's web page is <http://www.uvm.edu>.

The Graduate Catalogue is produced biennially by the Graduate College, the Provost's Office, and University Graphics & Printing. The information in the Graduate Catalogue was compiled by Nancy Brunelle, Leilani Bowie, and Ralph Swenson of the Graduate College.

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Academic Calendar

FALL 1998

Classes begin
Labor Day holiday
Fall recess
Thanksgiving recess
Classes end
Reading and exam period
 Reading days
 Exam days

September 1
September 7
October 9
November 25-27
December 9
December 10-18
December 10, 12, 13, 16
December 11, 14, 15, 17, 18

Tuesday
Monday
Friday
Wednesday-Friday
Wednesday

SPRING 1999

Martin Luther King holiday
Classes begin
President's Day holiday
Town Meeting recess
Spring recess
Honors Day
Classes end
Reading and exam period
 Reading days
 Exam days
Hooding Ceremony
Commencement

January 18
January 20
February 15
March 2
March 15-19
April 23
May 5
May 6-14
May 6, 8, 9, 12
May 7, 10, 11, 13, 14
May 21
May 23

Monday
Wednesday
Monday
Tuesday
Monday-Friday
Friday
Wednesday

Friday
Sunday

FALL 1999

Classes begin
Labor Day holiday
Fall recess
Thanksgiving recess
Classes end
Reading and exam period
 Reading days
 Exam days

August 30
September 6
October 15
November 24-26
December 8
December 9-17
December 9, 11-12, 15
December 10, 13-14, 16-17

Monday
Monday
Friday
Wednesday-Friday
Wednesday

SPRING 2000

Martin Luther King holiday
Classes begin
President's Day holiday
Town Meeting recess
Spring recess
Honors Day
Classes end
Reading and exam period
 Reading days
 Exam days
Hooding Ceremony
Commencement

January 17
January 18
February 21
March 7
March 20-24
April 14
May 3
May 4-12
May 4, 6-7, 10
May 5, 8-9, 11-12
May 20
May 22

Monday
Tuesday
Monday
Tuesday
Monday-Friday
Friday
Wednesday

Friday
Sunday

FALL 2000

Classes begin
Labor Day holiday
Fall recess
Thanksgiving recess
Classes end
Reading and exam period
 Reading days
 Exam days

August 28
September 4
October 13
November 22-24
December 6
December 7-15
December 7, 9-10, 13
December 8, 11-12, 14-15

Monday
Monday
Friday
Wednesday-Friday
Wednesday

SPRING 2001

Martin Luther King holiday
Classes begin
President's Day holiday
Town Meeting recess
Spring recess
Honors Day
Classes end
Reading and exam period
 Reading days
 Exam days
Hooding Ceremony
Commencement

January 15
January 18
February 19
March 6
March 19-23
April 20
May 2
May 3-11
May 3, 5-6, 9
May 4, 7-8, 10-11
May 18
May 20

Monday
Tuesday
Monday
Tuesday
Monday-Friday
Friday
Wednesday

Friday
Sunday



The University of Vermont

THE UNIVERSITY OF VERMONT AND BURLINGTON COMMUNITY

The University of Vermont 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 postrevolutionary generation. The University was the fifth New England college chartered (after Harvard, Yale, Dartmouth, and Brown), the second established by a state to grant the bachelor's degree, and the twentieth in the nation to do so.

The University pioneered in yet another area of society, that of giving women equal status with men in higher education, by becoming the first institution in the country to admit women to full membership in the scholarly society, Phi Beta Kappa.

Though it has enjoyed a long tradition of substantial private support, University development has been identified closely 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. The same Vermont General Assembly established that the bylaws 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 to go on public record as supporting freedom of religion upon its campus.

The University of Vermont consists of the Colleges of Agriculture and Life Sciences, Arts and Sciences, Engineering and Mathematics, Education and Social Services, Medicine, and the Graduate College; the Schools of Allied Health Sciences, Business Administration, Natural Resources, and Nursing; and Continuing Education.

With a population of about 39,000, Burlington is Vermont's largest city. The greater Burlington area of approximately 132,000 inhabitants is divided between pleasant suburbs and picturesque farms 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 major airlines, buses, and Amtrak, and is contiguous to Vermont's interstate highway system.

THE GRADUATE COLLEGE

The Graduate College of The University of Vermont is responsible for all advanced degree programs except the program leading to the degree of Doctor of Medicine. The Mission Statement for the Graduate College is as follows: The mission of the Graduate College is to provide the environment for high quality graduate education by stimulating and supporting the intellectual and professional development of a diverse faculty and student body; by promoting interdisciplinary and innovative forms of scholarship, research, and curricula; and by recognizing scholarly excellence.

Although the Graduate College was established formally in 1952, the University recognized early the value of graduate education, awarding its first master's degree in 1807. Today, the Graduate College offers 72 different master's programs of study and 20 doctoral programs. During the 1997-98 academic year, 346 master's and 59 doctoral degrees were awarded. The College enrolls approximately 1,200 students, with about 350 of these pursuing the doctorate.

The combination of sound library holdings, laboratories, and computer facilities, along with the engaging size of the University, affords a unique opportunity to pursue high quality graduate programs in a challenging yet personable environment.

A variety of scholarships, fellowships, assistantships, and loan programs are available in limited numbers to students with solid and sustained records of academic performance.

The Graduate College is served by an Executive Committee comprised of ten faculty and a graduate student member. The Executive Committee works closely with the Dean of the Graduate College to insure comprehensive and outstanding programs of study.

UNIVERSITY SCHOLARS

The University Scholar Awards program was established by the Graduate College to recognize outstanding and sustained contributions of University faculty to research and scholarship in their disciplines. Each year, four faculty members are selected for this award. For the academic year 1998-99, the University Scholars are Daniel Gade (Geography), Martin Krag (Orthopaedics and Rehabilitation), William Lakin (Mathematics), and Robert Manning (Natural Resources).



For the academic year 1997-98, the University Scholars were: Charles Colbourn (Computer Science), Stephen Higgins (Psychiatry and Psychology), Frank Manchel (English), and Susan Wallace (Microbiology and Molecular Genetics).

GRADUATE FACULTY TEACHING AWARD

The Graduate Faculty Teaching Award, given to one member of the Graduate Faculty each year, recognizes excellence in the teaching and mentoring of graduate students. The most recent recipient of this award is Professor Carol Green-Hernandez, Nursing, 1996-97.

GRADUATE TEACHING FELLOW AWARD

Each year, a number of graduate students who serve as Graduate Teaching Fellows are recognized for their teaching excellence; one of those is named Graduate Teaching Fellow of the Year. The two most recent recipients of the Graduate Teaching Fellow of the Year Award are Jennifer Connor, Psychology, 1998, and Stephanie Jennings, Plant and Soil Science, 1997.

RESOURCES FOR RESEARCH AND SCHOLARSHIP, AND CULTURAL ACTIVITIES

The University Libraries. Located in the Bailey/Howe Library, the main unit of the University libraries, are the services and print and electronic collections relating to the humanities, social sciences, and many of the sciences. This library holds the largest book and map collection in Vermont, and maintains a representative collection of major periodicals, scholarly journals, indexes, and abstracting services. It is a depository for United States and Canadian government publications and for U.S. patents and trademarks. The Special Collections Department includes the Wilbur Collection of Vermontiana, rare books, literary and historical manuscripts, and the papers of many individuals associated with the state and the federal government. A separate Chemistry and Physics Library is located in the Cook Physical Sciences Building. Collections in medicine and the health sciences are located in the Dana Medical Library. Materials in the Libraries' collections are accessible through the online catalog, LUIS. A wide choice of electronic resources are made available through the Libraries' information gateway, Sage. Sage provides access, in a fully integrated way, to LUIS, full text magazines and newspapers, a wide variety of indexes, a number of specialized reference works, and the World Wide Web. Sage is reached from workstations

in the libraries, from residence rooms, and from locations off campus. Audiovisual materials are located in the Media Resources Department of the Bailey/Howe Library and in the Dana Medical Library. The Library Research Annex (located directly east of the corner of East Avenue and Carrigan Drive) contains many older and less used monographs, serials, periodicals, and government documents from the Libraries. It also houses the UVM archives; many large, modern manuscript collections; and other older and rare printed materials from the Special Collections Department. It has public hours and a delivery service.

COMPUTING AND INFORMATION TECHNOLOGY

Computing and information technology plays a vital role in supporting the instructional, research, and service needs of the University. In addition to the discipline-specific computing facilities available in UVM colleges and schools, the Division of Computing and Information Technology (CIT) supports essential information technology infrastructure for all UVM students, faculty, and staff. CIT support includes the following:

- Full Internet access, including electronic mail (e-mail) and access to the World Wide Web (WWW). The UVM network is available throughout the campus, including on-campus residence hall rooms. E-mail and the Web are increasingly being incorporated into instruction and research. Students can register for courses by telephone and via the World Wide Web. UVM is also a member of the Internet 2 Consortium.

- Microcomputing areas equipped with Macintosh, Windows, and X-Windows (Unix) workstations. These areas are staffed by helpful consultants and include software for word processing, spreadsheets, statistics, scientific visualization, design, and a powerful geographic information system. All areas are networked, allowing access to UVM's host systems as well as to national and international resources available through the Internet.

- A variety of host systems, centered on a cluster of systems running the IBM AIX (UNIX) operating system. This cluster serves academic and research computing needs. Other systems, including IBM AIX (UNIX), DEC VAX/VMS, and IBM VM/CMS hosts, primarily support administrative functions.

- A modern digital telephone system providing low-cost long distance and including voice mail for all on-campus students, faculty, and staff.

- An Academic Resource Facility (the ARF) with high-end Macintosh, Intel, and Unix workstations, flatbed and slide scanners, CD-ROMs, CD recorders, digital video editing suite, and other specialized hardware for exploring, testing, and developing computing, visualization, and multimedia applications.

- Sales and service for Macintosh and Windows personal computers from major vendors. The UVM Microcomputer Depot preconfigures systems for the UVM network and sells them at competitive educational prices.

- Free publications, workshops, tutorials, consulting support, and a help line. CIT maintains an active role promoting and supporting information technology on campus.

Many other parts of the University provide specialized computing resources designed to meet the needs of specific programs. These include facilities provided by the Colleges of Engineering and Mathematics, Education and Social Services, Medicine, Arts and Sciences, and Agriculture and Life Sciences, the Schools of Business Administration, Natural Resources, and Nursing, the Language Laboratory, and Libraries and Media Services. In addition, Continuing Education provides teleclassrooms and a Digital Media Development Laboratory. Residential Life provides networking and computer labs in the residence halls.

See CIT's World Wide Web page at cit.uvm.edu or contact CIT by sending e-mail to cit@uvm.edu.

GRADNET. GRADNET is the electronic forum where graduate students, faculty, and staff discuss issues, research topics, graduate student life, and announcements that pertain to the graduate community. Information on subscribing is provided at Graduate Student Orientation or at the Graduate College.

The Robert Hull Fleming Museum. The Robert Hull Fleming Museum houses comprehensive collections representing artistic achievements of world cultures, prehistoric to contemporary. Through the exhibition and interpretation of works of art, anthropological artifacts, and other cultural objects, the Museum serves as a center for the visual arts and provides opportunities for multicultural and interdisciplinary education for the University and the people of Vermont.

Exhibitions are frequently augmented by lectures, gallery talks, and films. The Museum also houses class and seminar rooms for art history, anthropology, and other courses.

Sponsored and Institutional Research. The University received over \$40 million exclusively for sponsored research funding during fiscal year 1997 (ranks nationally as one of the 100 leading universities in terms of federal sponsored research support). In addition, there are a substantial number of faculty research projects supported, in part, by institutional research committees. Graduate students frequently serve as integral parts of faculty research projects in a wide range of disciplines.

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

The Vermont Seminars. The Vermont Seminars program augments the focus of teaching and research at the University and enriches educational offerings by bringing to campus individuals from a variety of walks of life, including faculty, statespersons, distinguished citizens, and leaders in special fields.

The George Bishop Lane Artists' Series. The University of Vermont Lane Series features a diverse season of performing arts events including classical music, early music, opera, theatre, jazz, and folk music. Each year brings a variety of artists — from established international favorites to promising new talent. The Lane Series, established in 1955 with a generous gift from the Lane family, enjoys an international reputation as a presenter of chamber and classical music.

Serving as a link among many constituencies, the Lane Series finds its audience, volunteers and advisors from the students, faculty, staff and alumni of UVM as well as the community at large. In addition to the presentation of performances, the Lane Series ensures students and public direct interaction with performers through master classes, workshops, residencies, lectures, and receptions. The Lane Series is committed to a dual mission of cultural presentation and outreach, and education. Through the ARTIX program (funded by Bombardier Capital and the Argosy Foundation) free tickets are provided to over 30 social service agencies to insure arts access to all audiences. Also offered is a \$5 student rush ticket to every performance.

The Friends of the Lane Series serve as advisors and volunteer many hours of service; corporate and private sponsors throughout the state provide financial support.

Concerts are presented in three venues: The intimate and acoustically superb UVM Recital Hall, the historic Ira Allen Chapel, and the Flynn Theatre in downtown Burlington.

Graduate College Research Day. In the spring each year, the Graduate College recognizes formally the research undertaken by graduate students. A full day is devoted to talks and poster presentations by students from all of the disciplines. The entire University community has the opportunity to see and hear about the high quality research that graduate students conduct.

The Degree Programs of the Graduate College

The Graduate College offers the following degree programs:

MASTER OF ARTS

English	Greek and Latin
French	History
Geography	Psychology
German	

MASTER OF SCIENCE

Agricultural	Forestry
Biochemistry	Geology
Animal Sciences	Historic Preservation
Biochemistry	Materials Science
Biology	Mathematics
Biomedical	Mechanical Engineering
Engineering	Microbiology and
Biomedical Technology	Molecular Genetics
Biostatistics	Molecular Physiology
Botany	and Biophysics
Cell and Molecular	Natural Resource
Biology	Planning
Chemistry	Nursing
Civil and Environ-	Nutrition and Food
mental Engineering	Sciences
Communication	Pathology
Sciences	Pharmacology
Community	Physical Therapy
Development and	Physics
Applied Economics	Plant and Soil Science
Computer Science	Statistics
Counseling	Water Resources
Electrical Engineering	Wildlife and Fisheries
Engineering Physics	Biology

MASTER OF BUSINESS ADMINISTRATION

MASTER OF PUBLIC ADMINISTRATION

MASTER OF SOCIAL WORK

MASTER OF EDUCATION

Curriculum and Instruction
Educational Leadership
Educational Studies
Higher Education and Student Affairs
Administration
Interdisciplinary Major (Self-Designed)
Reading and Language Arts
Special Education

MASTER OF ARTS IN TEACHING

Biology	Geography
Botany	Geology
Chemistry	German
English	Greek and Latin
Family and Consumer	History
Sciences	Mathematics
French	Physics

MASTER OF SCIENCE FOR TEACHERS

Biology (including Botany)
Geology
Mathematics
Physical Sciences (Chemistry and Physics)

MASTER OF EXTENSION EDUCATION

DOCTOR OF EDUCATION

Educational Leadership and Policy Studies

DOCTOR OF PHILOSOPHY

Agricultural	Electrical Engineering
Biochemistry	Materials Science
Anatomy and	Mathematical Sciences
Neurobiology	Mechanical Engineering
Animal Sciences	Microbiology and
Biochemistry	Molecular Genetics
Biology	Molecular Physiology
Botany	and Biophysics
Cell and Molecular	Natural Resources
Biology	Pharmacology
Chemistry	Plant and Soil Science
Civil and Environmental	Psychology
Engineering	

CONCURRENT DEGREE PROGRAMS: M.D./M.S. AND M.D./Ph.D.

Postsophomore students in the Doctor of Medicine program who have been accepted into a Graduate College program are permitted to apply credit from appropriate medical courses in which a letter grade of A, B, or C is earned toward a M.S. or a Ph.D. degree. Such students are enrolled in the Graduate College for one or more years to pursue research and enroll in those courses that normally are not included within their medical program of study. While students are working toward both the M.D. and M.S. or Ph.D., completion of each degree need not occur at the same time.



Policies of the Graduate College

APPLICATION POLICIES, DEADLINES, AND PROCEDURES

Eligibility. To be eligible for admission to any program, applicants must hold a U.S. baccalaureate degree earned prior to the date of first graduate enrollment at The University of Vermont or a degree from a foreign institution judged to be equivalent by the Graduate College. If the degree is from an unaccredited institution, students must submit both general and advanced subject GRE scores. Individual degree programs may have additional requirements as described in the program listings in the back section of this catalogue. A number of departments and programs provide opportunities for selected UVM undergraduates to participate in Accelerated Master's Programs (AMPs). For more information, see page 17.

Applicants are expected to be fluent in English. There is no English as a second language program at the University, although limited instruction is available to enhance speaking fluency in English.

Application and Financial Aid Deadlines

Admission. It is in the applicant's best interest to make sure that application materials are filed well in advance of deadlines. Most programs can accommodate only a limited number of new graduate students each year.

April 1 is the application deadline for fall enrollment in all programs, *except the following:*

Anatomy & Neurobiology	March 1
Botany and Agricultural	
Biochemistry	February 15
Cell and Molecular Biology	March 1
Civil and Environmental	
Engineering	February 1
Communication Sciences	February 1
Counseling	February 1
Curriculum and Instruction	August 1
Educational Leadership	
and Policy Studies	May 1
Educational Leadership	August 1
Educational Studies	August 1
English (Fellowship deadline)	February 15
Field Naturalist	February 15
Geology	February 15
Higher Education and	
Student Affairs	January 1
Historic Preservation	March 1
Interdisciplinary	August 1

Microbiology & Molecular	
Genetics	February 1
Natural Resource Planning	March 1
Natural Resources	March 1
Psychology	January 15
Public Administration	February 1
Reading and Language Art	August 1
Social Work	February 1
Special Education	August 1

Although some programs are willing, on occasion, to review late applications, we urge you to contact specific programs before filing a late application. Some programs accept applications for January admission. Please contact the program of interest regarding its policy on spring admissions.

Financial Aid. *The deadline for all students seeking financial aid in the form of fellowships or assistantships is March 1, or the program application deadline, whichever is earlier.* For information regarding financial assistance consult "Fellowships, Assistantships, Traineeships, Stipends, and Grants," page 28 and "Financial Aid," page 30.

Admission Procedure for Full- or Part-Time Students

Degree Students. Application forms are available from the Graduate Admissions Office, 333 Waterman Building, The University of Vermont, Burlington, VT 05405-0160 and at the Graduate College web site.

Applicants who are **U.S. citizens** must provide the following material. *All but the test scores must be submitted together in one package.*

a. The original and two copies of the completed application form and the statement of purpose.

b. Scores from appropriate standard graduate admission test(s) *taken within five years of the date of application. Test scores are required for any applicant seeking financial aid in the form of fellowships or assistantships.* For additional information, see "Graduate Admission Tests" below and consult the program listings that follow.

c. Two official transcripts from each college or university attended. UVM students must request the Registrar to send their transcripts to the Graduate College Admissions Office.

d. Letters of recommendation from three persons qualified to assess your potential for graduate work. College or university placement files are accepted. Photocopied references are acceptable only with original signatures; facsimile references are not acceptable.

e. Check individual department listing for specific requirements such as a resume, or a paper.

f. A \$25 nonrefundable application fee.

International applicants must provide the following materials. *All but the test scores must be submitted in one package.*

a. The original and two copies of the completed application form and the statement of purpose.

b. Scores from appropriate standard graduate admission test(s) *taken within five years of the date of application. Test scores are required for all applicants seeking financial aid in the form of a fellowship or assistantship.* For additional information, see "Graduate Admission Tests" below.

c. Scores from the Test of English as a Second Language (TOEFL) if your native language is not English or if your formal education has been conducted in a language other than English. A score of at least 550 is required for admission; a minimum score of 600 is required by some departments and for any applicant seeking fellowships or assistantships. Information about the TOEFL examination is available from the Educational Testing Service, Box 6155, Princeton, NJ 08541-6155, U.S.A. Web – <http://www.toefl.org>

d. Two official transcripts from each college or university attended and, if necessary, an English translation of the transcripts.

e. Letters of recommendation from three persons qualified to assess your potential for graduate work. College or university placement files are accepted. Photocopied references are acceptable only with original signatures; facsimile references are not acceptable.

f. A \$25 nonrefundable application fee, in U.S. dollars, by check or money order made payable to The University of Vermont.

g. For purposes of obtaining a visa, the United States Immigration and Naturalization Service requires that all international students submit evidence of independent financial support in the form of a signed statement from a bank or scholarship source.

Application Review Process. As soon as an application is received in the Graduate College Admissions Office, a file is established. Completed files are forwarded to the appropriate program.

Committees in each program review applications thoroughly. The statement of purpose is extremely important, as are test scores and past academic performance. Letters of support are weighed carefully. Programs must also consider external factors, such as the number of spaces they can make available to new applicants.

Recommendations to admit or not admit, to provide financial aid or not, are made by the programs and forwarded to the Graduate College where they are reviewed. Letters of acceptance or denial are sent from the Graduate College. Offers of financial support are made directly by programs.

If you do not hear anything regarding your application after a sufficient amount of time, please call the Graduate College Admissions Office (802-656-2699). Questions about admission to individual programs should be directed to the appropriate program.

All documents received in support of an application, except irreplaceable foreign materials or term paper and essays required by some departments, become the property of the Graduate College and cannot be returned, copied, or transferred.

It is the applicant's responsibility to ensure that all supporting materials for an application are received by the appropriate deadline.

Acceptance and Candidacy for Advanced Degrees. Applicants for the master's degree may be admitted to graduate studies or accepted to candidacy for the degree concurrent with admission. Acceptance to candidacy for the master's degree is granted only to those students who have met fully all undergraduate course prerequisites required for the graduate degree program and all departmental requirements for candidacy (e.g. course work, examinations, professional certification where applicable). The approval of the department and the Dean is required for concurrent admission and acceptance to candidacy.

Candidacy for the doctoral degree requires a full year of graduate study in residence at The University of Vermont. In addition, most programs require satisfactory completion of a qualifying examination. A doctoral student is accepted to candidacy upon the approval of the student's Studies Committee, the department or departments concerned, and the Dean of the Graduate College.

Nondegree Students. Persons who have completed a baccalaureate degree and wish to take courses that do not carry graduate credit or wish to take courses for graduate credit but do not seek a degree, do not need to make formal application to the Graduate College, but may enroll through Continuing Education. For more information, contact Continuing Education, 322 South Prospect Street, Burlington, VT 05405; (802-656-2085); 1-800-639-3210 or email EveningUniversity@uvm.edu.

Nondegree students are limited to a maximum of six course credit hours per semester unless additional enrollment is approved by the Dean of the Graduate College. A nondegree student who has accumulated nine credit hours of graduate course work at the University must seek approval for further enrollment from the Dean of the Graduate College.

GRADUATE ADMISSION TESTS

Information about admission tests is available from most college testing centers or as follows: Graduate Record Examinations, Educational Testing Service, Box 6000, Princeton, NJ 08541-6000 or Graduate Management Admission Test, Educational Testing Service, P.O. Box 6103, Princeton, NJ 08541-6103. The GRE can be taken in computerized or paper versions. Information is also available from the GRE web site, <http://www.gre.org>. Those considering application to a graduate program must remember that it can take four to six weeks for the Graduate College to receive the results of test scores from paper and pencil examinations.

Most graduate programs require applicants to submit graduate admission test scores, such as the GRE (Graduate Record Examination) or the GMAT (Graduate Management Admission Test). Many programs in Education will accept scores on the Miller Analogies Test in lieu of the GRE. *Applicants should consult the listing of the program to which they are applying to determine exactly which test scores are required. Scores must be from tests taken within five years of the date of application. Students who are seeking financial aid in the form of assistantships or fellowships are required to submit*

GRE or GMAT scores from tests taken within five years of the date of application.

ENROLLMENT POLICIES AND PROCEDURES

Health Record. The University requires that all students file a personal health and immunization record with the Center for Health and Wellbeing Student Health/Medical Clinic at the time of first enrollment. Appropriate forms are sent directly to newly enrolled students. They are also available at the Student Health/Medical Clinic, 425 Pearl Street.

Registration. Consult the Academic Calendar printed in the front of this catalogue for registration dates. Students register for courses at the time and in the manner designated by the University Registrar. Course lists are published each semester by the Registrar's Office. Early registration is encouraged for presently enrolled graduate students.

Students should consult with their program advisor before using touch tone telephone or web registration. All charges for the ensuing semester must be paid, or otherwise provided for, before registration is completed.

Graduate Course Levels. Courses which may apply towards a graduate program are generally numbered 200 and above. 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 unless special permission is given by the appropriate department or program. Please consult individual programs for possible exceptions.

Course Loads. Normally, full-time nonfunded graduate students enroll for nine to 12 hours per semester; full-time funded students, six to ten hours. Maximum enrollment is 15 hours per semester, and nine hours summer. Enrollment in excess of the normal full-time course load requires written approval from your advisor and the Dean of the Graduate College.

Auditing Classes. Courses may be taken for audit; however, tuition for the credit hours is charged as usual. *Under no circumstances will graduate credit or a grade be allowed for audited courses.* A student wishing to audit a course must meet minimum levels of performance set by the instructor at the time of registration in order to receive an audit grade on a transcript. *Tuition scholarships funded by the Graduate College do not cover tuition for audited courses.*

Physical Education Classes. 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 any fees for physical education activities.*

Credit by Examination. A student may, under certain circumstances, receive credit for a course by taking an examination. A fee of \$35 per credit is charged for each examination. Any credit earned by examination applies to the total number of credit hours allowed for validation and transfer (See "Transfer of

Credit," page 19). Appropriate forms to initiate the process of credit by examination are available in the Registrar's Office.

Add/Drop. Courses may be added or dropped, using touch tone telephone, the web, or a paper form, only during the first two weeks of classes. Appropriate add/drop forms are available from the Registrar's Office. After the first week of classes an instructor may refuse admission to a course if certain material (such as laboratories) cannot be made up and the loss of this work would seriously affect the quality of the educational experience of the student seeking to enter the course. Faculty are not required to give make-up examinations, papers, or quizzes. No drops are allowed after the second week of classes except in cases where a student is enrolled by administrative error and has not attended the course.

Withdrawal from Courses. Between the end of the second week to the end of the ninth week of classes, withdrawal requires completion of a Course Withdrawal form, available from the Registrar's Office or the University website. Withdrawal forms must include the signatures of the student's advisor and course instructor. The instructor sends the form to the Registrar's Office. The instructor also records the withdrawal grade on the final grade sheet which is sent to the Registrar at the end of the semester.

Between the ninth week and the last day of classes, withdrawal requires students to petition the Dean of the Graduate College explaining that they are unable to continue in the course due to circumstances beyond their control. Such a petition must contain conclusive evidence, properly documented, of the situation which prevents the completion of the course. Acceptable reasons do not include dissatisfaction with performance in a course or with an expected grade, with the course or the instructor, or the desire to change a major or program. If the petition is approved, the withdrawal procedure follows that process described above.

Undergraduate Enrollment for Graduate Credit. UVM senior undergraduates may enroll for graduate credit at UVM under the following circumstances: the course must be available for graduate credit; total enrollment including the graduate course must not exceed 12 credit hours in the semester in which the course is taken; the course must not be computed as part of the bachelor's degree; *permission to seek such graduate credit must be requested of the Dean of the Graduate College in writing by the Dean of the undergraduate college or school prior to enrollment for such credit.* Such graduate credit is limited to six hours. It can be used only at UVM if and when the student is admitted to a UVM graduate program and only if the course is judged appropriate by the student's advisor for the graduate program. Generally, other institutions will not accept such credit, earned before award of the bachelor's degree, in transfer to their graduate programs.

Accelerated Master's Degree Programs (AMPs). It is possible for highly qualified UVM undergraduates to be accepted into some UVM graduate programs prior to the awarding of the baccalaureate degree. This Accelerated Master's Program (AMP) option is

available for admission to UVM graduate programs in Animal and Food Sciences, Biology, Biomedical Technology, Biostatistics, Computer Science, Curriculum and Instruction, History, Materials Science, Mathematics, Mechanical Engineering, Microbiology and Molecular Genetics, Nursing, Professional Education, Public Administration, and Statistics. Please consult the program listing in the UVM undergraduate catalogue and in this *Graduate Catalogue* for details.

Grading Policies. Letter grades are used to indicate levels of performance in courses as follows: A, excellent; B, good; C, fair; F, failure. Designations of S, satisfactory, and U, unsatisfactory, are used to indicate levels of performance for credits received in Thesis or Dissertation Research and may be used to indicate levels of performance in a Seminar. There are no quality points associated with the letter grades of S and U.

A candidate for a graduate degree must complete the program with a minimum overall grade-point average of 3.00. For the purpose of determining a grade-point average, the following applies: A+, 4.00; A, 4.00; A-, 3.67; B+, 3.33; B, 3.00; B-, 2.67; C+, 2.33; C, 2.00; C-, 1.67; F, 0.00. A course may be repeated for credit only when failed and only once; only the second grade is then considered. Both grades remain on the student's transcript.

A student may be dismissed from the Graduate College if two grades or more below a B (3.00), or the designation of U in Thesis or Dissertation Research or Seminar are received.

The designation "Inc" or "I" applies to work of acceptable quality when the full amount is not completed because of illness or emergency. It can be awarded only with the prior permission of the Dean of the Graduate College. The Dean may set the limit of time when the work of the course is to be completed. *In no case shall this time be set longer than the beginning of the corresponding semester of the next academic year.*

The grade of XC (*Extended Course*) is awarded at the end of the semester to a student who is enrolled in an identified course the nature of which makes it unreasonable or impossible for the student to complete the required work within the regular semester.

Students who withdraw from a course after the date prescribed by the Registrar will receive the grade of W – withdrawn. The grade W does not enter into the grade-point average (GPA).

Graduate students may elect to take an undergraduate course on a satisfactory (S) – unsatisfactory (U) basis provided permission is obtained, prior to enrollment, from the department or program chairperson and the Dean of the Graduate College and a letter grade is not required by the Studies Committee for purposes of evaluation. Courses at the 200 level or above other than Seminar or Thesis/Dissertation Research may not be taken on a satisfactory (S) – unsatisfactory (U) basis for graduate credit.

A grade, other than Inc/I or XC, may be changed only if there was an error in its calculation. In cases in which a student requests reconsideration of a grade for a course already taken, the grade change, if any, must be made by the instructor and approved by the Dean by the end of the first month of the following semester unless an extension has

been granted by the Dean within the first month of the following semester.

Dismissal. Students whose academic progress is deemed unsatisfactory at any time may be dismissed from the Graduate College by the Dean upon consultation with the student's department or program. In addition, students may be dismissed if (a) they receive two grades or more below a B (3.00), or (b) they receive a U (Unsatisfactory) in their Thesis or Dissertation Research or Seminar.

CHANGE OF PROGRAM

If a duly admitted student wishes to change to a different program offered at UVM, a request must be made by the student in writing to the Dean of the Graduate College. Upon receipt of the request, the student's file will be forwarded to the Chairperson of the desired program for review. If both the faculty of the desired program and the Dean of the Graduate College approve, the formal transfer of program is made in the Graduate College Office with notification to the former program chairperson, new program chairperson, the student, and the Registrar. The time limit for completion of the degree runs from the date of matriculation in the new program, with credit brought in subject to the appropriate transfer limitation.

CONTINUOUS REGISTRATION

Students who have completed all credits required for the degree but have not completed all graduation requirements must enroll each semester for Continuous Registration (GRAD 900) and pay a \$100 Continuous Registration fee each semester until all degree requirements are completed, including removing incomplete grades; passing the comprehensive examination; or completing a thesis or dissertation.

LEAVE OF ABSENCE

A leave of absence suspends the time limit for degree completion for the duration of the leave. It does not suspend the time limit for the completion of individual courses.

Eligibility. Only students who have not enrolled for all course credit requirements may request a leave of absence. The maximum leave is one year. Students who have enrolled for all required credits but have not completed all degree requirements, such as passing the comprehensive examination or completing a thesis or dissertation, are not eligible for a leave of absence but must register for Continuous Registration.

Procedure. Students request a leave of absence from their program director or chairperson. If the program approves the request, the chairperson or director completes the Leave of Absence form available in the Graduate College Blue Book or from the Graduate College Office and forwards it to the Dean

for approval. A leave of absence does not take effect until after approval has been received from both the program chairperson or director and the Dean of the Graduate College.

Any student who does not enroll following termination of the leave of absence will be deactivated from the Graduate College.

DEACTIVATION AND REACTIVATION

Deactivation is equivalent to withdrawal from a graduate program. Students who do not enroll in their program following the termination of the leave of absence will be deactivated from the Graduate College by the Graduate Dean. Students who, prior to completing enrollment for all credit requirements for a graduate program, do not enroll for one or more credits for a period of one calendar year and are not on an approved leave of absence will be deactivated from the College by the Graduate Dean.

Reactivation into a program requires the approval of the program and the Graduate College. Students seeking reactivation must pay a \$25 Reactivation fee and all other fees, including current and back Continuous Registration fees, if applicable.

WITHDRAWAL FROM DEGREE PROGRAM

Students must notify the Graduate Dean's Office in writing of their intent to withdraw from a degree program. However, if a student does not register at The University of Vermont for course work, thesis or dissertation research, or continuous registration for a period of more than one calendar year, and does not notify the department or the Graduate Dean's Office in writing, the student will be considered to have withdrawn from the degree program. It will be necessary to apply for reactivation and pay a reactivation fee if the student wishes to resume the graduate program.

TRANSFER CREDIT AND CREDIT BY EXAMINATION

A limited number of graduate course credits acquired through transfer, or by credit by examination may be included as part of a student's program of study, with approval of the program faculty and the Dean of the Graduate College. Transfer credits involve courses taken at another institution or The University of Vermont prior to formal admission and approved by the graduate program for inclusion in the student's program of study. Credit by examination is earned by arranging through a program faculty member to take an examination that tests the student's skills and knowledge in a particular UVM course appropriate for inclusion in the student's degree program.

Approval of credit: Approval of credit is granted by the graduate program based on the specific program requirements described in the Graduate College Catalogue, as well as (1) the number of credits

requested, (2) the appropriateness of credit for inclusion in the degree program, and (3) the currency of the credit. These criteria are described below. Any exceptions must be approved by the program faculty and the Dean of the Graduate College.

Number of credits: Master's degree students are allowed a maximum total of nine hours of transfer credit, and/or credit by examination; Doctor of Philosophy students are allowed a maximum total of 24 credits; and Doctor of Education students are allowed no more than nine hours of credit. This means that all Master's students take at least 21 credits at The University of Vermont after admission; Doctor of Philosophy at least 51 credits; and Doctor of Education at least 47 credits after admission. For Master's programs that require more than 40 credits, program faculty may, in individual cases, allow more than nine transfer credits. In all cases, students must take at least one half of their degree credits at The University of Vermont and adhere to all requirements stipulated by the graduate program.

If an applicant is enrolled as a nondegree student in appropriate graduate courses under the advisement of the program during the semester in which the application is approved for admission, up to six hours of credit from that semester may be applied to the degree program. This credit will not reduce the number of transfer credit hours available.

Appropriateness of credit: Transfer credit and credit by examination must be approved by the program faculty as appropriate for inclusion as part of the student's degree requirements. Credit cannot be awarded for (1) courses taken as part of the requirements for an undergraduate degree program, (2) courses that would not receive graduate credit if taken at The University of Vermont, (3) courses with a grade lower than B (3.00), (4) thesis or dissertation research credits received at another institution, and (5) credit by examination given by another institution.

Currency of credit: Transfer credit and credit by examination must be taken within seven years of completion of the master's degree and within nine years of completion of the doctoral degree. Students wishing to apply for readmission to a program after deactivation must demonstrate currency of knowledge in the field of study to which they are applying. Currency of knowledge must be formally evaluated by the program faculty. In addition, the returning student must complete a program of study including at least two courses in the current program.

Concurrent Master's and Doctor of Philosophy Credit

Up to 24 hours of course work for which graduate credit is earned 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 that the credit is 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.

MAXIMUM TIME LIMITS FOR DEGREE COMPLETION

MASTER'S DEGREE

Full-Time Student	3 years
Part-Time Student	5 years

DOCTORAL DEGREE

All students	9 years
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Individual departments may set deadlines within these time limits.

DEGREE REQUIREMENTS

General Requirements for the Master's Degree

In addition to the requirements described below, individual programs may have their own specific requirements. Students should read and familiarize themselves with their program's requirements. Some of them are detailed in this catalogue under individual program listings and other requirements are available from the director or chairperson of each program.

Credit Hours. Most master's degrees require a minimum of 30 hours of credit. Consult individual program descriptions for exceptions. In programs that require a thesis, the number of credit hours earned in thesis research may vary between six (minimum) and 15 (maximum). Thesis credit is included as part of the 30-hour minimum. Consult individual programs for specific information. *With the prior approval of their department and the Graduate College, students may apply one 100/200 level, three-credit undergraduate course towards their graduate program. A student's advisor must petition the Graduate College for approval before the student enrolls in the course.* Consult individual programs for further limitations. Under no circumstances will a course numbered below 100 be applicable to a master's program.

Minimum Residence Requirements. Candidates for the master's degree must satisfactorily complete 21 hours in residence. The residency requirement is completed by courses that (1) are taken for graduate credit through The University of Vermont either in the academic year or summer on the main campus or at off-campus locations, and (2) are taken after the student has been admitted to the Graduate College. Some programs may require more than the above minimum hours in residence. Consult with the individual program.

Comprehensive Examination. *All master's degree students are required to pass a written and/or oral comprehensive examination in their field of specialization. If both formats are used, satisfactory completion of the written examination is prerequisite to standing for the oral examination. All comprehensive examinations are to be taken on The University of Vermont campus in Burlington. One re-examination only is permitted for any comprehensive examination. The comprehensive examination is not the same as an oral thesis defense, and must be passed satisfactorily before defending the*

thesis. Consult individual program descriptions for specific information.

When students plan to take their comprehensive examination they should enroll in GRAD 397: Master's Comprehensive Examination. There is no fee. A grade of "S" or "U" is recorded.

Research and Thesis. Consult the program description to determine whether or not a thesis is required. If a thesis is required, the candidate for the master's degree undertakes a problem of original research under the supervision of a member of the Graduate College Faculty in the department of specialization. At the conclusion of the research, the student must present a thesis which embodies the results of the work and demonstrates the capability for independent research.

Forms. Submit the Defense Committee Membership form and the Defense Notice form to the Graduate College by the designated deadlines. A Public Notice of the defense is required in order to defend. The Intent to Graduate form must be submitted to the candidate's department before the List of Potential Graduates is due.

Thesis Format. Students are required by the Graduate College to use a computer software program appropriate to the discipline to create the Table of Contents and the Lists of Tables and Figures from the thesis text headings. An unformatted thesis will not be accepted by the Graduate College for the Format/Record Check.

A thesis must be prepared and submitted in compliance with the "Guidelines for Writing a Thesis or Dissertation" available from the Graduate College Office. A formatted copy of the thesis must be submitted to the Graduate College for a *Format/Record Check at least three weeks prior to the scheduled defense.* Students must also provide defensible copies of the thesis to members of their Thesis Defense Examination Committee at least two weeks before the scheduled examination. Individual departments may require earlier deadlines.

Students must enroll in GRAD 399: Thesis Defense prior to defending their thesis.

The oral defense of a thesis can be scheduled only after successful completion of the comprehensive examination and the submission of an original copy of the thesis to the Graduate College for a Format/Record Check.

Thesis Defense Examination Committee. The Thesis Defense Committee consists of at least three University of Vermont faculty members, *at least two of whom must be regular members of the Graduate Faculty.* Ordinarily, two committee members will be from the candidate's program, including the thesis advisor. The third member, who acts as *chair of the committee, must be a member of the Graduate Faculty, must be from a different program and department than the candidate, and must be approved by the Graduate Dean upon nomination by the thesis advisor.*

The Chairperson of the Thesis Defense Committee has the responsibility for ensuring proper conduct of the examination, appropriate documentation of the results, and that the signatures of endorsement are added to the acceptance page of the thesis following a successful defense.

The acceptability of the thesis is determined by the Thesis Defense Committee. A grade of "S" or "U" is awarded. If a student's Defense Examination performance is not satisfactory, then only one re-examination is permitted.

After a successful thesis defense, candidates must forward an original and two copies of the corrected thesis to the Graduate College within the time period specified by the Thesis Defense Examination Committee, and/or the Graduate College.

Options within Master of Arts and Master of Science Programs. At least 21 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 credit included in these 21 hours must be earned in courses which have been approved for graduate credit. Students may wish to include in their programs up to nine hours of graduate level courses outside their fields of specialization. These courses must be approved in advance by the student's advisor or studies committee.

Additional Requirements for the Master of Arts in Teaching. The MAT degree is intended for people who are already licensed as secondary school teachers or who will complete teacher licensure requirements before graduation. For already licensed teachers, the program requires a minimum of 30 credit hours of course work; at least 21 hours in the field of specialization and at least six in education. For those seeking teacher licensure, the program requires at least 30 credit hours of education course work and at least 21 hours in the field of specialization. The individual program of study for each MAT student must be approved by their faculty advisor in their field of specialization and their faculty advisor in the Department of Education.

In addition to the comprehensive examination in the field of specialization, students must also take a comprehensive examination in the field of education. Consult specific program listings for additional requirements for this degree program.

Additional Requirement for the Master of Science for Teachers. Applicants for the Master of Science for Teachers must be licensed teachers. Students in a Master of Science for Teachers program may apply more than one three-hour, 100-level course toward their degree. Consult specific department listings for additional requirements and policies related to this degree program.

General Requirements for the Degree of Doctor of Education

Please consult the program description for specific degree requirements.

General Requirements for the Degree of Doctor of Philosophy

In addition to the requirements described below, individual programs may have their own specific requirements. Students should consult and familiarize themselves with their program requirements. Some of them are detailed in this catalogue under individual program listings and other requirements are

available from the director or chairperson of each program.

Credit Hours. The degree of Doctor of Philosophy requires a minimum of 75 credit hours earned in courses and in dissertation research. A minimum of 15 hours in courses used in compilation of the grade-point average must be taken in residence at The University of Vermont. Consult individual programs for additional information. Generally, the first year of each doctoral program consists almost entirely of required courses. *With the prior approval of their department and the Graduate College, students may apply two 100-level, three-credit courses towards their graduate programs. A student's advisor must petition the Graduate College for approval before the student enrolls in the course.* Consult individual programs for further limitations. Under no circumstances will a course numbered below 100 be applicable to a doctoral program.

Minimum Residence Requirements. Candidates for the doctoral degree must satisfactorily complete a minimum of 51 hours in residence. The residency requirement is completed by courses that (1) are taken for graduate credit through The University of Vermont either in the academic year or summer on the main campus or at off-campus locations, and (2) are taken after the student has been admitted to the Graduate College. Some programs may require more than the above minimum hours in residence. Consult with the individual program.

Teaching Requirement. All doctoral candidates must acquire appropriate teaching experience in their chosen fields prior to the award of the degree. The nature and amount of teaching, for which no academic credit is allowed, will be determined by each candidate's program.

Language Requirement. Consult the program listings to determine whether demonstration of competency in one or more foreign languages is required. The requirement is generally fulfilled by an examination administered by the program or in conjunction with the appropriate language department. Enroll for the examination as GRAD 485. There is no fee for taking the exam. The examination is awarded the grade of "S" (Satisfactory) or "U" (Unsatisfactory). It may be taken more than once if a grade of "U" is awarded.

If department policy substitutes competence in computer literacy, the language requirement may be fulfilled either by completing appropriate Computer Science courses with a grade of B (3.00) or better, or by satisfactorily completing an examination composed and graded by the staff of Computing and Information Technologies. Individual programs may set additional requirements.

Studies Committee. It is the responsibility of the Studies Committee to supervise the graduate student's program and to review progress at regular intervals. A Studies Committee consisting of at least three regular members of the Graduate Faculty is appointed by the department chairperson or designated departmental representative and approved by the Dean of the Graduate College as soon as possible following enrollment in the Graduate College, unless

the student's department employs an alternative approved procedure. The Chairperson of the Studies Committee serves as the student's academic advisor and also as the dissertation advisor or supervisor. *Only a regular member of the Graduate Faculty can serve as an advisor of a doctoral dissertation. On occasion, it may be appropriate for a professional other than a regular member of the Graduate Faculty to serve as a member of a Studies Committee. In such cases, written approval must be obtained from the Dean of the Graduate College prior to the student's beginning dissertation research.*

Comprehensive Examination. A written comprehensive examination in the field of study must be passed by the candidate *at least six months before the dissertation is submitted.* The examination must be prepared by the department concerned, in consultation with the candidate's Studies Committee. Only one re-examination is permitted. *Success in the written comprehensive examination is prerequisite to standing for the oral Dissertation Defense Examination.* All examinations are taken on The University of Vermont campus in Burlington. Some programs also require an oral comprehensive examination.

Students must enroll in GRAD 497: Doctoral Comprehensive Examination prior to taking the comprehensive examination. There is no fee. A grade of "S" or "U" is recorded.

Research and Dissertation. Each candidate, while in residence at The University of Vermont, must complete an acceptable original research project which contributes new knowledge or techniques in an academic field. Each candidate must enroll in a minimum of 20 credits of dissertation research. *Only a member of the Graduate Faculty may supervise dissertation research for the Ph.D.*

Forms. Submit the Defense Committee Membership form and the Defense Notice form to the Graduate College by the designated deadlines. A Public Notice of the defense is required in order to defend. The Intent to Graduate form must be submitted to the candidate's department before the List of Potential Graduates is due.

Dissertation Format. Students are required by the Graduate College to use a computer software program appropriate to the discipline to create the Table of Contents and the Lists of Tables and Figures from the dissertation text headings. An unformatted dissertation will not be accepted by the Graduate College for the Format/Record Check.

A dissertation must be prepared and submitted in compliance with the "Guidelines for Writing a Thesis or Dissertation" available from the Graduate College Office and the program. A formatted copy of the dissertation must be submitted to the Graduate College *for a Format/Record Check at least three weeks prior to the scheduled oral defense.* Each student must also provide defensible copies of the dissertation to members of the Dissertation Defense Examination Committee at least two weeks before the scheduled examination. Individual departments may require earlier deadlines.

Students must enroll in GRAD 499: Dissertation Defense prior to defending their thesis.

The oral defense of a dissertation can be scheduled only

after successful completion of the comprehensive examination and the submission of an original copy of the dissertation to the Graduate College for a Format/Record Check.

Dissertation Defense Examination Committee.

Upon receipt of a completed dissertation, the Dean of the Graduate College will appoint a Dissertation Defense Committee based upon nominations submitted by the candidate's advisor. The Dissertation Defense Committee consists of a minimum of four University of Vermont faculty members, *usually all regular members of the Graduate Faculty. At least two Graduate Faculty members must be from inside the department. At least one Graduate Faculty member must be from outside the candidate's department and program. This member will be designated Chairperson by the Graduate Dean upon nomination by the dissertation advisor.* Individual programs may require more than four committee members or have other specific membership requirements.

The Chairperson of the Dissertation Defense Committee has the responsibility for ensuring proper conduct of the examination, appropriate documentation of the results, and that the signatures of endorsement are added to the acceptance page of the dissertation following a successful defense.

The acceptability of the dissertation is determined by the Dissertation Defense Committee. A grade of "S" or "U" is awarded. If a student's Defense Examination performance is not satisfactory, then only one re-examination is permitted.

After a successful dissertation defense, candidates must forward an original and three copies of the corrected dissertation to the Graduate College within the time period specified by the Dissertation Defense Examination Committee and/or the Graduate College.

STUDENT RIGHTS AND RESPONSIBILITIES

Students have the responsibility to familiarize themselves with the policies and procedures of the University, the Graduate College, and their department or program. *Students are primarily responsible for knowing the degree requirements and following the policies which govern their academic program.* If students have concerns or doubts about individual policies and procedures, they may contact their advisor, their program or department chairperson, or the Graduate College Office, which is the ultimate arbiter of policies and procedures.

University policies and those of the Graduate College are contained in *The Cat's Tale* and this catalogue, respectively. Copies of *The Cat's Tale* are available to new graduate students and may also be obtained from the Graduate College and the Office of the Vice President for Student Affairs. In cases of conflict, the *Graduate Catalogue* supersedes academic policies in *The Cat's Tale*.

Advising. Unless a department or program employs an alternative approved procedure, each graduate student will have a faculty advisor to advise on matters of course selection, research direction, and overall guidance from admission to the Gradu-

ate College to completion of degree requirements. The initial advisor is assigned by the Department Chairperson or the Department Coordinator for graduate students prior to or shortly after enrolling in the Graduate College. If an initial advisor is not assigned by either of the above parties within two weeks after the initiation of course work in a given graduate program, the student is encouraged to contact the Graduate College. Many times, one faculty member serves as an initial advisor for several students, and it is not uncommon that the advisor may change as the student's program and research interests become refined and definite.

Another common model, especially in doctoral programs, is a Studies Committee comprised of appropriate faculty who share a student's scholarly and professional interests. The committee meets regularly to discuss the student's progress and consult with the student regarding academic development.

While there are a variety of advising models, in each case students have the right to consult regularly with their academic advisor or studies committee.

Professional Ethics and Academic Honesty. Graduate students are required to adhere to the highest standards of professionalism as students, researchers, and teachers, and the University, in order to encourage a positive atmosphere in all phases of academic learning, teaching and research, created specific guidelines and policies regarding academic honesty. They are outlined in *The Cat's Tale* and are also available from the Office of the Provost.

Sexual Harassment. No member of the University community may sexually harass another. Unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitute sexual harassment when:

a. submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment or education;

b. submission to or rejection of such conduct by an individual is used as the basis for academic or employment decisions affecting that individual; or

c. such conduct has the purpose or effect of substantially interfering with an individual's academic or professional performance or creating an intimidating, hostile, or offensive employment, educational, or living environment.

Any University of Vermont student having a complaint of sexual harassment should notify the Office of Affirmative Action and Equal Opportunity; students may also contact the Vice President for Student Affairs. If a student has personal concerns regarding sexual harassment, confidential counseling can be arranged through the Counseling and Testing Center. Policies and procedures governing complaints of sexual harassment are available in the office of each dean, department head, and chairperson as well as in the Bailey/Howe Library.

Discrimination. The University community will not tolerate discrimination. The Notice of Nondiscrimination, including a statement regarding policies, is published in the front of this catalogue.

Appeals. Students who believe that they have (1) suffered a violation of due process, (2) been subject

to a decision with no rational basis or an abuse of discretion, or (3) suffered a violation of a fundamental right may file a grievance, following procedures outlined in *The Cat's Tale*.

The Graduate College specifically hears all grievances regarding policies and procedures within the province of the Graduate College, or any that affect graduate education. Specifically excluded are grievances that contest grades on grounds other than those enumerated above.

A grievance properly begins within the student's own department by an appeal to a program director or chair. If this does not resolve the grievance, the student can present the grievance in writing to the Dean of the Graduate College. Grievances must state clearly and precisely the basis for appeal and provide supporting evidence that a student's rights have been jeopardized. The Dean may recommend that the grievance be reviewed by the Graduate College Executive Committee. The Dean is the final arbiter of Graduate College regulations. Students retain the right to appeal the Dean's decision to the Provost.

If the grievance does not fall within the province of the Graduate College, consult *The Cat's Tale* regarding University grievance policy and procedures.

Transcripts. An official transcript is the reproduction of a complete, unabridged permanent academic record validated with the University seal, facsimile signature of the Registrar, and date of issue. A Key to Transcript is included. Currently enrolled as well as former graduate students may obtain an official transcript of their permanent academic record by writing the Office of the Registrar, 360 Waterman Building. Please allow a minimum of one week for normal processing and three weeks following the end of a semester. Transcripts are not released when there is an indebtedness to the University.

Access to Records. Students have the right to review any of their educational records maintained by the University. Students also have the right to have all educational records maintained in a confidential manner. In appropriate situations, students may choose to waive some or all of these protections, but such waivers must be clearly stated in writing. If a student believes an educational record contains information which is inaccurate, a hearing may be scheduled to seek appropriate modification. Requests for reviews of records must be made to the Registrar.

Name and Address Exclusion. The Family Educational Rights and Privacy Act of 1974 grants to all University students the right not to have personal information contained in the records of the University released to any individual, agency, or organization. UVM includes the following categories under personal information subject to release:

- | | |
|-------------|---|
| Category I | Name, address, telephone number, dates of attendance; |
| Category II | Class, previous institution(s) attended, major field of study, awards, honors (including dean's list), degree(s) conferred (including dates); |

Category III Past and present participation in officially recognized sports and activities, physical factors (height, weight);

Category IV Date and place of birth.

Students who do not wish to have one or all of the above categories of information released should fill out an information exclusion card at the Registrar's Office.

CONFERRAL OF GRADUATE DEGREES

Degrees are conferred only in October, March, and May of each year. Diplomas are issued only in May.

It is the graduate student's responsibility to make sure that their name has been submitted by their department or program, to the Dean's Office of the Graduate College for Graduation.

Departments with graduate programs must submit a "List of Potential Graduate Students" along with an "Intent to Graduate" form for each student by July 1, December 1, and January 1 for the October, March, and May graduation deadlines.

Educational and Living Expenses

The tuition and fee charges listed here are for 1998-99 only and are subject to change in future years.

Tuition. Rates for the 1998-99 academic year are as follows: For Vermont residents, \$302 per credit hour; for nonresidents of Vermont, \$755 per credit hour.

GRADUATE STUDENT FEES

Application Fee. All applications for admission must be accompanied by a \$25 application fee. This fee is nonrefundable.

Continuous Registration Fee: GRAD 900. A fee of \$100 per semester is charged each graduate student who has enrolled for all credits required in the degree program but who has not completed all degree requirements (e.g. comprehensive examination, thesis defense) in order to maintain continuous enrollment. Students who have not cleared grades of I or XC, but who have enrolled for all required course work must pay this fee.

Comprehensive Fee. Students pay a Comprehensive Fee each semester according to the following schedule: 0-3 (including Continuous Registration), no fee; 4 credits, \$46; 5 credits, \$57; 6 credits, \$58; 7 credits, \$64; 8 credits, \$70; 9-11.5 credits, \$76; 12 or more \$217 (includes health fee).

Student Health Fee. A health fee is included in the full-time Comprehensive Fee. Students enrolled for fewer than 12 credit hours are eligible for University Health Services by paying a health fee of \$135 per semester.

Student Accident and Sickness Insurance. Through an arrangement with a commercial insurance company, students are able to procure health insurance which is designed to provide coverage for services beyond those provided by the Center for Health and Wellbeing. There is an additional charge for this extended coverage beyond the student health fee. The 1998-99 cost for one year's coverage for single students is \$555. Married students may obtain coverage for their spouse and children. Further details are available from the Center for Health and Wellbeing. To participate in this insurance, the student health fee must be paid each semester as well as the additional insurance premium.

Reactivation Fee. Reactivation following withdrawal without an approved leave of absence requires payment of a \$25 reactivation fee.

Advanced Degree Fee. The fee charged to each advanced degree recipient is as follows:

Doctoral Degree	\$25
Master's Degree (with thesis)	20
Master's Degree (without thesis)	10

This fee may be paid at any time but must be paid prior to the deadline established for submission of doctoral dissertations or master's theses for each of the three graduation periods.

It is the responsibility of the degree candidate to pay the appropriate advanced degree fee at the Graduate College Office, 333 Waterman, in order to have a degree awarded.

Housing and Living Expenses. The University offers a variety of housing opportunities. Jeanne Mance Hall at the northwest edge of campus offers dormitory accommodations for graduate students. Each room is furnished with a bed, dresser, wardrobe, and refrigerator. A kitchen and laundry center is located on each floor. Computer and study areas are located on the first floor. The maximum rates for the 1998-99 fall and spring semesters are \$390 per month for a single room. Summer rates are lower. In addition, a limited number of University-owned apartments are available for married and graduate students. The apartments are located at Fort Ethan Allen in Colchester on a bus route five miles from the main campus. For detailed information about either housing option, contact the Ethan Allen Housing Office, 1007 Ethan Allen Avenue, Colchester, VT 05446 (802-654-1735). If considering University housing, contact the Housing Office as soon as possible.

Graduate students may participate in a variety of meal plans from Marriott Food Services and take their meals at a number of locations around campus.

Rents in the Burlington area vary from approximately \$75 per week for a single furnished room to \$600 or more per month for a two-bedroom apartment. A single student should expect minimum overall living expenses of approximately \$850 per month.

Bill Adjustment. A refund of 100 percent will be processed for enrollment reduction effected prior to the end of the second week of classes, a refund of 50 percent will be allowed for reductions during the third and fourth week of classes; a refund of 25% during weeks five through eight; no refund will be processed thereafter. At the end of the semester, an audit will be made of each student's record. If the audit reveals that total credit hour enrollment is greater than at the end of the specified drop period,

the student will be financially liable for the total enrollment. 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. The student will receive a refund in accordance with the bill adjustment policy. 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 bill adjustment schedule.

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

UNIVERSITY RESIDENCY REGULATIONS IN-STATE STATUS REGULATIONS

The Vermont Legislature has established a lower rate of tuition for students who are Vermont residents. These regulations define eligibility requirements for in-state status classification. All students at The University of Vermont and State Agricultural College (UVM) shall be assigned in-state or out-of-state status classification consistent with these regulations. A Vermont domicile must be established for a student to be eligible for in-state status.

In-State Status Classification Rules

1. Domicile shall mean a person's true, fixed, and permanent home. It is the place at which one intends to remain indefinitely and to which one intends to return when absent.
2. As one element of domicile, a student must reside in Vermont continuously for one year prior to the semester for which in-state status is sought.
3. A residence established for the purpose of attending UVM shall not by itself constitute domicile.
4. An applicant becoming a student within one year of first moving to the state shall have created a rebuttable presumption that residency in Vermont is for the purpose of attending UVM and/or acquiring in-state status for tuition purposes.
5. A domicile or residency classification assigned by a public or private authority neither qualifies nor disqualifies a student for UVM in-state status. Such classification may be taken into consideration, however, in determining the student's status at UVM.
6. It shall be presumed that a student who has not reached the age of majority (18) holds the domicile of his/her parents or legal guardian(s).
7. Receipt of financial support by a student from his/her family shall create a rebuttable presumption that the student domicile is with his/her family, regardless of whether the student has reached the age of 18.

8. A student who has not reached the age of 18 whose parents are legally separated or divorced shall be rebuttably presumed to hold the domicile of the parent with legal custody.
9. A student of parents legally separated or divorced may be granted in-state status if a non-custodial or joint custodial parent is domiciled in Vermont and has contributed more than 50 percent of financial support for at least one year prior to the semester for which in-state status is sought.
10. The burden of proof as to eligibility for in-state status rests with the student. Eligibility must be established by clear and convincing evidence.

In-State Status Classification Documentation

11. The student must submit with the application form all relevant information.
12. The classification decision shall be based upon information furnished by the student, information requested of the student, and other relevant information available consistent with University policies and procedures and legal guidelines.
13. Testimony, written documents, affidavits, verifications, and/or other evidence may be requested.
14. The student's failure to produce information requested may adversely affect the decision for in-state status.
15. A student or others furnishing information may request the deletion from documents of irrelevant private data.

In-State Status Classification Appeals

16. The decision of the Residency Officer must be appealed in writing to the Residency Appellate Officer within thirty (30) calendar days of the date of the Residency Officer's written decision. Appeal to the Residency Appellate Officer is the final appeal at UVM.

In-State Status Reclassification

17. A student who does not qualify for in-state status classification may reapply for such classification each subsequent semester.
18. In-state status classification becomes effective the first semester following the date of successful application.

Re-Examination of Classification Status

19. Classification status may be re-examined upon the initiative of the Residency Officer in the exercise of sound discretion. Circumstances such as periodic enrollment may be cause for re-examination.

Adopted by the Board of Trustees, December 14, 1974; amended June 13, 1981, and May 2, 1987. These regulations took effect with the 1987-88 academic year.



Fellowships, Assistantships, Traineeships, Stipends, and Grants

Students who wish to be considered for fellowships as well as admission must submit completed applications, with supporting materials, by *March 1 of the academic year preceding that for which application is made, or the program's application deadline, whichever is earlier.* Any applicant requesting fellowship, assistantship, or traineeship support must submit an official copy of the Graduate Record Examination score report.

Application for fellowships is made by completing the appropriate section on the application form. No separate form is required except where indicated in the descriptions below.

Tuition scholarships accompanying Graduate Teaching, College, Research, and Student Affairs Assistantships do not cover physical education courses and activities, nor do they cover courses numbered below 200, except upon prior approval of the Dean of the Graduate College.

GRADUATE COLLEGE FELLOWSHIPS

The Graduate College offers ten fellowships in support of master's degree programs in the social sciences and humanities. Five fellowships provide a one year stipend (currently \$5,000) and a full tuition scholarship (36-credit hour maximum) for the degree program (one-two years). The remaining five fellowships provide the tuition scholarship only.

The fellowships are open to prospective students in the social sciences and humanities at the time of application. Holders of Graduate College Fellowships are required to carry full-time enrollment towards an advanced degree. The fellowships are not renewable.

GRADUATE TEACHING FELLOWSHIPS AND GRADUATE RESEARCH FELLOWSHIPS

Graduate Teaching Fellowships are awarded by many of the departments offering graduate work. Graduate Teaching Fellows are generally appointed for nine months with stipends averaging \$11,000 for 1998-99. Normally, Teaching Fellows enroll for a minimum of six to a maximum of ten hours per semester. In addition to the stipend, the fellowship award includes a tuition scholarship covering the number of credit hours specified in the award letter, but not to exceed ten credit hours per semester, during the period of the fellowship.

Graduate Research Fellowships are awarded in some of the science departments offering graduate work. Research Fellows may be appointed for nine or 12 months with stipends generally ranging from \$11,000 to \$14,500 and a tuition scholarship (see limits in Teaching Fellowship description). A maximum of half-time assistance in the department is expected of Graduate Teaching and Research Fellows, and fellows must expect that more than one academic year will be necessary to complete the requirements for the master's degree. If a Teaching or Research Fellow is a candidate for the doctoral degree, at least four calendar years must be anticipated for completion of the academic program. Generally, fellows are appointed in the departments in which they are doing graduate work.

Appointments are announced on or about the first week in April.

STUDENT AFFAIRS ASSISTANTSHIPS

Within the Division of Student Affairs, a number of assistantships are made available annually. Each assistantship provides graduate students a professional opportunity to support and develop the Division's goals and activities in its work with students. The candidates selected to fill these positions are assigned administrative and advisory positions in the residence halls, departments within the Division, and in other student services areas. Graduate students who hold Student Affairs Assistantships will gain valuable experience in the areas of group advising, administration, personnel 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. The majority of graduate students are enrolled in the Higher Education and Student Affairs graduate program. Selection is based upon academic record, character, recommendations, and quality of related experiences. A personal interview is required. Requests for applications and additional information should be addressed to the Division of Student Affairs, Nicholson House, 41 South Prospect Street, Burlington, VT 05405-0094. Questions can also be directed via e-mail: stuaaffasn@uvm.edu. Completed applications must be received by January 1 for full consideration. Applications received after January 1 will be considered only for unanticipated openings. Appointments will be announced on or about April 1.

GRADUATE ASSISTANTSHIPS

Graduate Assistantships are generally available when a department member receives a grant from a source external to the University. The appointment may be for either nine or 12 months at a starting salary of about \$16,750 and \$20,500 per appointment period (1998–99). Part of the salary is for tuition at the in-state rate with a maximum enrollment of ten credit hours each semester and nine credit hours during the summer session (12-month appointments).

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 assistantships, contact the chairperson of the department.

GRADUATE TRAINEESHIPS

Graduate Traineeships are available in certain departments through grants from various state and federal agencies. Traineeships are available currently to graduate students enrolled in the following departments or programs: Biochemistry, Biology, Cell and Molecular Biology, Communication Sciences, Pathology, Psychology, and Social Work. These traineeships generally include both a stipend and tuition scholarship.

UVM OPPORTUNITY FELLOWSHIPS

The Graduate Dean's Office administers fellowships to increase campus diversity in graduate programs. These fellowships, which are generally funded at a level equivalent to Graduate Teaching Fellowships, are available to students pursuing advanced degrees in any subject area at UVM. Please indicate interest in these fellowships on the application form.

SUMMER RESEARCH STIPENDS

To promote graduate scholarship and to assist students in completing their programs in a timely and successful manner, the Graduate College provides a limited number of summer research stipends to graduate students. The stipends, awarded competitively, are designed to help students devote the summer to some phase of their dissertation, thesis, or final research project. Details about the stipends are available from the Graduate College Office.

TRAVEL MINI-GRANTS

The Graduate College upon recommendation from the Graduate Student Advisory Committee provides mini-travel grants to help students underwrite the cost of attending conferences where they will present papers or posters of their research. These funds are awarded three times a year on a matching basis with the student's home program or department. Applications for grants are available from the department's copy of the Graduate College Blue Book or from the Graduate College Office. The Blue Book is the Graduate College's Policies and Procedures manual.

OTHER FELLOWSHIPS

A limited number of fellowships established by private donors are available periodically in selected departments.

Financial Aid

The University has several options designed to help graduate students finance their UVM education. In order to ensure that the financial aid application process is understandable and accessible, each applicant is assigned to a "service team" within the Financial Aid Office. Whenever a student has a question about his or her financial aid status, he or she may call upon the members of the service team who will be familiar with the applicant's particular circumstances.

Limited amounts of need-based financial aid are available for students enrolled in the UVM Graduate College. Much of the available aid consists of low interest student loans, repayable after graduation or upon withdrawal from the University. Those students with financial need who do not receive supplemental assistance in the form of assistantships or fellowships may find that their need-based financial assistance is insufficient to meet their entire cost of attendance. It is important, therefore, for graduate students to fully assess their costs and resources before making a final decision about attendance.

The University provides, through the Office of Financial Aid, long-term loans and/or work-study jobs for students based upon demonstrated need remaining after all assistantships, fellowships, traineeships, tuition grants, and any other source of financial assistance are considered.

In order to be considered for financial assistance, an applicant must meet the following requirements:

1. U.S. citizenship (or permanent resident status).
2. At least half-time enrollment.
3. Financial need as determined by federal eligibility requirements.

Application for financial aid should be made as soon after application for admission to the University as possible. In order to apply for aid, graduate students are required to complete the Free Application for Federal Student Aid (FAFSA). *The priority deadline for filing a FAFSA is March 1 of each year.* Applicants may also be asked to provide copies of prior year income tax returns and other supporting documentation. All graduate student applicants for aid must arrange to have Financial Aid Transcripts from institutions previously attended mailed to the UVM Office of Financial Aid. After admission to the University and upon submission of all required documentation, applicants will be notified of financial aid eligibility.

LOAN PROGRAMS

• **FEDERAL DIRECT STAFFORD LOAN PROGRAM.** The Federal Direct Stafford Loan Program is available for needy graduate students. Because The University of Vermont participates in the Federal Direct Loan Program, these loans may be obtained directly from the UVM Office of Financial Aid. Graduate students are eligible to borrow a maximum \$8,500 per year, depending upon the level of their need. A cumulative loan limit of \$65,500 is allowed for a combination of graduate and undergraduate Stafford Loan borrowing. Federal Direct Stafford Loans are interest-free while the student is enrolled at least half-time in a degree program. The interest rate thereafter is variable and repayment begins six months after leaving school or reducing enrollment to less than half-time.

• **UNSUBSIDIZED FEDERAL DIRECT STAFFORD LOAN PROGRAM.** The Unsubsidized Federal Direct Stafford Loan Program provides loan funding up to a maximum of \$10,000 per year, with a cumulative total of \$73,000 (including undergraduate borrowing). Payments on the loan principal may be deferred until after graduation. Repayment of interest (the rate is variable) begins 60 days following receipt of the loan check.

• **PERKINS LOAN PROGRAM.** A very limited number of Perkins Student Loans are available for graduate students and are administered by The University of Vermont. The amount of the loan will depend upon available funds. Perkins Loans are interest-free while the student is enrolled at least half-time in a degree program. The interest rate thereafter is five percent and repayment begins six months after leaving school or reducing enrollment to less than half-time.

JOB PROGRAMS

• **FEDERAL WORK-STUDY PROGRAM.** A limited amount of Federal Work-Study funding is available for needy graduate students. The Federal Work-Study Program provides financial assistance through employment on campus or with certain kinds of off-campus agencies. Students have the opportunity to select jobs in their field of study, interest, and skills.

• The Center for Career Development assists students in locating other part-time job opportunities. Students should contact the Career Development Office, E Building, Living/Learning Complex.

APPLICATION FOR FINANCIAL AID

Application forms are available from the Office of Financial Aid, 330 Waterman Building. Only one application (The Free Application for Federal Student Aid) is needed in order to apply for aid. *The aid application priority date is March 1.* Applications mailed to the Federal Processor after that date will be reviewed according to the date of submission. If additional information is required, the Office of Financial Aid will contact the student. Please note that any tuition grants, fellowships or assistantships are considered a financial aid resource, and must be considered before other University student aid will be awarded.

FINANCIAL AID REFUND POLICY

For students receiving financial aid, change in student status or credit hour load may result in revision or loss of financial aid, depending on the regulations governing the particular aid programs involved.

SATISFACTORY ACADEMIC PROGRESS FOR FINANCIAL AID RECIPIENTS

In order to maintain eligibility for financial aid, matriculated undergraduate and graduate students must progress at a rate that ensures completion of their degree programs within a reasonable time frame. Beginning with the first semester of study in a degree program at The University of Vermont, a federal financial aid recipient is required to accumulate earned hours totaling at least 75 percent of the number of hours attempted. Each student's progress will be measured at the end of each year of attendance to ensure adherence to this standard.

All students must have attained at least a 2.0 overall cumulative grade-point average in order to continue to qualify for assistance.

Any student not meeting the standard described above will be placed on Financial Aid Probationary Status for a one-year period (during which aid eligibility will be maintained). Should the student not meet the required credit standard or cumulative grade-point average standard by the end of that probationary year, the student's eligibility for additional financial aid will be withdrawn until the student has met the required standard.

Students whose aid is withdrawn for not maintaining academic progress according to the standard outlined above may appeal their loss of aid by writing to the Director of Financial Aid. The decision to withhold aid eligibility may be overridden by the Director

and a five member appeals committee in circumstances which warrant special consideration. Such circumstances may include but are not limited to medical emergencies or family crises which resulted in the student's not meeting the stated requirements.

FOR ADDITIONAL INFORMATION

More detailed information about the financial aid opportunities and procedures may be obtained from the UVM Office of Financial Aid located in 330 Waterman Building. Staff may be reached at (802) 656-3156.

The awarding of financial aid is administered in accordance with the University's guidelines on nondiscrimination described in this catalogue.

VETERANS BENEFITS

Students who are eligible to receive educational benefits from the Veterans Administration may obtain advice from the Center for Career Development, E Building, Living/Learning Center, (802) 656-3450.

NEW ENGLAND REGIONAL STUDENT PROGRAM

An opportunity for qualified legal residents of New England states to enroll at reduced rates for some 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 is available in the "Apple Book" and may be examined in the Graduate College Admissions Office or obtained from the New England Board of Higher Education, 45 Temple Place, Boston, MA 02111.

Applicants must indicate clearly, 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. In cases where the program of study is clearly unique or distinctive to the out-of-state institution, the UVM Graduate College Dean's Office will certify directly the applicant's eligibility to apply under the New England Regional Student Program. In cases where an apparently similar program of study is available at both institutions involved, the graduate deans of the two institutions will determine whether regional student status is appropriate.

Support Services for Graduate Students

Graduate Student Advisory Committee. The Graduate Student Advisory Committee (GSAC), comprised of graduate student representatives from various graduate programs, provides a forum for discussion of graduate student issues and assists the Dean and the Executive Committee in matters affecting graduate students. Issues considered by GSAC include academic matters, professional development and student life. GSAC sponsors occasional social events and conducts a mini-grants program to support, in part, expenses associated with student travel for professional purposes.

Center for Cultural Pluralism. The Center coordinates efforts to create a campus culture based on equality, respect for all members of our community, and appreciation of diversity. The Center is a highly visible, tangible symbol of commitment to inclusiveness and multicultural education. It provides a central meeting place for individuals and groups working on diversity issues and facilitates interaction and cooperation among students, faculty, and staff, and with members of the larger Burlington community as well.

Under the direction of the Executive Officer for Cultural Pluralism and Racial Equality, the Center develops policy and strategies for increasing diversity at UVM, including efforts to improve recruitment and retention of students, faculty and staff of color, transformation of the curriculum to include more multicultural perspectives, and creation of a campus climate in which each individual feels safe and valued in the classroom, residence halls, offices, and co-curricular activities. The Center oversees programming of social, cultural, and educational events throughout the year, works with standing committees devoted to various diversity efforts, conducts research, and develops grant proposals for additional funding for diversity initiatives from foundations.

In addition to the Executive Officer and staff, the Center houses the Race and Culture Course, meeting spaces, a classroom, art gallery, resource library, multicultural and religious student organizations, several handicapped-accessible offices available for campus-wide use, and offices for graduate assistants and visiting scholars.

The Center for Cultural Pluralism is located in Allen House on the University Green at the corner of Main Street and South Prospect, (802) 656-8833. Visitors are welcome.

ALANA Student Center. The primary goal of the Center is to help meet the academic, cultural, social, and emotional needs of ALANA (African, Latino/a, Asian, and Native American) students by providing resources and support. The Center offers information and programs to promote a just multiracial campus climate. Several ALANA student groups (Alianza Latina, Asian American Student Union, and New Black Leaders) meet at the Center. The Center has a small computer lab, meeting/study space, kitchen, and television lounge.

The ALANA Student Center is located in Blundell House on Redstone Campus, (802) 656-3819, <http://www.uvm.edu/~multicul>.

Career Services. Career Services staff assist first year students through seniors (and graduate students) from all majors. Whether you need to select a major, develop some career direction, choose a summer job, find an internship, identify a work-study position, prepare a resume, network with alumni, or get hired after graduation — Career Services is there to serve.

Career Services is located at Living/Learning Center, E Building, 656-3450. Email: career@granola.uvm.edu. Hours: Mon., Tues., Thurs., and Fri. 8:00 a.m. to 5:00 p.m.; Wed. 8:00 a.m. to 7:00 p.m.

Counseling Center. The Counseling Center is a campus resource, providing confidential individual and group counseling and outreach programs to students. Many graduate students consult the staff regarding stress, relationships, mental health issues and systems problems.

Center for Health and Wellbeing. The Center for Health and Wellbeing is available to all students (students in the College of Medicine do not use the Medical or Women's Clinics) for primary and preventive health care (including: Medical, Women's and Sports Therapy Clinics; mental health counseling, nutrition counseling, psychiatry, drug and alcohol services, health promotion and education). Most of these services are covered by the health fee (see page 25). Students entering the University are required to furnish the Center with a complete immunization record to include two valid measles (Rubeola) vaccinations and a medical history. A physical exam is not required.

The Burlington area has a large and sophisticated medical community of which the Center for Health and Wellbeing is a part. Students requiring consultations are referred to specialists in the area. When necessary, hospitalization is usually arranged at the

Fletcher Allen Hospital, a teaching hospital located on the edge of the main campus. *Note:* The University Health Center (UHC) is not the UVM Student Health/Medical Clinic (CHWB).

The University also makes available to students an optional health insurance plan that provides hospitalization and some outpatient benefits. Full-time students who do not provide proof of adequate health insurance at the time of registration will be required to purchase the University sponsored plan.

Services for Students with Disabilities. Services and accommodations for students with disabilities are coordinated by three offices: The Office of Specialized Student Services certifies and coordinates services for students with physical disabilities, learning disabilities, and attention deficit disorders; The Counseling Center certifies and coordinates services for students with emotional disabilities; The Center for Health and Wellbeing certifies and coordinates services for students with ongoing medical conditions. Services to equalize opportunities in the classroom and course accommodations are arranged through these offices. Students are encouraged to inform the staff of the appropriate certifying office of any needed services or accommodations at least two weeks in advance of each semester. Current and comprehensive documentation of disability will be required.

The Office of Specialized Student Services, A170 Living/Learning Center, 656-7753, TTY 656-3865.

The Counseling Center, 146 So. Williams St., 656-3340.

Center for Health and Wellbeing, 425 Pearl St., 656-3350.

ADA/504 Compliance, 428 Waterman, 656-8280.

Graduate College Workshops. Each year the Graduate College sponsors a series of workshops designed to support the professional development of graduate students. Examples of topics considered include teaching techniques and student learning, personal writing and evaluating student writing, grant writing, developing web pages, mentoring, ethical conduct of research, and more.

Exercise and Wellness. The University's extensive physical education facilities are available for recreational use 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.

In addition to the physical education facilities, the University has an active Outing Club. There are many opportunities in Vermont for participation on either an organized or informal level in such activities as hiking, camping, sailing, swimming, skiing, running, bicycling, and other outdoor activities.

Courses of Instruction

Course Numbering

Courses numbered 400 or above are limited to candidates for the degrees of Doctor of Education and Doctor of Philosophy; courses numbered 300 to 399 are generally limited to graduate students; courses in this catalogue, numbered 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 and/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 of the Graduate College prior to enrollment. Authorization will be limited to one appropriate course (three credit hours) for a master's program and to two appropriate courses (six credit hours) for a doctoral program. Graduate students may take additional 100-level courses beyond these values, but graduate credit will not be allowed for such courses. Graduate programs designed for the Master of Science for Teachers degree (M.S.T.) are exempted from this rule. Nondegree 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 two such courses may be taken independently for credit.

The form 201-202 indicates that such courses 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 course description that follows.

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.

Graduate Degree Programs and Courses of Instruction

Agricultural Biochemistry (AGBI)

Professors Barrington (Chairperson), Weller; Associate Professor Carrier.

Research programs include identification of proteins in plant parts (D. Weller); and mechanism of biorecognition between host plant and rhizobia (W. Carrier). Members of our faculty participate in the interdisciplinary Cell and Molecular Biology Program (see separate listing in this catalogue).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in biochemistry, chemistry, nutrition, or biology including a year in organic chemistry, with laboratory. Courses in biochemistry, and organic chemistry are strongly recommended. Satisfactory scores on the Graduate Record Examination (general).

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of one year of study and completion of admission requirements.

MINIMUM DEGREE REQUIREMENTS

Agricultural Biochemistry 201, 202, 220, 221, 230, 231, 381-384; thesis research (ten to 15 hours).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Same as admission for Master of Science degree. Physical chemistry, courses in cellular and molecular biology, mathematics, and physics suitable for student's program are recommended.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Completion of a full year of graduate study and residency at The University of Vermont. One year of laboratory courses in molecular or cellular biochemistry; approval of the Student's Studies Committee and the Graduate College Dean.

MINIMUM DEGREE REQUIREMENTS

Biochemistry 301-302; advanced courses in chemistry (six hours); additional course work as determined by Student's Studies Committee; participation in seminar throughout residency; doctoral dissertation research (20 to 35 hours).

COURSES OFFERED

201 General Biochemistry. Broad coverage of biochemistry including principles of analytical biochemistry. *Prerequisite:* Chemistry 42 or 141 or equivalent. Three hours and lab (one hour) as 202. Weller.

202 General Biochemistry Laboratory (0-3). Introduction to techniques and equipment used for the isolation and quantitative analysis of amino acids, proteins, sugars, and enzymes in biological materials. *Prerequisite:* Credit for or concurrent enrollment in 201. One hour.

210 Quantitative Biochemistry. Physical principles of biochemical methods and theory with strong emphasis on problem solving and data analysis. *Prerequisite:* 201. Three hours.

220 Molecular Biology. The structure and biological function of nucleic acids, proteins, and enzymes. Emphasis is on optical, electrophoretic, and ultracentrifugal methods. *Prerequisite:* 201. Three hours and lab (one hour) as 221. Carrier.

221 Molecular Biology Laboratory (0-3). Laboratory practice in protein characterization by disc and SDS-gel electrophoresis and gel isoelectric focusing. DNA separation and

characterization by agarose gel electrophoresis and restriction enzyme digestion. *Prerequisite:* Credit for or concurrent enrollment in 220. One hour. Currier, Weller.

230 Advanced Biochemistry. A study of metabolic cycles emphasizing research methods involving radioisotopes and chromatography. *Prerequisite:* 201 or permission of the instructor. Three hours and lab (one hour) as 231. Currier.

231 Advanced Biochemistry Laboratory (0-3). Laboratory experimentation emphasizing absorption, ion exchange, affinity, and partition chromatography. Introduction to modern GLC and HPLC techniques and enzyme isolation, purification, and characterization. *Prerequisite:* Credit for or concurrent enrollment in 230. One hour. Currier.

250 Plant Biochemistry. The study of specific biochemical principles that are unique to plants concentrating on the biochemistry of plant cell walls, photosynthesis, and secondary metabolites. *Prerequisite:* 201. Two hours. Currier.

295 Special Topics. Lectures, readings, laboratory studies, or field trips. Format and subject matter at the instructor's discretion. Spring, summer, and fall. *Prerequisite:* Departmental permission. Credit to be arranged.

301 Special Problems. *Prerequisite:* Departmental permission. Credit as arranged.

381-384 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 Doctoral Dissertation Research. Credit as arranged.

Anatomy and Neurobiology (ANNB)

Professors Emeritus Wells, Young; Professors Parsons (Chairperson); Associate Professors Cornbrooks, Fiekers, Forehand, Mawe, May, Powers; Assistant Professors Braas, Jaworski, Vizzard; Lecturers E. Cornbrooks, Ezerman, Fonda, Szilva; EM Coordinator Hendricks.

Departmental research activities center around nervous system structure, function and development. Specific areas of interest include: mechanisms regulating neuronal degeneration, regeneration and plasticity; role of extracellular matrix in glial differentiation; development and pattern formation in the autonomic nervous system; organization of somatosensory and autonomic pathways; neurotransmitter and neuropeptide expression and secretion; specific synaptic actions of neuroactive compounds; modification of calcium and other intracellular signaling pathways in excitable cells; and cardiovascular and gastrointestinal functions in normal and diseased states. World Wide Web: <http://salus.uvm.edu/~neuro/annbpg.html>

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Students are admitted to the Ph.D. program only, not to a M.S. program. Ph.D. students may subsequently complete a M.S. degree with the permission of the Department.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of required courses and Research Rotations. Acceptance of a written report and oral presentation on the proposed thesis as approved by the Research and Dissertation Committee.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Thirty credits of courses and research, including Anatomy and Neurobiology 301, 302, 311; comprehensive examination. Additional credits as arranged for laboratory research leading to a dissertation. A grade of B or better must be obtained in any course taken in Anatomy and Neurobiology.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Bachelor's degree; one year of organic chemistry/biochemistry; a year of advanced biology; one course in college physics. Additional courses in calculus, differential equations, statistics, computer science, and physical chemistry are recommended. A deficiency in one prerequisite course can be made up in the summer session before entry into the program. A master's degree is not a prerequisite for the Ph.D. degree. Satisfactory scores on the general (aptitude) Graduate Record Examination.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of required courses and research rotations. Approval of the written and oral portions of the qualifying comprehensive examination.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Anatomy 301, 302, 306, 311, 395 or 396, and 491; Cell and Molecular Biology 301; Physiology and Biophysics 301; Biochemistry 301, 302. Additional elective courses and teaching assignments as arranged with the department; three reading courses; departmental research rotations; dissertation research; credits as required by the Graduate College. Candidacy examination; successful completion of dissertation. A grade of B or better must be obtained in any course taken in Anatomy and Neurobiology.

COURSES OFFERED

Note: Departmental permission is required for all courses.

201 Human Gross Anatomy. Lectures and detailed regional dissections emphasize functional anatomy of major systems (e.g. musculoskeletal, cardiovascular, nervous). *Prerequisite:* Permission. Five hours. Mawe, May.

202 Neuroanatomy. Structural basis of nervous system function, including spinal reflex organization, detailed analysis of sensory and motor systems, clinical examples, human brain dissection. *Prerequisites:* 201 or permission. Three hours. Vizzard.

301 Medical Gross Anatomy. Individualized laboratory instruction, small group conferences, clinically correlated lectures. Basic anatomical information. Emphasis on importance of the relationship between normal human structure and function. Six hours. Ezerman, Fonda, Powers, Szilva.

302 Neuroscience. A correlated presentation of the neuroanatomy and neurophysiology of the mammalian central nervous system. Lectures, demonstrations, laboratory, and clinical correlation workshops. Four hours. Forehand, Jaworski, Parsons.

306 Techniques in Neurobiology. Discussion, demonstration of techniques used to study the nervous system. Experience with light, fluorescence, electron microscopy; microsurgical procedures; electrophysiological stimulating, recording techniques; neuronal tracing techniques. *Prerequisite:* Neuroscience 302. Three hours. Braas, Fiekers.

311 Medical Histology. The course as presented to medi-

cal students. Microscopic study of cells, tissues, and organs emphasizing the correlation of structure and function. Three hours. Cornbrooks, Fiekers.

320 Developmental Neurobiology. Provides fundamental knowledge of cell-to-cell interactions necessary for proper development and organization of the nervous system. Topics include pattern formation, neuronal differentiation, axon guidance, and target interactions. *Prerequisite:* Neuroscience 302 or consent of instructor. Variable credit. Cornbrooks, Forehand, Jaworski. Alternate years.

323 Neurochemistry. Biochemistry of the nervous system. Topics include ion channels, synaptic function, neurotransmitters and neuropeptides, signal transduction, and hormones in brain function. *Prerequisite:* 302 or Cell and Molecular Biology 301 or Biochemistry 301, 302. Variable credit. Braas, May. Alternate years.

325 Advanced Neuroanatomy. Morphology of the nervous system. Lectures and laboratory. Regional approach to anatomy. Units on development, blood supply, autonomic nervous system. Laboratory: brain dissection, microscopic examination (brain stem). *Prerequisite:* Neuroscience 302. Three hours. Staff. Alternate years.

342 Special Dissections in Gross Anatomy. A detailed and independent study of a single anatomical region, utilizing gross, microscopic, and embryological materials. *Prerequisite:* 301. Credit as arranged. Fonda, Powers.

351, 352 Techniques in Electron Microscopy. Techniques to produce electron micrographs of biological specimens. Operation of conventional transmission electron microscopes, specimen preparation, interpretation of micrographs. Lecture/demonstration of scanning electron microscopy. *Prerequisite:* Consent of instructor. Credit as arranged. Hendricks.

381, 382 Seminar in Anatomy and Neurobiology. Research presentations and critical review of the literature in various areas of anatomical and neurobiological sciences. One hour.

391 Master's Thesis Research. Credit as arranged.

395, 396 Special Topics in Neuroscience. A supplementary course to the medical neuroscience course (Neuroscience 302) designed for graduate students which will provide more detailed information concerning selected topics in neurobiology. *Prerequisite:* Neuroscience 302. Variable credit. Staff.

491 Doctoral Dissertation Research. Credit as arranged.

Animal Sciences (ASCI)

Professors Bramley (Chairperson), Carew, Foss; Associate Professors Gilmore, Plaut; Assistant Professors Knapp, Mischler, Nichols; Research Professor Pankey; Research Assistant Professor Zavizion; Extension Assistant Professor Glace; Adjunct Professors Ballard, Levine, Sniffen, Sturgis, Thomas, Tuerk.

Research activities in basic and applied science encompass a broad range of interests. The areas of study and research include nutrition; physiology; diseases of cattle affecting quality milk production; dairy foods; chemistry; microbiology; quality control aspects of the food industry.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An acceptable undergraduate major in the animal sciences, chemistry, biology, or a related field. Satisfactory scores on the general (aptitude) Graduate Record Examination must be presented. In some of the animal health areas, a degree of Doctor of Veterinary Medicine may be helpful.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

The applicant must satisfy the requirements of the Graduate College and pass the general qualifying examination administered by the Department of Animal Sciences.

MINIMUM DEGREE REQUIREMENTS

Option A – 30 credit hours of study with a minimum of 15 credit hours in courses in Animal Sciences or related fields and a minimum of 9 credit hours of thesis research. Students are required to attend and participate in Journal Club or Graduate seminar every semester that they are enrolled for credits.

Option B – 30 credit hours of study with 24 credit hours in courses in Animal Sciences or related fields and a minimum of 6 credit hours of literature research. Students are required to attend and participate in Journal Club or Graduate seminar every semester that they are enrolled for credits.

An Accelerated Master's Program (AMP) is available for students majoring in Animal Sciences or Biological Sciences. Further details can be obtained from the Department of Animal Sciences, 102 Terrill Hall, (802) 656-2070.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory scores on the general (aptitude) Graduate Record Examination must be presented.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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 Sciences believes each graduate program has its individual needs and must be arranged accordingly. The candidate must meet all the 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 dissertation 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.

212 Animal Genetics and Breeding. Principles of quantitative and statistical genetics studied in relation to animal breeding. Methods of selection and schemes of mating discussed. *Prerequisites:* Statistics and biology or permission. Four hours. Gilmore.

213, 214 Dairy Herd Management. Organization and operation of dairy enterprises. Theories and methods of application of feeding, breeding, and management programs and principles. *Prerequisites:* 110 or equivalent. Four hours. Gibson.

215 Physiology of Reproduction and Lactation. Fundamental principles of the physiology of reproduction and lactation with emphasis on, but not limited to, farm animals. *Prerequisite:* 120 or permission. Four hours. Plaut. Alternate years.

216 Endocrinology. Physiology of endocrine and autocrine/paracrine systems and growth factors. *Prerequisites:* Course in both biology and physiology; one course in anatomy desirable. Concurrent enrollment in 217 required. Three hours. Plaut. Alternate years.

217 Endocrinology Laboratory. Laboratory techniques used in endocrine research. *Prerequisites:* Corequisite 216 and permission. One hour.

220 Lactation and Milking. The history and development of machine milking and dairy herd automation. Material to be covered includes mammary anatomy, physiology and immunology as well as methods of collection and storage of milk of good hygienic quality. *Prerequisites:* 134/135, 141 or 142 or permission. A chemistry course, preferably Agricultural Biochemistry 201. Three hours. Bramley.

230 Agricultural Policy and Ethics. Examines American agriculture and policies from various perspectives — historical, political, ecological, technological, social, economics, and ethical. Emphasis on contemporary issues, policy options, future developments. *Prerequisites:* Junior standing or permission. Three hours. Rogers.

282 Animal Sciences Graduate Seminar. Reports and discussions of problems and special investigations in selected fields. One to three hours. Pankey.

297, 298 Special Problems in Animal Sciences. Research activity under direction of a faculty member whose approval has been given. Written proposal and report are required. *Prerequisite:* Permission. May enroll more than once for maximum of six hours. Coordinator.

391 Master's Thesis Research. Credit as arranged.

392 Independent Literature Research. Reading and literature research culminating in a paper on a topic of current interest in Animal Sciences. *Prerequisites:* Permission. Variable hours — 6 required for M.S. Bramley.

491 Doctoral Dissertation Research. Credit as arranged.

Anthropology (See page 106.)

Art (See page 106.)

Biochemistry (BIOC)

Professors Chiu, Collen, Cutroneo, Hart, Long, Mann (Chairperson), Sobel, J. Thanassi, P. Tracy, R. Tracy, Woodworth (Emeritus); Associate Professors Francklyn, Morrical; Adjunct Associate Professors Church, Crabb; Assistant Professors Berger, Lyons; Research Associate Professors Butenas, Mason, N. Thanassi.

Current research programs include protein structural dynamics during muscle contraction (Berger); synthesis of coagulation enzyme inhibitors (Butenas); regulation of gene expression in developing and neoplastic tissues (J-F. Chiu); physiology and biochemistry of thrombosis (D. Collen); molecular biology of visual cycle proteins (J. Crabb); regulation of procollagen synthesis (K. Cutroneo); protein-nucleic acid recognition (C. Francklyn); environmental, nutritional, and hormonal modulators of pulmonary defense mechanisms (B. Hart); molecular biology, cloning and expression of blood coagulation proteins; site-specific mutagenesis (G. Long); protein structure by multi-dimensional high field NMR techniques (B. Lyons); macromolecular assembly in blood coagulation and bone formation (K. Mann); transport of iron into cells by receptor mediated iron-binding proteins (A. Mason); enzymology of protein and nucleic acid processing and breakdown (W. Meyer); enzymology of DNA replication, recombina-

tion and repair (S. Morrical); thrombosis, thrombolysis, and coronary artery disease (B. Sobel); collagen gene expression (N. Thanassi); cellular interactions with coagulation proteins (P. Tracy); determination of thrombosis related cardiovascular disease risk factors (R. Tracy); nature of the binding of metals to proteins, particularly the iron-binding proteins of blood plasma (R. Woodworth).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE OR FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory score on the Graduate Record Examination including the subject (advanced) portion. In addition:

Year courses in organic chemistry, physical chemistry, and physics (equivalent to Chemistry 141, 142 or 143; 144, Chemistry 162 and Physics 15, 16); quantitative chemistry; mathematics through differential and integral calculus, a year course in a biological science.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE OR FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Under most circumstances, meeting the requirements for admission as stated above will allow advancement to either degree program.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Thirty credit hours, 16 of which must be taken from graduate courses offered by the Department of Biochemistry, including Biochemistry 301, 302, 303, 381, and 391 or 392.

Thesis Option

Up to 14 credit hours of Master's Thesis Research (391).

Nonthesis Option

Up to eight credit hours of Independent Literature Research (392).

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

A total of 75 hours, including 20 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; three hours from graduate courses offered by the Department of Chemistry; ten additional hours from courses in physical or biological sciences; 30 hours of Doctoral Dissertation Research.

COURSES OFFERED

Biochemistry 212, 213, 301-302, 303, 305-306, and 381 are offered annually. Advanced courses are given in alternate years.

212 Biochemistry of Human Disease. Disorders of hemoglobin, iron bilirubin; biochemistry of diabetes, pancreatitis, atherosclerosis, liver and kidney dysfunction; acid-base balance; gene therapy; diagnostic enzymology. *Prerequisites:* Chemistry 42 or 141, Agricultural Biochemistry 201 or permission. Three hours per semester. Hart.

213 Biomedical Biochemistry Laboratory. Introduction to basic principles underlying biochemical analysis in areas of biomedical interest. *Prerequisites:* Concurrent registration in Biochemistry 212 or permission. One hour per semester.

301, 302 General Biochemistry, Parts I and II. Survey for science majors. Part I (301): chemistry, structure, metabolism, and function of proteins, carbohydrates, lipids; en-

zymes, bioenergetics and respiratory processes. Part II (302): amino acids, nucleic acids, protein synthesis, cellular and physiological control mechanisms. *Prerequisites:* Chemistry 141, 142 or 143, 144, and departmental permission. Three hours per semester.

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 departmental permission. One to four hours. Long.

305-306 Medical Biochemistry. A survey course in human biochemistry, with particular emphasis on medical applications. *Prerequisites:* For medical students only. If taken as M.D./Ph.D. student – Six credits. P. Tracy.

307, 308 Special Topics in Biochemistry. Areas of biochemistry not treated in concurrent advanced course offerings. *Prerequisites:* 301, 302 or 305-306; Chemistry 162. One to three hours per semester.

320 General Enzymology. General consideration of enzyme nomenclature, purification, assay, kinetics, mechanisms, cofactors, active sites, subunit structure, allosteric and regulatory properties, and control of multienzyme systems. *Prerequisites:* 301, 302, or 305-306; Chemistry 162. Three hours.

331 Nucleic Acids. The study of structure, composition, organization, function, synthesis, and metabolism of nucleic acids and nucleoprotein particles and matrices in eukaryotic organisms. *Prerequisites:* 301-302, 305-306. Three hours. Morrical.

371 Physical Biochemistry. Protein interaction, solubility and fractionation, electrophoresis, sedimentation, phase rule study, diffusion, viscosity, spectrophotometry, and related topics. *Prerequisites:* 301, 302 or 306; Chemistry 160 or 162. Three hours.

375 Cancer Biology. Overview of cancer biology for health science students. Foundation for cancer research. Lecture format; interdisciplinary viewpoint; outside lectures. *Prerequisites:* 301-302 or 305-306; under special circumstances, 212. Three hours per semester. Chiu.

381 Seminar. A review of recent developments and current literature in the various fields of biochemistry. *Prerequisite:* Departmental permission. One hour per semester.

391 Master's Thesis Research. Credit as arranged.

392 Independent Literature Research. Reading and literature research culminating in a paper on a topic of current interest in biochemistry. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Biology (BIOL)

Professors Bell, Heinrich, Schall, Van Houten (Chairperson); Associate Professors Davison, Goodnight, Gotelli, Kilpatrick, Landesman, Stevens, Vigoreaux; Assistant Professors Brody, Conn, Murakami, Schneider; Adjunct Professor Herbers; Adjunct Assistant Professors Hayashi, Jaken, Ondarza, Serrero, Stevens.

Faculty research interests fall into two broad groupings, developmental biology/cell and molecular biology/physiology; and ecology/evolution/natural history. Current ongoing research projects include: A) taxonomy and natural history of insects, particularly Rhysodid beetles; parasite-host ecology, ecology and evolution of plant-animal interactions; population and community ecology of lizards; evolution of insect societies, behavioral ecology; population genetics and molecular systematics in organisms as diverse as Himalayan rodents, Polynesian black flies and neotropical mosquitoes; genetic

differentiation and evolution in structured populations; population genetics, cytoplasmically inherited reproductive incompatibility, evolutionary consequences of parasite-host interactions; physiological energetics of insects; B) molecular biology of receptors, signal transduction and development; identification of novel muscle proteins by means of biochemical and genetic approaches, how molecular interactions define mechanical properties of muscles; genetics of chemoreception and chemotactic behavior of protozoa; electrophysiological basis of signal transduction; analysis of G protein signaling in *Drosophila* using genetic, molecular and immunohistochemical approaches.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in Biology or its equivalent. Satisfactory scores on the Graduate Record Examination, general (aptitude) section. Acceptability to the faculty member with whom the candidate wishes to do thesis research.

ACCELERATED MASTER'S PROGRAM IN BIOLOGY

A master's degree in Biology can be earned in a shortened time by careful planning in the junior and senior years of Biology B.S. majors at UVM. Students should discuss this possibility with the Department Graduate Program Director as soon as they think they might be interested in the program. The M.S. can typically be earned in one additional year. Up to six credits of undergraduate course work taken in the junior and senior year can be counted towards the M.S. degree requirement, including BIOL 202, 203, 205, 208, 209, 212, 217, 219, 223, 225, 238, 246, 254, 255, 263, 264, 265, 267, 270, and 276.

To be eligible for the AMP, a student must be a declared Biology B.S. major and have identified a faculty sponsor. Other requirements include a G.P.A. typically higher than 3.1 overall and 3.3 in biology courses. Following admission, students are required to take at least 3 credit hours of undergraduate research. After graduation with the B.S. degree, students are eligible to become candidates for the M.S. degree. Applications and further information may be obtained from the Department of Biology.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of a qualifying examination.

MINIMUM DEGREE REQUIREMENTS

Biology Graduate Colloquia, four hours; 11 to 18 additional hours in biology and related fields; thesis research (eight to 15 hours). Each candidate must participate in the teaching of at least one undergraduate course.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS IN TEACHING

The department offers a program leading to the degree of Master of Arts in Teaching (see page 20). Satisfactory scores on the Graduate Record Examination, general (aptitude) section, are requirements for acceptance for this degree.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES 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 Examination, general (aptitude) section.

MINIMUM DEGREE REQUIREMENTS FOR THE M.S.T. (BIOLOGY)

Thirty hours of course work to include a selection of courses in the Departments of Botany and Biology 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 where approved by the advisor and the Dean. Appropriate courses in related science departments may be used to complete the required 30 hours. No thesis is required; however, each degree recipient must complete a written and oral examination.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of: college level courses appropriate for science majors including a year of mathematics, a year of physics, organic chemistry, at least one year of biology; the Graduate Record Examination, general (aptitude) section; and acceptability to the faculty member with whom the candidate wishes to do dissertation research. Deficiencies in prerequisites may be made up after entering the program.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

The diagnostic examination prior to registration for the first semester; the comprehensive exam; minimum requirement course work of 30 hours and additional courses as required by the advisor and Studies Committee; at least one academic year of graduate study at The University of Vermont.

MINIMUM DEGREE REQUIREMENTS

Of the 75 credit hours required for the degree, at least 30 hours must be earned in courses suitable for graduate credit and must include six hours of Graduate Colloquia. The selection of courses will be designated for each student by his/her advisor and Studies Committee. At least 20, but not more than 45, credits must be earned in dissertation research. Each candidate must participate in the teaching of at least one undergraduate course.

COURSES OFFERED

Prerequisites for all courses: as listed, or equivalent, or by permission of instructor.

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, Math. 9, or permission. Three hours. Davison.

203 Population Ecology. Analysis of growth, regulation, and interrelations of biological populations in theoretical, laboratory, and natural systems. *Prerequisite:* Biology 102. Three hours. Schall. Alternate years.

205 Advanced Genetics Laboratory. Lecture/discussions alternated with laboratories to provide experiences with genetic techniques. Bench work and data analysis are emphasized. *Prerequisite:* Biology 101. Four hours. Van Houten.

208 Morphology and Evolution of Insects. Interrelationships, fossil history, comparative anatomy of major insect groups. Morphology and way of life of representatives of

important insect orders and classes of arthropods. *Prerequisite:* 104 or Biology 102. Four hours. Bell. Alternate years.

209 Field Zoology. Collection, identification of invertebrates; September field work. Half of student's collection is general, identified to family; half is one or two groups identified to species. *Prerequisite:* 104 or Biology 102. Four hours. Bell.

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. Landesman.

217 Mammalogy. Classification, identification, morphology, evolution, and distribution of mammals. *Prerequisite:* Biology 102. Four 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. Kilpatrick. Alternate years.

223 Developmental Biology. An analysis of the cellular, subcellular, molecular, and genetic mechanisms that operate during oogenesis and embryogenesis in invertebrate and vertebrate organisms. *Prerequisites:* Biology 101, 103. Three hours. Landesman.

225 Physiological Ecology. Processes by which animals cope with moderate, changing, and extreme environments. *Prerequisites:* 104 and Biology 102. Three hours. Heinrich.

238 Winter Ecology. Natural history and winter adaptation of plants and animals of western Maine. Field work during winter break, oral and written reports completed during spring semester. *Prerequisite:* Permission. Three hours. Heinrich.

246 Ecological Parasitology. Parasite-host interactions examined with evolutionary perspective. Topics include the origin of parasites, evolution of virulence, and ecological consequences of parasitism. Laboratory includes original experiments. *Prerequisite:* 102. Four hours. Schall.

254 Population Genetics. The forces that change gene frequencies in populations are examined. Topics include Hardy-Weinberg-Castle equilibrium, selection, mutation, migration, genetic drift, and quantitative genetics. *Prerequisites:* 102; calculus and statistics recommended. Four hours. Stevens.

255 Comparative Reproductive Physiology. Various means by which animals reproduce. Special emphasis on the embryological origin and evolutionary relationships of sex cell differentiation. *Prerequisites:* 104; permission. Three hours. Davison.

263 Genetics of Cell Cycle Regulation. Molecular events during the cell cycle; mutants defective in cell cycling; comparison of normal and transformed (cancer) cell cycling. *Prerequisite:* Biology 101 or permission. Three hours. VanHouten. Alternate years.

264 Community Ecology. Theoretical and empirical analyses of community structure. Topics include population growth, metapopulation dynamics, competition, predation, species diversity, niches, disturbance, succession, island biogeography, and conservation biology. *Prerequisites:* Biology 102, at least junior standing. Three hours. Gotelli.

265 Developmental Molecular Genetics. Current topics in developmental genetics explored through lectures and discussions of current literature; emphasis on molecular approaches. *Prerequisite:* Biology 101. Three hours. Van Houten. Alternate years.

267 Molecular Endocrinology. Study of hormone action at the cellular and molecular level. *Prerequisite:* Biology 101. Four hours.

270 Speciation and Phylogeny. Contributions of modern research in such fields as genetics, systematics, distribution, and serology to problems of evolutionary change. *Prerequisite:* Biology 101 (102 recommended). Three hours. Kilpatrick. Alternate years.

281 Seminar. Review and discussion of current zoological research. Attendance required of Biology graduate students. Seniors in zoological research programs are expected to enroll. Without credit.

282 Eco Lunch. Research presentations in ecology and evolutionary biology. *Prerequisite:* Graduate standing. Zero to one hour. Schall.

283 Ecology-Evolution Journal Club. Research presentations and critical review of the current literature. *Prerequisite:* Graduate standing. Zero hours. Goodnight.

284 Cell Lunch. Research presentations in Cell and Molecular Biology. *Prerequisite:* Graduate standing. Zero or one hour. Van Houten.

295, 296 Special Topics.

301 Cell and Molecular Biology. Advanced survey of cell organelles, their composition, origin, and the relationship between their structure and function. Emphasis on recent literature and current controversies. *Prerequisites:* Chemistry 142, graduate standing in biology or permission. *Cross-listing:* CLBI 301. Three hours. Vigoreaux.

302 Specialized Cells and Cell Processes. Current issues and research in the field of plant, invertebrate, mammalian cell, and molecular biology. *Prerequisites:* 301. *Cross-listing:* CLBI 302. Three hours. Schneider.

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.

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 Dissertation Research. Credit as arranged.

Biomedical Engineering (Interdisciplinary)

The program in Biomedical Engineering is interdisciplinary and offers the Master of Science degree. Graduate students obtain the M.S. degree through a program administered cooperatively by the Mechanical Engineering and Electrical Engineering departments. The program is directed jointly by Tony S. Keller (Mechanical Engineering), Richard G. Absher (Computer Science/Electrical Engineering) and Bruce D. Beynnon (Orthopaedics and Rehabilitation).

Participating faculty with strong commitments to biomedical engineering research and education are from the departments of Civil and Environmental Engineering, Electrical Engineering, Mathematics and Statistics, Mechanical Engineering, Molecular Physiology and Biophysics, Orthopaedics and Rehabilitation, Physical Therapy, and Physics. The extensive research facilities of the participating faculty and departments are available to all graduate students enrolled in the program, and the program provides the flexibility necessary for students to gain competence in the area of their choice. Research includes: *Bioinstrumentation, Biomechanics, Biomedical Imaging, Biomedical Systems and Signal Analysis, Clinical Engineering, Implant Design, Rehabilitation Engineering, Simulation, and Biomathematics.*

Students in the program are generally supported by sponsored research projects, participating departments and training grants. Inquiries about current research and funding opportunities should be directed to Laurel Zeno, Vermont Space Grant Consortium, 332B Votey Bldg., Burlington, VT 05405; Phone: (802) 656-1429; Fax: (802) 656-8802. Web server: <http://www.emba.uvm.edu/EM/Engineering/ME/naja/First.html>

Research includes: (Absher) electronics test engineering, speech signal processing, adaptive control systems; (Beynnon) sports medicine, ankle, knee, shoulder and spine biomechanics, low back pain; (Clark) health care technology planning, management and database systems, instruments for research and testing of medical devices; (Fleming) sports medicine, lower and upper extremity ligament and tendon injuries, and biomechanics; (Hamrell) mechanisms of sarcomere function, normal and diseased heart muscle, viral myocarditis; (Haugh) statistical process control and quality improvement, medical and dental biostatistics, orthopaedics & rehabilitation, low back pain, pharmacokinetics, reliability estimation, time series and transfer function analysis; (Hazard) spinal disability risk factors, trunk lifting capacity, low back pain; (Huston) vibrations, wind engineering, aeroelasticity of long span bridges, dynamics of machines, dynamic behavior of the human body, smart structures; (Johnson) sports, shoulder and knee biomechanics, trauma; (Keller) spine mechanics, material and structural properties of biologic tissues, orthopaedic implant biomechanics and design, and skeletal growth and remodeling; (Krag) normal and degenerative disc biomechanics, spinal instrumentation, spinal disorders; (Lakin) applied mathematics, analysis of the intracranial system; (Laible) computational mechanics, biomechanics of flow and transport modeling in biologic materials; (Low) cell and tissue remodeling; (Maughan) molecular biophysics of muscle contraction; (Stokes) biomechanics of spine and spinal deformity; (Warshaw) smooth muscle physiology, including structure/function relationship of molecular muscle motors; (Wu) muscle mechanics, molecular mechanics, ultrasonic bio-sensors, ultrasonic heating and enhanced anti-cancer action.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Students applying for admission to the graduate program must meet the general requirements of admission of The University of Vermont Graduate College. Admission is competitive and students are selected on the basis of their scholastic preparation and intellectual capacity. The following minimum preparation is recommended:

Biology, Chemistry: Two semesters each, or four introductory courses in the following subjects - anatomy, biology, biophysics, chemistry, physiology.

Engineering: Two introductory courses in one or more of the following subjects - biomechanics, mechanics, thermodynamics, electrical engineering, control theory, or fluid mechanics.

Mathematics: One course past differential equations.

Physics: Two semesters of physics.

Special arrangements may be made, on an individual basis, for students who are highly prepared in one area, but less well prepared in another.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Completion of any deficient admission requirements.

MINIMUM DEGREE REQUIREMENTS

Candidates for the degree of Master of Science must complete 30 graduate credit hours of an approved program of study, including 18-24 semester credits of graduate-level courses approved by the program faculty and distributed as follows: Physiology and Biophysics (eight credits); engineering subspecialty (electrical, civil, or mechanical engineering), seven-11 credits; physics, mathematics or engineering elective, three credits. In addition, the candidate must present a research thesis (six-12 credits) and pass a final oral examination. Most candidates complete a six-seven credit thesis.

Biomedical Technology (BMT)

Associate Professors Huot (Director), Reed, Sullivan; Assistant Professor Chen.

The Department of Biomedical Technologies offers a Master of Science degree providing in-depth preparation in the biomedical sciences. It is an appropriate course of study for professionals interested in advanced clinical practice, research and development, education or the pursuit of further graduate opportunities.

Opportunities for research include: regulation of cell growth, infectious diseases, quality control, coagulation enzymology, platelet immunology, and clinical projects in Medical Laboratory Science, Nuclear Medicine Technology and Radiation Therapy offered in conjunction with various basic science and clinical departments in the College of Medicine and the Fletcher Allen Health Care.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Completion of an accredited baccalaureate program in Biomedical Technology, medical laboratory science, nuclear medicine technology, radiation therapy or related fields, and national certification or equivalent in one of these areas. A minimum of one year's pertinent professional experience is preferred. GRE aptitude score is required.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of a two semester, graduate-level course in Biochemistry (equivalent to Biochemistry 301-302) and the comprehensive examination.

MINIMUM DEGREE REQUIREMENTS

Thirty credits total consisting of at least the following: Biomedical Technology 381 (two credits), thesis research (six credits), biochemistry lecture (six credits), plus other approved graduate courses. A non-credit teaching practicum in the Department's undergraduate programs is required.

ACCELERATED MASTERS PROGRAM IN BIOMEDICAL TECHNOLOGY

A master's degree in Biomedical Technology can be earned in a shortened time by careful planning in the junior and senior years at UVM. Students should discuss this possibility with the Department Graduate Program Director as soon as they think they might be interested in this program. For example, the M.S. could be earned in one additional year, as six credits of undergraduate courses may also be counted concurrently towards the M.S. degree requirements.

To be eligible for the AMP a student must be a declared major in one of the Department's program offerings. After application for admission to the Graduate College is accepted, up to six approved credits on concurrent undergraduate/graduate credit basis are taken. Eligible courses

include BMT 242, 244, 281, 293 and a maximum of 2 credits selected from BMT 229, 239, 249, 259 and 269. Other admission requirements are a minimum G.P.A. of 2.67 in the basic science core (CHEM 23 or 31 & 32, CHEM 42 or 141 & 142, ANPS 19 & 20 or BIOL 1 & 2, MATH 19 or higher); and an overall G.P.A. of 3.0 or higher. Following admission, students are required to take at least 3 credit hours of undergraduate research. After graduation with the B.S. degree, students are eligible to become a candidate for the M.S. degree. Applications and further information may be obtained from the Graduate Program Director in the Department.

COURSES OFFERED

381 Special Topics Seminar. Presentation and discussion of current areas of importance to professionals. Seminar emphasizes clinical pathophysiology, education, administration and research. Students, faculty and guests present topics of interest for analysis and discussion. One hour per semester. S/U grading.

391 Master's Thesis Research. Credit as arranged.

395 Advanced Topics. Lecture, directed reading or laboratory experiences on advanced or contemporary topics not presently included in other course offerings. Prerequisite: Permission. One to three hours.

Biostatistics

This program is administered through the Statistics Program in close collaboration with the faculty and staff of the Medical Biostatistics Unit of the College of Medicine (Dr. Taka Ashikaga, Director). Dr. Larry Haugh is the program director.

The program offers a concentration in biostatistics leading to the M.S. degree. The curriculum takes full advantage of courses taught in the Statistics Program and includes experience in a variety of health, biomedical, and related research projects in the College of Medicine. This experience is designed to provide candidates with opportunities to use their academic training and work experience in defining research problems, formulating rational methods of inquiry, and gathering, analyzing, and interpreting data. The Medical Biostatistics research activities cover the full range of studies that take place within an academic medicine environment. These include population-based health surveys of various types and evaluations of health promotion programs and professional education activities, such as community intervention studies to prevent adolescent smoking, to enable women to quit smoking, and to promote breast cancer screening. They also include clinical studies of disability due to low back pain, bioengineering experiment design and measurement studies, and clinical trials for neurologic diseases, as well as data from other preclinical, clinical, and epidemiologic studies. Emphasis is placed on learning to perform computerized data analysis as the statistician in a research team.

Opportunities are also available for biostatistical and biometrical research related to problems in agriculture and the life sciences, as well as natural resources. Collaborating faculty in these areas are available to provide consulting or research experiences. Opportunities include multivariate or spatial data analyses for ongoing wildlife and water quality studies. (See also Statistics Program description.)

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES AND ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major which provides a foundation for

the application of statistical methodology and concepts to health and biomedical or agriculture/natural resource problems. For example, premedicine majors who have delayed their application to medical school will be well suited for the program. It is anticipated that candidates will have completed three semesters of calculus and a course including matrix algebra methods. However, provisional admission to the program can be given prior to the completion of these requirements. Computer experience is desirable. The Graduate Record Examination is strongly advised and is required of any applicant who wishes to be considered for a teaching fellowship or research assistantship. Current undergraduate students at The University of Vermont should contact the program director for details on the Accelerated Master's Program.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Plan A: (Thesis) A 30-hour degree program which includes 24 semester hours of approved course work, with at least 21 hours in Biostatistics/Statistics courses. This must include Biostatistics 200, 221, 223, 231, 241 or 261, 321, 323, other Biostatistics courses numbered 201 or above (except 211, 308), and other quantitative methods courses, or (if approved) courses in a specialized field of application, plus six semester hours of approved thesis research (391).

Plan B: (Nonthesis) A 33-hour degree program which includes 30 semester hours of approved course work with at least 21 hours in Biostatistics/Statistics courses. This must include Biostatistics 200, 221, 223, 231, 241 or 261, 321, 323, other Biostatistics courses numbered 201 or above (except 211, 308), and other quantitative methods courses, or (if approved) courses in a specialized field of application, and three semester hours of approved statistical research (381).

Under both plans, students must have or acquire a knowledge of the material in Biostatistics 201 and 211, and are expected to participate in the projects of the College of Medicine Biometry Facility as advised, and to attend the regular colloquium series as part of their training. The comprehensive examination covers theoretical and applied aspects acquired in the core courses of the program. During the latter part of their training the students will be expected to take major responsibility for some project, including the presentation of the final report for this project.

COURSES OFFERED

200 Medical Biostatistics and Epidemiology. Introductory design and analysis of medical studies. Epidemiological concepts, case-control and cohort studies. Clinical trials. Students evaluate statistical aspects of published health science studies. *Prerequisite:* Statistics 141 or 143 or 211. Three hours. Cross-listing: Statistics 200.

201 Statistical Analysis via Computer. See Statistics 201.

202 Population Dynamics. See Sociology 202.

211,221 Statistical Methods I and II. See Statistics 211, 221.

223 Applied Multivariate Analysis. See Statistics 223.

224 Statistics for Quality and Productivity. See Statistics 224.

225 Applied Regression Analysis. See Statistics 225.

229 Survival Analysis. See Statistics 229.

231 Experimental Design. See Statistics 231.

233 Surveys Sampling. See Statistics 233.

235 Categorical Data Analysis. See Statistics 235.

237 Nonparametric Statistical Methods. See Statistics 237.

241 Statistical Inference. See Statistics 241.

253 Applied Time Series and Forecasting. See Statistics 253.

254 Sociology of Health and Medicine. See Sociology 254.

261, 262 Statistical Theory I, II. See Statistics 261,262.

308 Applied Biostatistics. Intensive introduction to the rationale for and application of biostatistical methods in planning experiments and interpreting data in the biological, health and life sciences. Five hours. Cross-listings: Molecular Physiology and Biophysics 308, Statistics 308.

321,323,324,325,329 Seminars in Advanced Statistics. See Statistics 321, 323, 324, 325, 329.

352 Modeling and Estimation of Animal Populations. See Wildlife and Fisheries Biology 352. Four hours. Cross-listing: Statistics 352.

381 Statistical Research. See Statistics 381.

385 Consulting Practicum. See Statistics 385.

391 Master's Thesis Research. Credit as arranged.

395 Advanced Topics in Biostatistics. See Statistics 395.

Botany (BOT)

Professors Barrington (Chairperson), Etherton, Ulbrich, Worley; Associate Professors Hoffmann, Hughes, Tierney; Research Associate Professor Lintilhac; Research Assistant Professors Perkins, Stratton; Assistant Professors Molofsky, Paris, Perkins; Adjunct Professor Tyree.

The Botany Department has ongoing research programs in: *ecology and evolution* including physiological ecology of aquatic plants, effects of acid depositions on forest ecosystems, physiological ecology of acid depositions, systematics and evolution of vascular plants, biogeography; *physiology* including morphogenesis and developmental biology of embryonic plant systems, mineral nutrition, growth and development, translocation, cellular electrophysiology, membrane function, amino acid transport, aluminum effects on cell membranes; and *cell and molecular biology* including molecular genetics; recombinant DNA of fungi and plant molecular development.

The Botany Department participates actively in the Cell and Molecular Biology Program which provides opportunities for interdisciplinary research with other life science departments.

The Botany Department offers a multidisciplinary non-thesis program leading to the degree of Master of Science, Field Naturalist Option. Enrollment is limited to a small number of mature, highly talented individuals who have demonstrated sustained interest in field aspects of the natural sciences. The program is designed to provide students with: (1) a solid grounding in field-related sciences; (2) the ability to integrate scientific disciplines into a coherent whole at the landscape level; (3) the ability to evaluate sites from a number of perspectives and/or criteria; (4) the ability to translate scientific insights into ecologically sound decisions; and (5) the ability to communicate effectively to a wide range of audiences.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

The equivalent of a UVM major or minor in a natural or physical science. Satisfactory scores on the Verbal and Math sections of the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS

A total of 30 credits of course work and thesis research. A minimum of 15 credits of course work should be in botany, other natural sciences, and supporting fields, and at least nine credits should be in thesis research.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE, FIELD NATURALIST OPTION

An undergraduate or graduate degree in earth or life sciences is expected; additionally, a demonstrated commitment to field sciences (e.g., participation in environmental and conservation organizations, workshops, field trips, research); strong scores on the Graduate Record Examination. A subject (advanced) test in biology or geology is advised for students who lack an undergraduate degree in natural sciences. Recent college graduates are encouraged to pursue interests outside academe before application to the Field Naturalist program.

MINIMUM DEGREE REQUIREMENTS

Thirty credit hours of courses to include at least two courses in each of three core areas: (1) life science; (2) earth science; and (3) ecology, the course selection to be determined by the student's studies committee. Enrollment in the Field Naturalist Practicum (Botany 311) each semester; oral comprehensive examination the fourth semester; written field research project (Botany 392) at the end of the fourth semester.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS IN TEACHING

The Department offers a program leading to the degree of Master of Arts in Teaching (see page 21). Satisfactory scores on the Graduate Record Examination general (aptitude) section are requirements for acceptance for this degree.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES 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 general (aptitude) section.

MINIMUM DEGREE REQUIREMENTS FOR THE M.S.T. (BIOLOGY)

Thirty hours of course work to include a selection of courses in the Departments of Botany and Biology 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 where approved by the advisor and the Dean. Appropriate courses in related science departments may be used to complete the required 30 hours. No thesis is required; however, each degree recipient must complete a written and oral examination.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The equivalent of a UVM major or minor in a natural or physical science. Satisfactory scores on the Verbal and Math sections of the Graduate Record Examination.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Completion of one academic year in graduate study at The University of Vermont; completion of any language required by the student's studies committee. The candidate must demonstrate ability to comprehend the contents of articles in the biological sciences in a modern foreign language appropriate to the student specialty and approved by the Studies Committee.

MINIMUM DEGREE REQUIREMENTS

A total of 75 credits of course work and dissertation research. A minimum of 40 credits of course work should be in botany, other natural sciences and supporting fields, and at least 20 credits should be in dissertation research. In addition, each candidate must participate in six semester hours of supervised teaching.

COURSES OFFERED

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:* 104 or equivalent. Three hours. Etherton. Alternate years, 1998–99.

209 Biology of Ferns. Evolutionary biology; a survey of New England ferns and their phylogenetic relationships; current research emphasizing morphological, biogeographical, genetic, and phytochemical aspects of speciation. *Prerequisites:* 108; 132 or 101 recommended or equivalent. Three hours. Barrington. Alternate years, 1999–2000.

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 permission. Three hours.

223 Fundamentals of Field Science. Pattern and process in natural systems. Weekly discussions of unifying questions in science with field labs teaching sampling and analysis of vegetation, soils, and animals. *Prerequisites:* Permission. Three hours. Hughes.

226 Environmental Problem Solving. Students negotiate a contract, work as a team, and map and inventory forested natural areas as they apply problem solving skills to Vermont environmental project. *Prerequisites:* Instructor permission. One to three hours. Daniel.

229 Water Relations of Plants. See Forestry 229.

232 Botany Field Trip. Trips to selected environments outside Vermont. Led by several faculty members representing different fields of Botany. Overall, integrated approach to ecology, structure, and function. One hour. Christmas or spring vacation or end of school year.

234 Ecology of Freshwater Algae. Environmental factors influencing distribution and seasonal succession; quantitative methods for estimating standing crop productivity; kinetics of algal growth; competitive and synergistic interactions. *Prerequisite:* 160 or Biology 102 or equivalent. Three hours. Alternate years, 1999–2000.

241 Tropical Plant Systematics. Principles and methods of angiosperm phylogeny. Recent systematic and evolutionary research on flowering plants; survey of tropical flowering plant families. Student presentations on recent research. *Prerequisite:* 109 or equivalent. Four hours. Barrington. Alternate years, 1998–99.

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. Alternate years.

251 Principles of Light Microscopy. Introduction to the optics, construction and care of the light microscope. Theory of phase and interference contrast, fluorescence, and video methods. *Prerequisites:* One year of Physics (six credits), or permission. Alternate years, 1998–99. One hour. Lintilhac.

252 Molecular Genetics: Regulation of Gene Expression in Eukaryotes. How cells control the flow of genetic information from gene into active gene product. Distinction between quiescent and active genes, mechanisms of genetic communication/regulation. *Prerequisites:* Biology 101 or Agricultural Biochemistry 201 or Biochemistry 301, or equivalent; others by permission. Cross-listing: Biology 252, Cell and Molecular Biology 252. Three hours. Ullrich. Alternate years, 1999–2000.

254 Genetics of Fungi. Understanding the classical and molecular genetics of fungi with respect to their contribution in agriculture, basic genetics, biotechnological industry, recombinant DNA and gene expression. *Prerequisites:* Biology 101 or Agricultural Biochemistry 201 or Biochemistry 301, or equivalents; others by permission. Cross-listing: Cell and Molecular Biology 254. Three hours. Ullrich. Alternate years, 2001–2002.

256 Advanced Plant Genetics. Review of major topics in higher plant genetics and cytogenetics. Designed to be applied to the systematics, breeding, and gene engineering of higher plants. *Prerequisite:* 132 or Biology 101 or equivalent. Three hours.

257 Physiology of the Plant Cell. Detailed study of photosynthesis, plant cell membrane function, and plant cell growth. *Prerequisites:* 104; Chemistry 141, 142 or Chemistry 42; Physics 11, 12 or 31, 42 or equivalents. Four hours. Etherton. Alternate years, 1997–98.

258 Biology of the Fungi. 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 of the fungi. *Prerequisites:* 101 or 104 or 132 or permission. Four hours. Ullrich. Alternate years, 2000–2001.

261 Plant Growth and Development. Theoretical and experimental approaches to vegetative and reproductive meristemogenesis in plants. Biophysics and biomechanics of cell and organ growth. Pattern formation, meristem structure, and phyllotaxis. *Prerequisites:* 104, 108, or permission. Three hours. Lintilhac. Alternate years, 1998–99.

281 Botany Seminar. Presentations of personal research by faculty, graduate students, and outside guest speakers. Attendance required of botany graduate students and seniors in botanical research programs. Without credit.

295 Special Topics. For advanced students within areas of expertise of faculty and staff. Aspects of ecology, physiology, genetics, cytology, bryology, pteridology, paleobotany, photobiology, membrane physiology, cell biology. *Prerequisite:* Permission. Credit as arranged.

301 Cell and Molecular Biology. Advanced survey of cell organelles, their composition, origin, and the relationship between their structure and function. Emphasis on recent literature and current controversies. *Prerequisites:* Chemistry 142, graduate standing in biology or permission. Three hours. Cross-listing: Cell and Molecular Biology 301.

311 Field Naturalist Practicum. Landscape analysis; planning and designing field projects; integrated problem solving. *Prerequisites:* Enrollment in the Field Naturalist program. Variable hours up to three.

381 Selected Problems in Modern Botany. Subject matter varies. Topics will stress current graduate student and staff research interests in a journal review or presentation-discussion format. *Prerequisite:* Permission. One to three hours.

391 Master's Thesis Research. Credit as arranged.

392 Master's Project Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Business Administration (BSAD)

Professors Brandenburg, Grinnell, Gurdon, Hunt, Savitt, Sesnowitz (Dean), Shirland; Associate Professors Averyt, Cats-Baril, Dempsey, Gatti, Jesse, Kraushaar, McIntosh, Noordewier, Parke, Sinkula, Tashman, Thompson; Assistant Professors Baker, Battelle, Harrison, Ramagopal.

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 the understanding and critical evaluation of conceptual and theoretical principles relevant to the decision process in the functional areas of business.

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

The MBA program is accredited by the American Assembly of Collegiate Schools of Business (AACSB).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES AND FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION

The MBA program consists of Prerequisite (basic skills), Core, and Advanced (beyond the core) courses. A student can be admitted to the Graduate College before completion of Prerequisite courses, but all prerequisites must be completed before the student is admitted to candidacy for the MBA degree.

All applicants must meet the general requirements for admission to the Graduate College. In addition to transcripts of prior undergraduate and graduate work, the applicant is required to submit scores on the Graduate Management Admissions Test. Students are selected for admission based on high promise of academic achievement in the MBA program. That promise will be judged by previous academic work, GMAT scores, relevant work experience, writing ability, and recommendations.

MINIMUM DEGREE REQUIREMENTS

Students must complete all of the courses listed. Each Prerequisite course normally will be satisfied by completion of an appropriate three hour undergraduate level course. Computer usage skill may be demonstrated by appropriate experience. Prerequisite courses must be completed before enrollment in Core courses. Enrollment in Advanced courses is restricted to students who have completed the appropriate Core course in that functional area.

Prerequisite Courses

1. Macroeconomic Principles*
2. Microeconomic Principles*
3. Differential Calculus
4. Computer Usage
5. Statistics

*BSAD 302 may be taken to fulfill both the Macroeconomics and Microeconomics prerequisites.

Core Courses (18 hours)

1. BSAD 305 Fundamentals of Marketing Management
2. BSAD 306 Fundamentals of Accounting
3. BSAD 307 Organization and Management Studies
4. BSAD 308 Corporate Finance
5. BSAD 309 Fundamentals of Legal Environment of Business
6. BSAD 340 Production and Operations Management

Advanced Courses (30 hours)

(Of the 30 hours in this category, at least 24 must be in 300-level courses)

- I. Functional Area Courses (one selected from each area):
 1. Accounting and Finance (BSAD 260, 263, 266, 267, 282, 284, 360, 365, 380, Special Topics)
 2. Economic and Political Environment (BSAD 234, 304, 337, Special Topics)
 3. Human Resources Management (BSAD 222, 226, 375, 376, 379, Special Topics)
 4. Marketing (BSAD 251, 258, 352, 359, Special Topics)
 5. Management Information Systems (BSAD 345, 347, Special Topics)
 6. Production and Operations Management and Quantitative Methods (BSAD 270, 293, 341, 346, Special Topics)
- II. Electives: Nine hours of graduate business courses
- III. BSAD 396 Business Policy

A normal course load for full-time students is 12 hours per semester. Part-time students typically take six hours per semester. Substantially all Core courses must be completed before enrollment in Advanced courses. Business Policy will be taken during the student's last semester in the MBA program. In addition, satisfactory completion of a comprehensive examination is required for graduation from the program.

Students who have received undergraduate degrees in business within the past five years from schools accredited by the AACSB are allowed to waive the Core courses and may complete the program in one year by taking 15 hours of course work per semester. Other students with academic experience covering material in particular Core courses may waive such courses upon successful completion of qualifying examinations.

Course Sequencing

For full-time students needing to complete all Core (18 hour) and Advanced (30 hours) courses, the usual sequencing of courses is as follows:

First Year

Fall Semester	Spring Semester
BSAD 305	BSAD 308
BSAD 306	BSAD 309
BSAD 307	2 Functional Area Courses
BSAD 340	

Second Year

Fall Semester	Spring Semester
2 Functional Area Courses	2 Functional Area Courses
2 Elective Courses	Elective Course BSAD 396

For full-time students needing to complete only the Advanced (30 hours) courses, a typical course sequencing is as follows:

Fall Semester	Spring Semester
3 Functional Area Courses	3 Functional Area Courses
2 Elective Courses	Elective Course BSAD 396

As an alternative, some students may choose to complete two Advanced courses during the summer session (if available, since summer offerings are limited) in order to reduce their regular semester program to 12 hours.

COURSES OFFERED

222 Human Resource Management. Critical examination of contemporary problems, controversies in personnel administration. Current issues, topics (affirmative action, discrimination in employment) covered with more traditional topics of wage and salary administration, etc. *Prerequisites:* MBA standing, 307. Three hours.

226 Current Issues in Management and Organizational Theory. Subjects may include training and development, selection and recruitment, and affirmative action. *Prerequisite:* 120. One to three hours.

234 Canadian-U.S. Business Relations. A study of the Canadian-U.S. bilateral relationship as it affects international business, emphasizing trade, investment, energy, and industrial development policies. *Prerequisites:* Economics 11, 12. Three hours.

251 Marketing Research. The role of research in a marketing information framework. Emphasis on survey research, data collection, and analysis. Experimental designs also examined. *Prerequisites:* 150, Statistics 141. Three hours.

258 International Market Analysis. Cultural, economic, historic, and political factors affecting the analysis of foreign markets. Focuses on the processes by which market entry decisions are developed and implemented. *Prerequisites:* Graduate standing; BSAD 150 or permission of instructor. Three hours.

260 Financial Statement Analysis. A study of the concepts and techniques underlying corporate financial statement analysis, with an emphasis on business equity valuation. *Prerequisites:* BSAD 180 or 308. Three hours.

263 Accounting and the Environment. An examination of the critical role of accounting in implementing and assessing the firm's environmental strategy. A variety of accounting issues are addressed through readings and case studies. *Prerequisites:* BSAD 61 or 65 or concurrent enrollment in 308. Three hours.

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

267 Auditing. Independent and internal auditing. Topics include standards, ethics, and legal responsibilities of the profession, financial statements, audit concepts, and techniques, and the audit option. *Prerequisite:* 162. Three hours.

270 Introduction to Operations and Research. Concepts

and models of operations research as applied to the business environment. Emphasis on modeling and using solution results for managerial decision making. Extensive computer use required. *Prerequisites:* MBA standing, 304. Three hours.

282 Security Valuation and Portfolio Selection. Examination of the investment decision process. Specific topics include operations of equity securities markets, market efficiency, capital asset pricing model, and portfolio management. *Prerequisites:* MBA standing, 308. Three hours.

284 Financial Institutions and Markets. Study of level and structure of interest rates. Topics: flow of funds accounting, market vs. natural rate of interest, interest rate structure, behavior of interest rates over business cycle. *Prerequisites:* MBA standing, 308. Three hours.

293 Integrated Product Development. Project-based course focusing on the entire product life cycle. Team dynamics, process and product design, quality, materials, management, and environmentally conscious manufacturing. *Prerequisite:* Graduate standing. Three hours. Cross-listings: ME 265, Stat. 265.

295 Special Topics. Advanced courses on topics beyond the scope of existing departmental offerings. See Schedule of Courses for specific titles and prerequisites. One to three hours.

302 Business Economics. An introduction to the principles of economics as relevant to business decision-making. The use of various analytical tools are stressed through their application in solving a variety of managerial problems. *Prerequisites:* MBA standing or permission of MBA Program Director. Three hours.

304 Managerial Economics. Application of economic, mathematical, and statistical models to managerial decision making. Emphasis given to optimization techniques, spreadsheet analyses, decision trees, and cost/benefit analysis. *Prerequisites:* MBA standing. Three hours.

305 Fundamentals of Marketing Management. Accelerated course on marketing principles and theory. Analytical approach to study of product pricing strategies; distribution, communication, and promotion; consumer behavior and development of corporate marketing strategy. *Prerequisite:* MBA standing. Three hours.

306 Fundamentals of Accounting. Introduction to basic concepts, assumptions, conventions providing foundation for developing financial statements. Analysis, interpretation of the income statement, balance sheet, statement of changes in financial position. *Prerequisite:* MBA standing. Three hours.

307 Organization and Management Studies. A survey course of the principles of management and organization behavior. The fundamentals of planning, organizing, leading, staffing, and controlling are covered. Particular attention is given to organization theory and behavior, including topics such as motivation, group behavior and decision making. All areas are covered in an international context. *Prerequisite:* MBA standing. Three hours.

308 Corporate Finance. An introduction to financial decision making in the firm. Decisions related to acquisition and allocation of funds are examined and practiced through cases and problems. *Prerequisites:* MBA standing, 306. Three hours.

309 Fundamentals of Legal Environment of Business. General overview of areas of interaction between businesses and governments. Examination of governmental policy toward business and review of laws governing business-government interactions. *Prerequisite:* MBA standing. Three hours.

337 International Trade and Investment Policy. Examination of international trade rules of the GATT and the pend-

ing World Trade Organization; analysis of the impact on domestic and international firms. *Prerequisites:* MBA standing, 309. Three hours.

340 Production and Operations Management. Study of the operations function in manufacturing and service organizations. Design, planning, and control are examined, with emphasis on managerial analysis and decision making. *Prerequisite:* One course in statistics. Three hours.

341 Forecasting. Modern forecasting methods and practices including smoothing, regression, econometric and Box-Jenkins models; combining forecasts and forecasting simulations. Professional software used for developing forecasts. *Prerequisites:* MBA standing. One course in statistics or research methods. Three hours.

345 Management Information Systems. An introduction to the design and implementation of management information systems. A theoretical framework is developed and applied by students to an information system. *Prerequisite:* MBA standing. Three hours.

346 Decision-Making Models. Application of decision-making models to administrative problems. Structuring decisions through decision trees, making choices, assessing risk, resolving conflicting objectives and overcoming organizational impediments. *Prerequisites:* One course in statistics. Three hours. Cross-listing: Public Administration 308.

347 Analysis of Decision Support Systems. Normative guidelines to design, implement, and evaluate information systems that support unstructured managerial tasks. The guidelines are developed by analyzing information distortion in organizations. *Prerequisites:* MBA standing, 307, 345. Three hours.

352 Business to Business Marketing. Exploration and analysis of the marketing of goods and services to organizations. Topics include organizational buying, market segmentation, positioning, pricing, communication, physical distribution and customer services, and sales management. *Prerequisites:* MBA standing, 305. Three hours.

359 Marketing Policy. Concepts from quantitative methods, economics, behavioral sciences applied to marketing management. Includes: marketing opportunities, organizing for marketing, planning marketing programs, control of marketing effort. Case book method. *Prerequisites:* MBA standing, 305. Three hours.

360 Contemporary Financial Accounting and Reporting. Current financial accounting, reporting practices; focus on contemporary issues, problems. Impact of pronouncements of Accounting Principles Board, Financial Accounting Standards Board, Securities and Exchange Commission, and other bodies. *Prerequisites:* MBA standing, 306. Three hours.

365 Management Accounting. Study of development, utilization of accounting information for product costing and pricing purposes, for routine planning and control of organizational activities, for decision-making purposes. *Prerequisites:* MBA standing, 306. Three hours.

375 Organization Theory. Organization theories examined for insights into behaviors of organizations and their members. Open systems perspective. Identification of contingencies in organization design based on human, structural, technological, environmental variables. *Prerequisites:* MBA standing, 307. Three hours.

376 The Management of Change In Organizations. Applied behavioral science perspective adopted to identify conceptual issues, develop diagnostic skills, examine alternative intervention strategies relevant to accomplishment of planned changes in organizational systems. *Prerequisites:* MBA standing, 307. Three hours.

379 Strategic Management. Case studies of existing organizations are used to illustrate the intellectual, social processes of adaptation to a changing environment; strat-

egy formulation, implementation. Not offered every year. *Prerequisites:* MBA standing, completion of First-Year courses. Three hours.

380 Managerial Finance. Focus on key financial decisions that affect the value of the firms. Topics: capital structure, leasing, mergers and acquisitions, capital market theories and evidence. *Prerequisites:* MBA standing, 308. Three hours.

394 Independent Readings and Research. Allows a student to pursue independent research under the direction of a faculty member. Normally, the course will include a research paper. *Prerequisites:* MBA standing, permission of the Graduate Studies Committee. One to three hours.

395 Special Topics. Topics and material that may develop later into a regular course offering; in addition, it may include topics and material offered only once. *Prerequisites:* MBA standing, permission of the Graduate Studies Committee. One to three hours.

396 Business Policy. A case course focusing on the resolution of complex cases involving simultaneous solutions of problems in two or more functional areas. *Prerequisites:* MBA standing; last semester of study. Three hours.

Cell and Molecular Biology (Interdisciplinary)

Participating faculty are from the following departments: Agricultural Biochemistry; Anatomy and Neurobiology; Animal Science; Biochemistry; Biology; Biomedical Technology; Botany; Genetics; Medicine; Microbiology and Molecular Genetics; Molecular Physiology and Biophysics; Obstetrics and Gynecology; Pathology; Pediatrics; Pharmacology; Physics; and Surgery.

An interdisciplinary program leading to M.S. and Ph.D. degrees in Cell and Molecular 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 students to gain competence in the area of their 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 and Molecular Biology Program Director, Anne Huot, Department of Biomedical Technology.

Research includes: (Albertini) human somatic-cell genetic mutations, histocompatibility genetics; (Bateman) mechanism of eukaryotic transcription initiation; (Bednar) biochemical (fibrinolytic and arachidonic acid cascades) and rheologic (neutrophil and platelet) mechanisms of brain injury; (Berger) protein structural dynamics during muscle contraction; (Braas) molecular mechanisms regulating neuroendocrine hormone expression and function; (Bramley) pathogenic mechanisms associated with bacterial infection of the mammary gland; (Budd) T-lymphocyte signal transduction and development in normal and Fas-lpr autoimmune mice; (Burke) structure, function and applications of ribozymes; (Chen) RNA recognition and gene regulation, pathogenesis of HIV; (Chiu) regulation of gene expression in developing and neoplastic tissues; (Conn) genetics of human *Plasmodium* transmitting anopheline mosquitoes; (Cornbrooks) nervous system development and regeneration; (Crabb) protein chemistry, peptide synthesis/sequencing, visual cycle proteins molecular biology; (Curier) cell-cell interactions in plant-microbe symbiosis; (Cutroneo) regulation of collagen gene expression; (Finette) mechanisms and clinical importance of somatic mutations in children; (Fives-Taylor) cross signaling between

bacterial cells and host cells; (Forehand) development of specific synaptic connections in the autonomic nervous system; (Francklyn) protein-nucleic acid recognition, structure and function of RNA and RNA binding proteins, especially aminoacyl-tRNA synthetases; (Gilmartin) regulation of mRNA processing in HIV-1, biochemistry of eukaryotic transcription termination; (Grant) leukemia, genetics and mechanisms of leukemogenesis; (Haeblerle) molecular regulation of cell motility and muscle contraction; (Hart) metal toxicity in the lung, pulmonary tolerance to pollutants; (Heintz) protein-DNA interactions at eukaryotic origins of replication, eukaryotic cell cycle; (Huber) immune mechanisms of tissue damage in viral infections; (Huot) cellular interactions involved in regulation of growth; (Jaken) signal transduction through protein kinase C; (Johnson) control of cellular morphogenesis during the yeast cell cycle; role of low-molecular-weight GTP-binding proteins in cell polarity; (Kelley) growth factor/cytokine involvement in proliferation and protein/connective tissue turnover; (Koh); (Kurjan) cell-cell interactions involved in yeast mating; (Liang); (Lidofsky); (Maughan) molecular mechanisms of muscle contraction and metabolism in *Drosophila*; (Mawe) neural hormonal control of gastrointestinal function; (May) regulation of neuropeptide expression and neurotransmitter phenotype, molecular endocrinology; (Melamede) *in vitro* production of antibodies using page display systems in *E. Coli*; (Mitchell) cytoskeletal protein metabolism and smooth muscle cell differentiation; (Morrical) enzymology of DNA replication, recombination and repair; (Mossman) carcinogenesis of tracheobronchial tree, pulmonary fibrosis; (Murakami); (Newell) apoptosis and the immune system; (Nicklas) molecular analysis of mutations occurring *in vivo* in humans exposed to genotoxins; (Novotny) molecular genetics of development in fungi; (Osol) vascular smooth muscle and endothelial cells, regulation of diameter of resistance arteries during pregnancy and chronic hypertension; (Parsons) synaptic physiology/pharmacology, transmitter actions, motor end plate, autonomic neurons; (Patlak) structure-function studies of single ion channels; (Pederson) assembly and function of transcription and replication initiation complexes in yeast; (Plaut) growth factor regulation of mammary development; (Politis) role of proteolysis for mammary development and differentiation; (Posada) regulation of MAP kinases; (Rincon) signal transduction and gene transcription regulation during thymic development and T cell activation; (Sachs); (Sato); growth factor receptors in tumorigenesis, serum free cell culture, cellular endocrinology; (Schaeffer) maintenance and induction of the carcinogenic state; (Schneider) genetics of signal transduction in *Drosophila* development; (Shackford) understanding the mechanisms of secondary brain injury; (Sobel) dysregulation of fibrinolytic system protein expression and atherogenesis; (Stein) characterization of bacterial virulence factors that facilitate replication within host cells; (Stevens) cellular and molecular biology of tissue damage by toxic chemicals and its repair; (Sun) insulin signal transduction and the mechanism of insulin resistance; (Taatjes) glycosylation reactions in the Golgi apparatus; (Tierney) plant molecular biology, plant development biology, cell wall structure; (Tracy) molecular characterization of the cell-cell and cell-protein interactions regulating hemostasis and thrombosis; (Ullrich) molecular genetics of regulatory genes and development; (Van Houten) molecular genetics, biochemistry, physiology of chemoreceptors, calcium and other second messengers; (Vigoreaux) functional studies of muscle proteins in *Drosophila*; (Wallace) biological processing of oxidative DNA lesions, molecular analysis of repair and mutagenesis of oxidative DNA lesions; (Ward) mechanisms of host cell invasion by *Toxoplasma* and *Plasmodium*; (Woodcock-Mitchell) differentiation of epithelial cells during development and injury; (Woodworth) biochemistry of iron-binding and iron-trans-

port proteins and site-directed mutants thereof, cellular iron metabolism; (Yandell) mechanisms of inherited cancer predisposition.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE AND FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Biology (three semesters, including genetics), chemistry through organic, mathematics through calculus, physics (two semesters), physical chemistry. Satisfactory scores (60 percentile) on general (aptitude) 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. Deficiencies may be made up after matriculation.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Completion of any deficient admission requirements.

MINIMUM REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Thirty hours of graduate level credit including Cell Biology 301-302 and one course in each of the following areas: genetics, biochemistry (one year); a techniques course approved by the Studies Committee; cell biology seminar each semester; thesis research.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Completion of any deficient admission requirements including one semester of physical chemistry equivalent to chemistry 160.

MINIMUM REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Cell Biology 301-302, one course in each of the three following areas: genetics, biochemistry (one year), and techniques course approved by the Studies Committee; a minimum of 11 additional hours of course work. Studies Committee will advise course selection. Dissertation research, minimum 20 credits. All students must demonstrate satisfactory progress: finish minimum course work within three years; finish cumulative exam within prescribed time limits; participate in seminar program.

The expected sequence for all first year students in the fall is CLBI 301, biochemistry, CLBI 381, and CLBI 391 or 491; in the spring is CLBI 302, biochemistry, CLBI 381 and CLBI 391 or 491. Additional courses or substitutions are offered with flexibility, but must have permission of the Program Director.

COURSES OFFERED

295 Special Topics. Credit as arranged.

301 Cell and Molecular Biology. Advanced survey of cell organelles, their composition, origin, and the relationship between their structure and function. Emphasis on recent literature and current controversies. *Prerequisites:* Chemistry 142, graduate standing in biology or permission. Three hours. Cross-listing: Biology 301. Vigoreaux.

302 Specialized Cells and Cell Processes. Current issues and research in the field of plant, invertebrate, mammalian cell, and molecular biology. *Prerequisite:* Cell Biology 301. Three hours. Cross-listing: Biology 302. Schneider.

381 Seminar. One hour.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Chemistry (CHEM)

Professors Allen, Flanagan, Geiger (Chairperson), Jewett, Krapcho, Kuehne, Strauss; Associate Professors Goldberg, Leenstra, Welton; Assistant Professors Friestad, Gordon-Wylie, Landry, Madalenoitia.

Current research in organic chemistry includes design and synthesis of peptide mimics, applications of molecular diversity to catalyst design, syntheses of medicinally valuable natural products, studies of the stereochemistry of C-alkylation of α -anions, decarboxylation of geminal diesters, biomimetic syntheses, preparation of benzomorphans and their analogues which have chemotherapeutic potential, synthesis and reactions of hybrid organic-inorganic polymers, mechanistic studies of organic chemical reactions, and development of novel synthetic methodologies.

Physical chemistry research projects include hydrogen absorption by metals, alloys, and intermetallic compounds with a view toward storage of hydrogen as a fuel, theoretical studies of the electronic structure of chemical bonds in small molecules using *ab initio* variation calculations, chemical thermodynamics, statistical mechanical modeling of chemical systems, and the use of various types of molecular spectroscopy, such as fluorescence, magnetic resonance, and IR/Raman, to address questions of structure, bonding, and dynamics in chemical and biophysical systems.

Research in inorganic chemistry includes investigations of the syntheses, structure, and spectroscopic properties of main-group ring systems and polymers with an emphasis on phosphazenes and borazines, electrochemical control of the structure and reactivity of transition metal complexes, solid state structure by x-ray diffraction, complexes of polydentate ligands, physical inorganic and organotransition metal chemistry. Additional research areas include materials chemistry, solid state chemistry, mesoporous materials, biomineralization, and chemical vapor deposition.

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 process in nonaqueous media, studies of transient, imploding plasmas as solid sample atomizers for atomic spectroscopy, the development of instrumentation and techniques suitable for the direct localized and bulk trace elemental analysis of nonconducting solid samples via atomic spectrometry.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS (PHYSICAL SCIENCES)

An undergraduate major in an appropriate field. Satisfactory scores on the general (aptitude) Graduate Record Examination. Completion of at least one full year of teaching.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS (PHYSICAL SCIENCES)

Successful completion of Physics 128, Chemistry 141 and 162, 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.)

A program is also offered leading to the degree of Master of Arts in Teaching (see page 21).

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

The above prerequisites for admission to candidacy must be supplemented by: (1) completion of 30 hours of credit, of which at least 18 must be in Physical Sciences Option (A) or (B) as described below. The remaining 12 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 231 and six semester hours of Chemistry chosen from Chemistry 161, 232, 201, 264, and 241. This option is primarily for teachers of chemistry.

Physical Sciences Option (B): nine semester hours of Chemistry numbered 141 and above and nine hours of Physics in courses numbered above 200. This option is primarily for teachers of physics.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in an appropriate field. Satisfactory scores on the Graduate Record Examination general (aptitude) section for those requesting financial assistance.

REQUIREMENTS FOR ADVANCEMENT 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 three 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 15 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 386 (only for those electing Plan A), and (d) Chemistry 381 (Seminar), 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: 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) one additional hour of Chemistry 381 (Seminar).

Plan B: Completion of six hours of Independent Literature Research Project (Chemistry 395); (2) completion of at least 30 hours of graduate credit (courses and Literature Research Project); and (3) one additional hour of Chemistry 381 (Seminar).

M.S. students should decide at the beginning of their program whether they will pursue Option A or Option B and inform the Department and Graduate College of their decisions.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

An undergraduate major in an appropriate field. Satisfactory scores on the Graduate Record Examination general (aptitude) section for those requesting financial assistance.

REQUIREMENTS FOR ADVANCEMENT 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 the second year of residence: (1) at least 15 hours of research (Chemistry 491); (2) satisfactory performance in the cumulative examinations in the 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 386 (two credits) and 381 (two credits), three semester hours of credit of advanced level work in three of the five areas of chemistry (analytical, biochemistry, inorganic, organic, and physical). The remainder of each student's program will be determined by a departmental studies committee on the basis of qualifying examination performance, background, and research interests. In the normal course of events a student should expect to devote much of the first year to formal course work; (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 a doctoral research project, write an acceptable dissertation, and defend it; (2) present a total of 75 hours of credit in course work and dissertation research, and (3) make an oral and written presentation of an original research proposal, Chemistry 388 (at least six months prior to the submission of the dissertation).

COURSES OFFERED

Prerequisites for all courses: as listed, or equivalent, or by permission of instructor.

201 Advanced Chemistry Laboratory (1-6). Laboratory and discussion only. Laboratory problems requiring modern analytical, physical, and inorganic synthetic techniques. *Prerequisites:* 146, 221, credit for or concurrent enrollment in 161 or 162. Three hours.

202 Advanced Chemistry Laboratory (0-6). Laboratory only. Laboratory problems requiring modern analytical, physical, and inorganic synthetic techniques. *Prerequisite:* 201. Two hours.

214 Polymer Chemistry. Polymer size and weight distribution. Kinetic models for step polymerization, addition polymerization, copolymerization. Physical properties, characterization of polymers in the solid state and in solution. *Prerequisites:* 142 or 144, 162. Three hours. Allen.

221 Instrumental Analysis. Systematic survey of modern methods of chemical analysis. Fundamental principles and applications of spectroscopy, electrochemistry, and separation techniques. *Prerequisites:* Credit for or concurrent enrollment in 161 or 162. Three hours. Geiger, Goldberg.

222 Advanced Analytical Chemistry. In-depth coverage of selected modern instrumental methods of chemical analysis, emphasizing most recent developments in spectroscopy, electrochemistry, and separation techniques. *Prerequisite:* 221. Three hours. Geiger, Goldberg.

224 Chemical Separations. Theory and practice of chromatographic separations. Emphasis on gas-liquid, liquid-liquid, and liquid-solid chromatography. *Prerequisite:* 221. Three hours.

225 Electroanalytical Chemistry. Principles of modern electrochemical analysis, mainly finite current methods — voltammetry, polarography, chronoamperometry, cyclic voltammetry, double layer theory, electron transfer kinetics. Three hours. Geiger.

226 Analytical Spectroscopy. Principles of optical spectroscopic methods of analysis. Emphasis on theory and practice of atomic spectroscopy and new molecular spectroscopic methods. *Prerequisite:* 221. Three hours. Goldberg.

227, 228 Special Topics in Analytical Chemistry. Selected topics of current interest in the area of analytical chemistry. New techniques and methodologies, especially in chemical instrumentation. Credit as arranged. Geiger, Goldberg.

231 Inorganic Chemistry. Survey of inorganic systems. Symmetry, group theory, structure, bonding, acid-base chemistry, crystal field theory. Chemistry of solid state, ionic, covalent and electron deficient systems. *Prerequisite:* 162. Three hours. Allen, Gordon-Wylie, Landry.

232 Advanced Inorganic Chemistry. Ligand field and molecular orbital theories applied to transition metal complexes, introduction to organometallic chemistry, inorganic reaction mechanisms, bioinorganic chemistry. *Prerequisite:* 231. Three hours. Allen, Gordon-Wylie, Landry.

234 Organometallic Chemistry. Systematic survey of syntheses, properties, structures, bonding, reactions of both main group and transition series organometallic compounds. Variation of structure and stability of metal-carbon bond throughout periodic system. *Prerequisite:* 231. Three hours. Allen, Gordon-Wylie, Landry.

236 Physical Inorganic Chemistry. Fundamental physical basis for spectroscopic techniques, other observable phenomena important to inorganic chemistry. Topics: ligand field theory, magnetism, magnetic resonance, Mossbauer spectroscopy, optical activity. *Prerequisites:* 161, 231. Three hours. Allen, Gordon-Wylie, Landry.

237, 238 Special Topics in Inorganic Chemistry. Areas of current interest involving inorganic systems such as bioinorganic, solid state and polymers with unusual properties. Credit as arranged. Allen, Gordon-Wylie, Landry.

241 Advanced Organic Chemistry. Stereochemistry, reactivity criteria, reaction mechanisms and synthetic methods are stressed. Reactive intermediates such as carbanions, carbocations, carbenes, and free radicals are used to systematize mechanistic discussions. *Prerequisites:* 142 or 144, 162. Three hours. Friestad, Krapcho, Kuehne, Madalengoitia, Strauss.

242 Advanced Organic Chemistry. Mechanistic considerations of reactions which include enolates, additions (such as cycloadditions, hydroborations, etc.), annulations, oxidations, rearrangements, eliminations, and approaches to multistep syntheses. *Prerequisites:* 241. Three hours. Friestad, Krapcho, Kuehne, Madalengoitia.

251 Physical Organic Chemistry. Structure-reactivity relationships, molecular properties and their interpretation. Methods and results of investigations of mechanisms of common organic reactions. *Prerequisites:* 142 or 144, 162. Three hours. Jewett.

253 Practical NMR Spectroscopy. Introduction to high resolution pulsed Fourier transform nuclear magnetic resonance spectroscopy. Chemical shifts, scalar coupling, relaxation, molecular symmetry considerations, chemical exchange effects. *Prerequisites:* 142 or 144, 161. Three hours.

257, 258 Special Topics in Organic Chemistry. Advanced level discussion of specific topics in organic chemistry of current interest such as photochemistry, carbenes,

bioorganic chemistry, magnetic resonance, etc. Credit as arranged. Friestad, Jewett, Krapcho, Kuehne, Madalengoitia, Strauss.

262 Chemical Thermodynamics. Systematic study of the application of thermodynamics to chemical problems. Concepts of statistical thermodynamics introduced. *Prerequisites:* 161, 162. Three hours. Flanagan.

263 Introduction to Quantum Mechanics. General consideration of quantum mechanics. Development of techniques pertinent to the application of quantum mechanics to chemical problems. *Prerequisites:* 161. Three hours. Weltin.

264 Fundamentals of Spectroscopy. In-depth discussion of the theory of molecular states and transitions between them, with applications to electronic spectroscopy. Explicit treatment of vibrations in molecules. *Prerequisites:* 161, Math 121. Three hours. Leenstra.

265 Statistical Mechanics. Development of statistical mechanics and its application to problems of chemical interest. *Prerequisites:* 161, 162; 263 recommended. Three hours. Flanagan.

267, 268 Special Topics in Physical Chemistry. Advanced discussion of physical chemistry and chemical physics, group theory, solid state, molecular orbital theory, irreversible thermodynamics, kinetics and mechanisms, solution theory, calculations, spectroscopy. Credit as arranged. Flanagan, Leenstra, Weltin.

285, 286 Special Topics. Selected topics of an interdisciplinary nature, designed particularly for advanced undergraduate chemistry majors. Possible subjects include environmental chemistry, chemical technology, chemical economics. Offered as occasions arise. Variable credit.

342 Natural Products — The Alkaloids. The major classes of alkaloids 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 242. Three hours. Alternate years. Kuehne.

344 Natural Products — The Terpenes. The chemistry of mono, sesqui, di and triterpenes, including degradations, structure proofs, total syntheses, rearrangement reactions, and biogenesis. *Prerequisite:* Credit or concurrent enrollment in 242. Three hours. Alternate years. Kuehne.

363 Quantum Chemistry. Applications of quantum mechanical techniques to problems of chemical interest. *Prerequisite:* 263. Three hours. Offered as occasion warrants. Weltin.

381, 382 Seminar. Current problems and literature. One hour.

386 Methods of Chemical Investigation. Introduction to advanced modern chemical methods. *Prerequisite:* Permission. Two hours.

388 Research Problem Conception and Solution. Independent origination of research problems and the methods of their solution. Required of all doctoral candidates. *Prerequisite:* Permission of department. This course shall be completed at least six months in advance of the Ph.D. dissertation defense, and in no case later than the end of the seventh semester of graduate studies at UVM. One hour.

391 Master's Thesis Research. Credit as arranged.

395 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.

491 Doctoral Dissertation Research. Credit as arranged.

Civil and Environmental Engineering (CE)

Professors Beliveau, Cassell, Dawson, Hemenway, Laible, Pinder; Associate Professors Dougherty, Downer, Hayden (Graduate Coordinator), Olson (Chairperson); Research Assistant Professors Karatzas, Rizzo.

Graduate programs in Civil and Environmental Engineering that lead to the Master of Science and Doctor of Philosophy degrees are offered. The curricular and research programs emphasize engineering related to environmental issues; in addition, biomechanical, structural, geotechnical, and transportation studies are possible at the master's level.

Research includes groundwater pollution and optimal remediation design, indoor air pollution and related health effects, computational methods for high-performance computers, circulation and contaminant transport in lakes and estuaries, environmental restoration, hazardous waste management and landfill siting, mathematical modeling of chemical and mechanical processes in the spine, and dynamic behavior of structures.

Generally, enrollment in the Ph.D. program is limited to full-time students.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

A bachelor's degree and the approval of this Department. Satisfactory scores on the Graduate Record Examination general (aptitude) section. International students whose native language is not English or who have not received their education in English are required to submit satisfactory results from the TOEFL examination. Completed applications are due February 1.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Specific course work may be required of those who lack a sufficiently strong engineering background.

MINIMUM DEGREE REQUIREMENTS

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

Plan A: Completion of advanced courses in civil and environmental engineering, mathematics, and other approved disciplines and the completion of an acceptable master's thesis. At least 30 hours must be accumulated, six to nine of them in thesis research.

Plan B: Completion of 36 hours of advanced courses in civil and environmental engineering, mathematics, and other approved disciplines.

Students must declare which option they intend to pursue at the beginning of their program.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

An undergraduate degree in an appropriate field of study and demonstrated academic performance as measured by grades and satisfactory scores on the Graduate Record Examination general (aptitude) section. Applicants whose native language is not English or who have not received their education in English must present satisfactory results from the TOEFL examination. Completed applications are due February 1.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

It is ordinarily expected that a student will complete the following requirements for advancement to candidacy prior to the end of the second year in the program: (1) one year of residency at UVM; (2) teaching experience in one course; (3) at least 12 credit hours of research; (4) at least 15 credit hours of course work at the graduate level acceptable to the student's Studies Committee; (5) satisfactory performance on a comprehensive examination that includes a written part and an oral part; and (6) satisfactory record of performance in courses and in teaching and research assignments.

MINIMUM REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

In addition to advancement to candidacy, the student must (1) present at least 75 credit hours in approved course work and research (including those required for advancement to candidacy), of which at least 35 credit hours are in research and six credit hours are in course work in disciplines ancillary to Civil and Environmental Engineering; and (2) write and successfully defend an acceptable dissertation.

COURSES OFFERED

210 Airphoto Interpretation. Aerial photographic interpretation; principles of stereoscopic viewing, identification of airphoto features related to landform, vegetation, drainage, soils, topography; use of airphoto interpretation in soil identification. Three hours.

220 Introduction to Finite Element Analysis. Introduction to finite element analysis; applications in solid mechanics, hydrodynamics, and transport; analysis of model behavior; Fourier analysis. Computer project required. *Prerequisites:* Computer programming, linear algebra, and PDE's, or permission of instructor. Three hours.

248 Hazardous Waste Management Engineering. Management of hazardous and industrial waste from generation to disposal; pollution prevention within industry; waste minimization, recovery, reuse, treatment technologies; environmental regulations, risk assessment, costs and public policy; group projects. *Prerequisite:* senior standing in engineering or sciences. Three hours. Hayden.

251 Environmental Facilities Design — Wastewater. Design wastewater conveyance and treatment facilities; sewage-treatment plant design, and equipment selection. *Prerequisite:* 151 or equivalent. Three hours.

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

253 Air Pollution. Sources of air pollution, methods of measurement, standards, transport theory and control techniques used. Emphasis on source measurement and contaminant control design. *Prerequisites:* Chemistry and Math. 21 or equivalent. Three hours.

254 Environmental Quantitative Analysis. Chemistry and microbiology of water quality management, diffusion equilibria, reaction kinetics, acids and bases, colloids, enzymes, bacterial physiology, pollution indicator organisms. *Prerequisites:* Permission. Four hours.

255 Physical/Chemical Processes for Water & Wastewater Treatment Theory and application of physical/chemical processes for treating water and wastewater; reactor dynamics, mass transfer, absorption, ion exchange, precipitation/coagulation, sedimentation, filtration, membrane pro-

cesses; bench-scale and pilot-scale experimentation. *Prerequisites:* 150, 151, 154 or equivalent or permission. Three hours. Hayden.

256 Biological Processes for Water & Wastewater Treatment. Theory and application of biological processes for treating industrial and domestic wastewaters and contaminated groundwater; microbiological considerations; aerobic and anaerobic processes; reactor design, in-situ bioremediation; bench-scale and pilot-scale experimentation. *Prerequisites:* 151 and 154 or equivalent or permission. Three hours. Hayden.

259 Measurement of Airborne Contaminants. Quantifying airborne contaminants from processes and ambient levels. Laboratories demonstrate calibration and measurement, stack sampling, and ambient air monitoring, and specific contaminant generation and measurements. *Prerequisite:* 252 or 253 or permission. Three hours.

260 Hydrology. The basic theory of precipitation, runoff, infiltration, and groundwater; precipitation and runoff data; and application of data for use in development of water resources. *Prerequisite:* 160, Statistics 141 or equivalent. Three hours.

261 Open Channel Flow. Application of basic laws of fluid mechanics to flow in open channels; channel design, transition structures: riprap, culverts; gradually-varied flow problems including flood plain, floodway studies. *Prerequisite:* 160 or equivalent. Three hours.

265 Groundwater Hydrology. Principles of groundwater hydraulics, well characteristics, aquifers; and use of numerical methods to solve groundwater flow problems. *Prerequisites:* Math. 121 or equivalent, programming experience or permission.

280 Applied Soil Mechanics. Use of soil mechanics in evaluation of building foundations, braced excavations, earth structures; lateral earth pressures, pile foundations, caisson foundations, slope stability, and construction problems. *Prerequisite:* 180 or equivalent. Three hours.

282 Engineering Properties of Soils. Study of soil properties influencing engineering behavior of soils; soil mineralogy, physiochemical concepts, plasticity properties, permeability, and compaction; laboratory study of soil index properties, permeability, compaction tests. *Prerequisite:* 180 or equivalent. Three hours.

283 Designing with Geosynthetics. Geotextiles, geogrids, geonets, geomembranes, geocomposites, geopipes; design for separation, reinforcement, filtration, drainage, erosion control, liners. Applications in transportation, drainage, solid waste containment. Material testing, behavior. *Prerequisites:* 180 or permission. Three hours.

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.

295 Special Topics. Special topics in recently developed technical areas. *Prerequisite:* Senior or graduate enrollment. Hours and credits as arranged.

304, 305 Advanced Engineering Analysis I, II. See Mechanical Engineering 304, 305. *Prerequisites:* Math 271 or Math 230; CE 304 for CE 305. Three hours. Cross-listings: ME 304, 305; Math 275, 276.

321 Engineering Computations on Advanced Architectures. Engineering computations using multiprocessing computers, concurrent processing, algorithms for numerical approximation of differential equations, linear systems. Programming projects required. Three hours.

360 Advanced Hydrology. Application of statistics to engineering hydrology; concept, use of instantaneous unit hydrograph; study of runoff models; flow through porous me-

dia; design techniques for water resources projects. *Prerequisites:* 260, Math. 271 or permission. Three hours. Offered as occasion warrants.

365 Contaminant Hydrogeology & Remediation. Practical, theoretical aspects of contaminant hydrogeology, advances in technologies, mass transport and transformation in saturated and vadose zones; movement, distribution, and remediation of nonaqueous-phase liquids. *Prerequisites:* 265 or with instructors permission. Three hours.

366 Numerical Methods for Surface Water Processes. Development of the governing equations for geophysical hydrodynamics/transport, shallow water equations, analysis and implementation of finite element/finite difference computational algorithms. *Prerequisites:* 220. Three hours.

372 Matrix Methods in Structural Dynamics. Matrices, eigenvalue problems, forced vibration, wave propagation. *Prerequisite:* 171 or permission. Three hours. Cross-listing: Mechanical Engineering 330.

390 Advanced Topics in Civil and Environmental Engineering. Special topics to intensify the programs of graduate students in civil and environmental engineering. Hours and credits to be arranged.

391 Master's Thesis Research. Credit as arranged.

395 Advanced Special Topics. Advanced topics in recently developed technical areas. Hours and credits as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Classics (CLAS)

Emeritus Professors Bliss, Davison, Gilleland; Professors Ambrose, R.H. Rodgers, B. Saylor Rodgers, Schlunk (Chairperson); Assistant Professor Bailly; Adjunct Assistant Professor Cirignano.

Current research interests include Homer; Mycenaean and Homeric Greece; Greek and Latin lyric and elegiac poetry; Greek drama; the Attic orators; ancient literary criticism; Greek and Roman philosophy and intellectual History; Greek and Roman historiography; Greek and Latin Prose; Cicero; Vergil; Latin epic; Petronius, satire; Greek and Roman technological authors; Roman history; Roman Imperial Families; Mythology; Arabic and Medieval philosophy; Archaeology; Medieval studies.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major or minor or the equivalent; a reading knowledge of a modern foreign language, usually French, German, or Italian.

MINIMUM DEGREE REQUIREMENTS

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

Those who expect 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 (see page 21). Satisfactory scores on the general (aptitude) Graduate Record Examination are prerequisite for acceptance to candidacy for this degree.

COURSES OFFERED

GREEK (GRK)

- 201 Greek Orators.** Selected speeches of Lysias and Demosthenes. Three hours. B. Saylor Rodgers. Alternate years.
- 202 Greek Comedy.** Two plays of Aristophanes. Three hours. Ambrose. Alternate years.
- 203 Greek Historians.** Thucydides, Books I and II; selections from Herodotus and Xenophon's *Hellenica*. Three hours. B. Saylor Rodgers. Alternate years.
- 204 Greek Tragedy.** Sophocles, *Antigone*, and Euripides, *Medea*, or two equivalent plays. Three hours. Ambrose. Alternate years.
- 205 Greek Philosophers.** Dialogues of Plato with attention to language and dialectical method; Aristotle, Xenophon or Presocratic philosophers may be read. Three hours. Bailly. Alternate years.
- 206 Greek Epic.** Reading in the *Iliad* and *Odyssey*. Problems of epic composition and language together with mythological and historical background. Three hours. Schlunk. Alternate years.
- 227 Greek Lyric Poetry.** A study of early Greek personal, elegiac, and choral poetry from Archilochus to Pindar, including Sappho and Alcaeus, Simonides and Bacchylides. *Prerequisites:* Two years of college Greek or equivalent. Three hours. Schlunk. Alternate years.
- 295, 296 Advanced Special Topics.** Advanced special topics or seminars in Greek beyond the scope of existing formal courses. *Prerequisite:* Permission. Credit as arranged, maximum of six hours for graduate students.

LATIN (LAT)

- 203 Republican Prose.** Extensive reading in Caesar and Sallust, and in the speeches of Cicero. Three hours. B. Saylor Rodgers. Alternate years.
- 204 Epic Poets.** Extensive reading in Lucretius, Vergil, Ovid, and others. Three hours. Ambrose, Schlunk. Alternate years.
- 227 Roman Lyric Poets.** Selections from the works of Catullus, Horace, Propertius, Tibullus. Three hours. R. Rodgers. Alternate years.
- 251 Roman Letters.** Letters of Cicero, Horace, and Pliny. Three hours. Bailly. Alternate years.
- 252 Comedy.** Two plays of Plautus and Terence. Study of the precursors of this literary form. Three hours. Ambrose. Alternate years.
- 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. B. Saylor Rodgers. Alternate years.
- 255 Historians of the Empire.** Augustus, *Res Gestae*; Tacitus, *Annals*, I-IV; selections from Suetonius and Ammianus Marcellinus. Three hours. B. Saylor Rodgers. Alternate years.
- 256 Satire.** Selections from Horace and Persius; Juvenal, Petronius. Study of the development of this literary form. Three hours. R. Rodgers. Alternate years.
- 271 Silver Latin.** Extensive reading of post-Augustan authors not included in other advanced courses. Three hours. R. Rodgers. Alternate years.
- 295, 296 Advanced Special Topics.** Advanced special topics or seminars in Latin beyond the scope of existing formal courses. *Prerequisite:* Permission. Credit as arranged, maximum of six hours for graduate students.

GREEK AND LATIN (GKLT)

- 300 Proseminar.** Introduction to philology. Students will normally take this their first semester. Three hours. Ambrose.
- 381 Seminar.** Intensive study at the graduate level of Greek and Latin authors not read in the candidate's undergraduate program. Credit as arranged.
- 391 Master's Thesis Research.** Credit as arranged. Normally total six hours.

Communication Sciences (CMSI)

Professor Guitar (Chairman); Associate Professors McCauley, Prelock; Assistant Professor Roberts; Clinical Staff: Belin, Bruce, Smith.

The faculty does research in speech and language development and disorders, speech physiology and perception, and sociolinguistics.

The Master of Science degree program in Communication Sciences is accredited for speech-language pathology by the Council on Academic Accreditation of the American Speech-Language-Hearing Association (ASHA). The Eleanor M. Luse Center for Communication: Speech, Language, and Hearing which shares quarters with the Department and is a primary practicum site, holds accreditation from the Professional Services Board of ASHA in both Speech Pathology and Audiology. Students are required to fulfill academic requirements for the Certificate of Clinical Competence-Speech Language Pathology of the American Speech-Language-Hearing Association. All students are supervised by clinically certified members of the faculty and staff of the Eleanor M. Luse Center.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Baccalaureate degree from an accredited institution; satisfactory performance on the general (aptitude) Graduate Record Examination. Completion of courses equivalent to CMSI 80 (Introduction to Linguistics), CMSI 90 (Phonetics), CMSI 94 (Development of Spoken Language), CMSI 101 (Speech Science) or a course in speech anatomy or physiology, CMSI 281 (Cognitive Neuroscience) or an equivalent neuroscience course, a course in statistics, and a course in developmental or child psychology. In order to be accepted into the program, applicants must have completed or be currently enrolled in a sufficient number of prerequisite courses so that they will have no more than one outstanding course at the time of their admission.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of the written comprehensive examinations. Students will not be admitted to candidacy if practicum grades are incomplete. Students may write the comprehensive examination only in or following that semester in which they have completed 30 semester credits of graduate study and 300 hours of supervised clinical practicum and four credits in clinical study.

MINIMUM DEGREE REQUIREMENTS

Thesis Option

The student will complete 34 hours of graduate level courses and six additional credits for conducting the research leading to an M.S. thesis. All research-oriented students will be encouraged to pursue this option. Courses taken must include six credits in audiology.

Nonthesis Option

The student will complete 40 hours of graduate level course work. These include at least 30 credits in Speech-Language Pathology, six credits in Audiology, and four credits in Clinic Study. Students are also required to give a diagnostic and/or therapeutic presentation which will be critiqued by the faculty.

COURSES OFFERED

Prerequisites for all courses: as listed, or equivalent, or by permission of instructor.

208 Cognition and Language. Study of cognition and language in terms of mental representation models; contemporary models of memory, as well as capacity theories of language comprehension and production. *Prerequisites:* Psychology 109 or 110 or Statistics 111 or 141 or permission. Three hours. Cross-listing: Psychology 208.

215 Cognition and Aging. Changes in both sensory and cognitive aspects of aging, including changes in vision, hearing, perception, learning, and memory. *Prerequisites:* 208 or permission. Three hours. Cross-listing: Psychology 215.

271 Audiological Assessment. Examination of basic parameters in measurement of hearing. Pure tone testing, masking, impedance, and speech evaluations. *Prerequisite:* 105 or permission. Three hours.

272 Auditory Habilitation of Hearing Impaired Children. Survey of the handicapping effect of hearing disorders on the developing child and the principles of rehabilitation utilized for treatment of this disorder. *Prerequisites:* Fifteen credits in CMSI, including 94, 271 or equivalent. Three hours.

281 Cognitive Neuroscience. The structure and organization of the human central nervous system as relative to higher cognitive and linguistic behaviors. *Prerequisite:* Nine credits in CMSI at the 200 level. Three hours.

282 Medical Speech-Language Pathology. Overview of populations and terminology specific to practice within medical settings. Topics include motor speech, aphasia, dementia swallowing, laryngectomy/voice, cognition, and tracheostomy/ventilator dependence. One hour.

283 Swallowing Disorders. Introduction to normal and disordered swallowing function across the life span including etiologies, signs/symptoms of dysphagia, diagnostic procedures and treatment within an interdisciplinary model. Three hours.

284 Augmentative Communication. An introduction to development and selection of augmentative/alternative communication strategies and systems for persons with severe communication challenges. Three hours. Favro.

285 Collaborative Intervention within School Settings. Introduction to a transdisciplinary approach to collaborative, curriculum-based assessment and intervention for students with special needs in school settings. Three hours. Prelock.

287 Current Research in Normal and Disordered Language Acquisition. Recent advances in the study of child language. *Prerequisite:* 94. Three hours.

291, 292 Clinical Study. Supervised practicum experiences with children and adults presenting disorders of speech, hearing, and language. *Prerequisite:* Permission. Credit as arranged.

293, 294 Seminar. *Prerequisite:* Permission. Variable credit.

310 Preparation and Management of Speech and Language Evaluation and Therapy. Principles of behavioral observation, analysis and modification as they apply to the assessment and remediation of communication disorders. *Prerequisite:* Permission. Three hours. Bruce.

311 Interdisciplinary Leadership Training for Health Professionals: Research Seminar I. Seminar exploring interdisciplinary process and collaborative teaming, cultural competence, and family-centered care as they relate to neurodevelopmental and related disabilities. *Prerequisites:* Permission of instructor. Variable one to three hours. Prelock. Cross-listings: ECHD 295, EDSP 295, FNS 295, GRNU 296, PA 395, PSY 380, PT 381, SWSS 380.

312 Interdisciplinary Leadership Training for Health Professionals: Research Seminar II. Seminar exploring interdisciplinary process and collaborative teaming, cultural competence, and family-centered care as they relate to neurodevelopmental and related disabilities. *Prerequisites:* Permission of instructor. Variable one to three hours. Prelock. Cross-listings: ECHD 295, EDSP 295, FNS 295, GRNU 296, PA 395, PSY 380, PT 381, SWSS 380.

373 Pediatric Audiology. Methods and techniques for hearing evaluations in children. The audiologist in the school system. *Prerequisites:* 105, permission. Three hours.

377 Habilitation and Rehabilitation Procedures for Hearing Impaired Adults. Electronic, social, linguistic, acoustic, psychological, and pedagogical principles of rehabilitation of the hard of hearing. *Prerequisites:* 94, 271. Three hours.

380 Research Methods in Communication Disorders. Empirical research methodology as applied to the study of normal and deficient speech and hearing processes. Students analyze data statistically and write a research proposal. Three hours. McCauley.

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

383 Seminar in Language/Learning Disabilities. Theories of language/learning disabilities relevant to diagnosis and treatment are reviewed. Recent research and identification/management procedures are also stressed. *Prerequisite:* 387, or permission. Three hours.

384 Articulation-Phonological Disorders. Etiology, diagnosis, pathology, and habilitation and rehabilitation of articulation of speech. *Prerequisite:* Permission. Three hours. McCauley.

385 Voice Disorders. Study of normal and abnormal laryngeal anatomy and physiology as they relate to diagnoses and treatment of a wide variety of vocal pathologies. *Prerequisite:* Permission. Three hours. Belin.

386 Adult Neuropathologies. Etiology, pathology, diagnosis, and principles of rehabilitation of CNS pathologies affecting communication. Emphasis on motor speech disorders and cognitive consequences of traumatic brain injury. *Prerequisites:* 281, 389 or equivalent. Three hours.

387 Language Disorders. Identification, evaluation, and rehabilitation procedures for children with language disabilities. *Prerequisite:* 94. Three hours.

388 Stuttering. Study of adult and child fluency disorders which focuses upon symptomatology, etiology, diagnosis, and rehabilitation of stuttering patients. *Prerequisite:* 94. Three hours. Guitar.

389 Adult Aphasia. Study of linguistic and cognitive impairments associated with stroke and other types of neuropathologies in the adult patient. Emphasis on rehabilitation strategies, principles, and procedures. *Prerequisite:* 281. Three hours.

391 Master's Thesis Research. Credit as arranged.

392 Research Case Presentation Research. Variable credit.

leadership. Upon such completion and submission of a qualifying paper, students will be considered for candidacy for the degree. Students must also pass a written comprehensive examination prior to the award of the degree of Doctor of Education.

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

Satisfactory completion of all core requirements and the qualifying paper will satisfy the prerequisites for acceptance to candidacy.

Requirements for the degree of Doctor of Education include a minimum of 56 semester credit hours of doctoral studies completed at UVM following formal admission to the program with the following distribution.

15 semester hours in the core courses (minimum)

21 semester hours general distribution (minimum)

Dissertation Research — 20 semester hours (minimum).

All course credit hours beyond the core are distributed in educational leadership, research, critical perspectives, organizational change and selected specialty content areas.

TRANSFER OF CREDIT

A maximum of nine (9) semester hours may be accepted in transfer from an accredited graduate program. Transfer credit may be completed prior to admission to the Doctor of Education Program provided that the credit is approved by the student's Studies Committee and that the credit conforms to all other Graduate College requirements.

RESIDENCY REQUIREMENT

The residency requirement for the Doctor of Education (Ed.D.) degree consists of the following:

1. Completion of the five core courses (15 semester hours), and
2. Completion of 12 semester credit hours of coursework during two contiguous semesters beyond the core.

For further requirements concerning Studies Committees, Research and Dissertation, and the Dissertation Defense Examination Committee, refer to "General Requirements for the Degree of Doctor of Philosophy," page 21.

Application deadline is May 1.

Detailed information on the course of study is available from Program Director, Susan Hasazi, Professor, The University of Vermont, Office of the Dean, College of Education and Social Services, 311 Waterman Bldg., Burlington, VT 05405-0160.

MASTER OF EDUCATION

For admission to a Master of Education program, the applicant must present satisfactory scores for the Graduate Record Examination (general portion) or Miller Analogies Test (MAT) at the time of application for admission. 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 is based upon the student's undergraduate curriculum, professional experience, and aims and purposes in pursuing the master's degree.

Each program must include a minimum of either 30 semester hours of approved course work or 24 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 to begin study at the graduate level, 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 met previously. Graduate courses which currently fulfill this requirement include: EDFS 203, 204, 205, 206, 209, 255, 302, 303, 314, 347, 352, 354, and EDSS 313 and EDLS 377.

To insure effective planning of a graduate program for the degree of Master of Education, no more than nine hours credit will be accepted in partial fulfillment of degree requirements for courses taken prior to acceptance to the Graduate College.

Comprehensive Examination

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

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

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

Thesis Option

If the thesis option is elected, there must be an oral or written comprehensive examination *prior* to the oral examination in defense of the thesis.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF EDUCATION

Eighteen hours of Education and related areas or appropriate professional certification. The Education courses prerequisites may not apply to the Higher Education and Student Affairs Administration, Educational Leadership, or Interdisciplinary Major Program in the Department of Integrated Professional Studies. This is particularly true of persons seeking positions which do not require public school certification.

MINIMUM DEGREE REQUIREMENTS

Eighteen hours in courses in Education numbered above 200, including a minimum of six graduate hours in the foundations of education, 12 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.

CERTIFICATE PROGRAMS

The following certificate programs are offered for post-baccalaureate study by the College of Education and Social Services. They do not lead to a graduate degree and are not offered by the Graduate College. Interested persons are encouraged to contact directly the Dean's Office of the College of Education and Social Services for further information.

POST-BACCALAUREATE TEACHER PREPARATION PROGRAM

The Post-Baccalaureate Teacher Preparation Program is de-

260 Parallel Algorithms and Programming Techniques. Taxonomy of parallel computers, basic concepts for parallel computing, effectiveness and scalability, parallel algorithms for a variety of problems, message-passing programming paradigm and data-parallel languages. *Prerequisites:* 104 or permission. Three hours.

265 Computer Networks. Introduction to the theoretical and pragmatic principles of computer networking and client-server computing. Topics include: Local Area Networks; the Internet; ATM technology; TCP programming. *Prerequisites:* 101, 104. Three hours.

266 Network Security and Cryptography. Security and secrecy in a networked environment. Cryptography: public and private key. Authentication: trusted agents, tickets. Electronic mail and digital signatures. Privacy and national security. *Prerequisites:* 104, Math 124 or 171. Three hours.

274 Computer Graphics. Graphical representations of two and three dimensional objects on color raster display. Line generation, region filling, geometrical transformations, hidden line and surface removal, rendering techniques. *Prerequisites:* 104, Math 121, Math 124 or Math 271. Three hours.

294 Independent Readings and Research. Independent readings and investigation under the direction of a faculty member. *Prerequisite:* Departmental permission. Three hours.

295 Special Topics in Computer Scienc. Lectures on advanced topics. *Prerequisites:* Departmental permission. Three hours.

321 Advanced Computer Architecture (3-0). Study of advances in computer architecture. Topics may include: distributed and multiprocessor systems, array and vector processors, data driven architecture, memory hierarchies, and management schemes. *Prerequisite:* 222. Three hours.

331 Database Management Systems (3-0). Introduction to the design and implementation of modern database management systems. Data models, query languages, concurrency control, and crash recovery. *Prerequisites:* 201, 203, 243. Three hours.

346 Theory of NP-Completeness (3-0). Classes P and NP, Cook's Theorem, techniques for proving NP-completeness, NP-hard problems, approximation algorithms and schemes, probabilistic algorithms and schemes, P vs. NP. *Prerequisites:* 224, 243. Three hours.

351 Knowledge Representation (3-0). Systematic study of the methods of representing and retrieving information in modern computers. Logical models, semantic nets, procedural nets, and rule systems. *Prerequisites:* 224 and 251. Three hours.

361 Advanced Operating Systems (3-0). Topics covered will generally be chosen from one or more of the following areas: detailed case studies, distributed systems, real-time systems, object-oriented systems, and security. *Prerequisites:* 201, 222. Three hours.

363 Models of Computing Systems (3-0). Studies of user and program behavior. Aspects of computer systems: scheduling, resource allocation, memory sharing, paging, deadlocks. Mathematical models, queuing systems, simulations, performance evaluation, prediction. *Prerequisites:* 201, 222, Statistics 151. Three hours.

391 Master's Thesis Research. Credit as arranged.

394 Independent Study. Independent readings and investigation under the direction of a faculty member. *Prerequisite:* Permission. Credit as arranged (three to six hours).

395 Advanced Topics in Computer Science (3-0). Subject will vary from year to year. May be repeated for credit. *Prerequisite:* Permission. Three hours.

Education

Professors Emeriti Boller, Burrell, Carlson, Ducharme, Fishell, Gobin, Hood, Hunt, Leggett, Letteri, Peterson, Ponzo, Reagin, Rippa; Professors Abruscato, Agne, Burford, Clarke, Conrad, Fitzgerald, Fox, Griffin, Hasazi, Larson, Lipson, Nash, Paolucci-Whitcomb, Shiman, Stevenson, Tarule, Williams, Within; Associate Dean Richardson; Associate Professors Bishop, Capone, Erb, Glesne, Goldhaber, Hunter, Manning, Meyers, Mosenthal, Rathbone, Roche, Shelton, Wessinger; Assistant Professors Aiken, Burdett, Coffey, Comerford, Connolly, Dewees, Geroski, Kasser, Salembier, Weinstock; Research Associate Professors Cloninger, Giangreco, Proulx; Research Assistant Professors Edelman, Furney, Hamilton, Welkowitz; Lecturer Nichols.

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 practice, research problems, and in-service relationships with cooperating school systems and social service agencies. The programs in various areas of specialization are described below.

Satisfactory performance on the aptitude sections (verbal and quantitative) of the Graduate Record Examination or Miller Analogies Test (MAT) is required for admission to the Graduate College for students pursuing the degrees of Master of Education. The Master of Science degree in Counseling only requires the Graduate Record Examination.

DOCTOR OF EDUCATION IN EDUCATIONAL LEADERSHIP AND POLICY STUDIES

A Doctor of Education (Ed.D.) degree is offered in Educational Leadership and Policy Studies. This is an applied research based program for professionals serving in educational management positions in schools and school-related organizations; e.g. state departments of education, professional associations, higher education, and human service agencies.

Program emphases include: the design and implementation of educational research; policy studies; adaptation of theoretical constructs and models related to leadership and change in educational and social service settings; knowledge and skills in interorganizational relationships; budget and strategic planning and program evaluation.

This program has been designed to respond to the expanding demands placed on leaders in educational and human service organizations where they are increasingly expected to design and supervise local research and varied evaluative studies; interpret and apply recent national research findings; analyze and apply governmental regulations and court decisions; develop organizational responses to emerging social expectations; organize and lead staff development programs; understand and apply broad-based economic principles and social and fiscal policy; develop and manage budgets; assess and respond to the psychological needs of educational consumers; employ effective interpersonal management and decision-making skills.

PREREQUISITES FOR ADMISSION TO GRADUATE STUDIES

Applicants must possess a master's degree or equivalent, from an accredited institution and a cumulative grade-point average of 3.00 for previous graduate study. Other requirements include a representative scholarly writing sample and a resume. Students applying for graduate fellowships and/or assistantships are required to demonstrate satisfactory scores on the Graduate Record Examination (GRE).

Students admitted to graduate studies must complete successfully a core of study consisting of courses in research, foundational, and policy studies, and organizational change and

267 Small Business Planning. Instruction and guidance in the actual process of preparing a business plan. Students prepare a business plan including a market analysis; and legal, financial, and operational plans. *Prerequisites:* 85, 266, or equivalent. Four hours.

272 Seminar on World Food Problems and Policies. Review of recent books and periodical literature; discussion and written or oral reports on topics of contemporary interest. *Prerequisites:* Permission. Three hours. Ford. Alternate years with 273.

273 Agricultural Planning and Project Development. Agricultural sector planning and project development processes with a focus on policy instruments; links between agriculture and the rest of the economy; data requirements; and activity preparation, evaluation, and implementation. *Prerequisite:* 171 or permission. Three hours. Ford. Alternate years with 272.

287 Spatial Analysis. (See Geography 287.) Three hours.

295 Special Topics. Lectures or readings on contemporary issues in Community Development and Applied Economics. Enrollment may be more than once, up to 12 hours.

351 Research Methods. Developing research projects with the scientific methods; evaluating alternative literature review, sampling, surveying, and analytic methods; and reporting the results. *Prerequisite:* Three hours of statistics. Three hours.

354 Advanced Microeconomics. Principles and applications of advanced microeconomics: consumer and market demand, firm and market supply, perfect and imperfect markets, partial and general equilibrium, and policy analysis. *Prerequisites:* 254 or equivalent. Three hours. Wang.

377 Practicum in Extension Education. Advanced supervised practicum to provide direct involvement in extension education and training settings. Individually planned to apply course-related learning in an applied setting. *Prerequisites:* Completion of at least six hours in appropriate 200-level CDAE courses or permission. Variable credit: one to 12 hours. Only for students pursuing the M.Ed. degree.

391 Master's Thesis Research. Credit as arranged.

395 Special Topics. Lectures or readings on contemporary issues in Community Development and Applied Economics at the graduate level. *Prerequisite:* Graduate standing. Three hours.

Computer Science (CS)

Professor Colbourn; Associate Professors Snapp, Yang; Assistant Professors Baruah, Xue; Lecturers Douglas, Eppstein, Erickson; Research Assistant Professor Eppstein.

Research activities in Computer Science encompass a broad range of topics including formal language theory, operating systems, simulation, architecture, networking, artificial intelligence, and performance evaluation.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

A bachelor's degree and the approval of department. Satisfactory scores on the Graduate Record Examination general (aptitude) section. International students whose native language is not English or who have not received their education in English are required to submit satisfactory results from the TOEFL examination. Completed applications are due February 1.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Specific course work may be required of those who lack a sufficiently strong computer science background.

MINIMUM DEGREE REQUIREMENTS

Thesis Option

Thirty hours of which six to nine hours will be thesis research, the remainder is course work.

Nonthesis Option

Thirty-three hours of course work.

Students in both options must take or have completed the equivalent of Computer Science 201, 202 or 203, 222, 224, 243, and must take additional graduate level courses in Computer Science, or related areas with departmental permission, to fulfill the credit hour requirements.

COURSES OFFERED

Prerequisites for all courses: as listed, or equivalent, or by permission of instructor.

200 Discrete Simulation. See Civil Engineering 227. No CS graduate credit.

201 Operating System (3-0). Supervisory and control software for multiprogrammed computer systems. Processes synchronization, interprocess communication, scheduling, memory management, resource allocation, performance evaluation, object-oriented systems, case studies. *Prerequisite:* 104. Three hours.

202 Compiler Construction (3-0). Practice in design and implementation of translators for ALGOL-like languages. Regular and context-free grammars, parsing, code generation for stack and register machines. Interpreters. Run-time storage administration for block-structured languages. *Prerequisites:* 103, 104 and 243. Three hours.

204 Database Systems. Techniques for processing very large collections of data. Secondary storage. Database design and management. Query languages and optimization. Database recovery. *Prerequisites:* 100, 104. Three hours.

222 Computer Architecture (3-0). Architecture of computing systems. Control unit logic, input/output processors and devices, asynchronous processing, concurrency, parallelism, and memory hierarchies. *Prerequisites:* 101, EE 131. Three hours.

224 Analysis of Algorithms (3-0). Introduction to both analytical experimental techniques in algorithm analysis. Basic algorithm design strategies. Introduction to complexity theory. *Prerequisites:* 103, 104, Math. 173. Three hours. Cross-listing: Math. 224.

243 Theory of Computation (3-0). Introduction to the theoretical foundations of computer science. Models of computation. Church's thesis and noncomputable problems. Formal languages and automata. Syntax and semantics. *Prerequisite:* 104. Three hours. Cross-listing: Math. 243.

251 Machine Intelligence. Introduction to methods for realizing intelligent behavior in computers. Knowledge representation, planning, and learning. Selected applications such as natural language understanding and vision. *Prerequisites:* 103 and 104. Three hours.

256 Neural Computation. Introduction to artificial neural networks, their computational capabilities and limitations, and the algorithms used to train them. Statistical capacity, convergence theorems, backpropagation, reinforcement learning, generalization. *Prerequisites:* Math 124 (or 271), Stat 151, programming skills, and graduate standing or instructor permission.

Community Development and Applied Economics (CDAE)

Professor Halbrendt (Chair); Associate Professors Bloom, Ferreira, Ford, Kolodinsky, Pelsue, Petrillo, Schmidt; Assistant Professors Liang, Nicholson, Sullivan, Wang; Lecturers Ashman, Dombro; Extension Associate Professors Harris, Scannell; Extension Assistant Professors Carlson, Wackernagel; Adjunct Professors Wood, Schramm; Emeritus Professor Fife.

Vision:

CDAE is a center of excellence that contributes to the development of sustainable communities.

Mission:

The Department of Community Development and Applied Economics (CDAE) promotes sustainable community development through its commitment to interdisciplinary teaching, applied research and outreach. CDAE courses and field experiences provide students with a foundation in applied economics, skills in communication, critical thinking and problem solving, and an awareness of social, civic and environmental responsibility. CDAE research expands knowledge of the social, economic and environmental factors that affect our communities, small businesses, the agricultural sector and consumers. CDAE outreach works to improve the quality of life and economic opportunities in Vermont and around the world.

The Department offers a Master of Science Degree in CDAE and a degree in Master of Extension Education. Research includes dairy production and marketing, international demand analysis, consumer-related issues, community and economic development, retailing, family- and home-based business.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory scores on the Verbal and Math sections of the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS

The degree requires a total of 30 credit hours, of which 24 are from advanced courses in CDAE and other related fields plus six hours of thesis research. A written comprehensive examination and an oral defense of the thesis are also required. A student's thesis research is often an integral part of the faculty-led, ongoing research projects in the Department.

Students in the graduate program must have a 3.00 grade point average to remain a degree candidate. A student may be dismissed from the Graduate College if two or more grades below a "B" are received.

Core Course Requirements

Four core courses and a research seminar are required for each graduate student:

1. CDAE 354 — Advanced Microeconomics: Theory of the consumer, theory of the firm, perfect and imperfect competition, welfare economics, uncertainty and selected topics in economic policy.
2. CDAE 351 — Research Methods: Procedures of developing a research project, applications of economic theory and analytical tools in empirical economic research.
3. One additional course in quantitative or qualitative analysis to be approved by the Studies Committee (e.g., Statistics 225: Applied Regression Analysis; Statistics 223: Applied Multivariate Analysis; EDFs 347: Qualitative Research Methods).
4. One course in community development to be approved by the Studies Committee (e.g., CDAE 205: Rural Communities in Modern Society; CDAE 218: Community Organization and Development)

5. Research Seminar. Every student is expected to attend these seminars and is required to give a seminar.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF EXTENSION EDUCATION

An undergraduate degree with an acceptable major area of specialization.

All students must present satisfactory scores on the general (aptitude) Graduate Record Examination. Transcripts are evaluated on an individual basis.

Students who are deficient in key subject areas or where transcript grades appear to be marginal may be required to complete satisfactorily certain courses before acceptance as a degree candidate.

COURSES OFFERED

205 Rural Communities in Modern Society. Changing structure, dynamics of rural social organization in the context of modernization and urbanization. Emphasis on rural communities in the U.S. Three hours. Schmidt. (Cross-listed as Sociology 205.)

207 Markets, Food, and Consumers. Learn how producers, processors, wholesalers, cooperatives, retailers, consumers, and governments affect the movement of food and fiber products through the production-marketing chain. *Prerequisite:* 61 or equivalent. Three hours. Alternate years.

208 Agricultural Policy and Ethics. An examination of American agriculture and policies from various perspectives — historical, political, ecological, technological, social, economic, and ethical. Emphasis on contemporary issues, policy options, and future development. *Prerequisites:* 61 or equivalent, permission. Three hours. Rogers (Animal Sciences).

218 Community Organization and Development. Communities as changing sociocultural organizational complexes within modern society. Problems of formulation, implementation of alternative change strategies. Three hours. Schmidt. (Cross-listed as Sociology 207).

237 Economics of Sustainable Agriculture. Comparative economic analysis of small vs. large scale, full- vs. part-time farming, traditional vs. alternative agricultural systems, specialization vs. diversification, and issues in agricultural sustainability. *Prerequisites:* 61 or equivalent. Three hours. Pelsue. Alternate years.

253 Macroeconomics for Applied Economists. Explore macroeconomic principles and concepts as they affect individuals and businesses in local, regional, national, and global economics. *Prerequisites:* Economics 11, and CDAE 61 or equivalent. Three hours. Spring.

254 Microeconomics for Applied Economists. The study of economic choices of individuals and firms, and the analysis of competitive and noncompetitive markets. Emphasis on application of intermediate microeconomic theory. *Prerequisites:* 61 or equivalent. Mathematics 19, or permission. Three hours. Fall. Wang.

264 Price Analysis and Forecasting. Supply-demand relationship and price determination, price uncertainty and risk, futures and option contracting, market structure and performance, quantitative price forecasting methods and applications. *Prerequisites:* 254, Math 19, or permission; computer science and statistics helpful. Three hours. Spring.

266 Small Business Decision-Making. Applications of quantitative methods in analysis of small business decisions. Topics include incremental analysis, uncertainty, inventory policies, queuing theory applications, and mathematical programming. *Prerequisites:* 166, 167, or equivalent. Three hours. Wang.

signed for individuals who have a bachelor's degree from an accredited four-year institution and who want to become licensed to teach in Vermont. The basic program fulfills the professional education requirements for state licensure. Areas and levels of licensure include: Grades K-12 — art, music, physical education; Grades K-6 (elementary) — general elementary education, physical education; Grades 7-12 (secondary) — English, foreign language, mathematics, physical education, science, social studies.

Applicants to the Post-Baccalaureate Teacher Preparation Program must meet the following entrance criteria.

1. Hold a bachelor's degree from an accredited institution of higher education.
2. Possess a general education background based on those studies known as liberal arts which embrace the broad areas of a social and behavioral sciences, mathematics, biological and physical sciences, the humanities, and the arts.
3. Demonstrate a commitment to the teaching profession.
4. Have obtained an overall GPA of 2.5 in undergraduate course work.
5. For elementary candidates: Previous course work must include 30 semester hours in a single liberal arts academic area to meet Vermont licensure requirements.
6. For secondary candidates: Previous course work must include 30 semester hours in one of the academic areas listed below to meet Vermont state licensure requirements for the major academic concentration.

Majors: Biological science, chemistry, earth science, English, French, geography, German, history, Latin, mathematics, physical science, physics, Spanish.

Broad Field Majors: Natural science, social studies, environmental studies.

7. For secondary candidates: Have obtained a GPA of 2.5 in the academic area in which licensure is desired.

The Post-Baccalaureate curriculum includes both undergraduate and graduate courses. Nine graduate credits may apply toward the M.Ed. degree at UVM, contingent on acceptance into the Graduate College.

The deadline for applications is April 1 for the next academic year. Course work begins during the summer or fall, depending upon the area of licensure. Applications are accepted and considered only once each year with updated informational materials and application forms available in January. Requests for further information about the PBTP Program and application forms may be obtained by contacting the PBTP Coordinator, Department of Education, 533 Waterman Building.

CERTIFICATE OF ADVANCED STUDY

A Certificate of Advanced Study (sixth-year certificate), a 30- to 36-graduate credit hour program beyond the master's degree, is offered in the following fields:

- a. **Educational Leadership.** A program designed to prepare administrators and planners for public schools, educational and social agencies, and middle management positions in higher education.
- b. **Counseling.** Individuals who have completed a master's degree in Counseling or a related field are eligible for admission to the C.A.S. program. The program is designed to further develop skills in counseling, consultation, and program planning and coordination. Inquiries about the Counseling program can be addressed to the Coordinator of the program in 405 Waterman Building.

- c. **Integrated Studies.** A program designed for students who have completed their master's degree and are interested in exploring a self-designed, integrated program of study drawing upon graduate level experiences currently provided by departments of Integrated Professional Studies and Education of the College of Education and Social Services. The program does not lead to any type of state licensure.

The Program in Special Education offers the Certificate of Advanced Study to students with appropriate master's degrees in the following areas: consulting teacher/learning specialist, early intervention, essential early education, integration specialist, and intensive special education. A minimum of 30 credit hours of course work is required.

DEPARTMENTS

I. Education:

The Department of Education offers several programs of instruction:

Curriculum and Instruction. This master's program is designed to develop leadership in such educational settings as teaching, curriculum theory, curriculum development, and related areas of research for elementary and secondary public and private school settings. Areas of focus within the M.Ed. in addition to those described in detail below include elementary or secondary education, information technology, and health/physical education. The program is also appropriate for those with instructional roles in human services agencies.

Programs are developed to provide a comprehensive background in fields basic to instruction and curriculum development as well as the application of that knowledge to a specialized field. They include courses aimed at the examination and improvement of instructional practices in elementary and secondary schools, and understanding of curriculum theory and the application of curriculum development. Opportunities for independent study and research are encouraged in all specializations.

Within Curriculum and Instruction, the Licensure Master of Education program for secondary teachers is designed for those students who aspire to earn both a master's degree and a license to teach in public secondary schools. The program particularly welcomes students from UVM and northeastern colleges and universities majoring in arts and sciences, agriculture and natural resources who have completed majors in humanities, the arts, social sciences, science and mathematics. Students will become licensed to teach in grades seven through twelve in one academic year and two summers. With additional study an endorsement for the middle grades may be earned.

UVM students who are in their third year of study for a Bachelor's degree may apply to the Accelerated Licensure Master of Education program. These students, when accepted, may complete nine semester hours, six of which may be counted towards the minimum requirements for the Master's degree. Application forms and further information may be obtained from the Department of Education.

Inquiries regarding this program should be addressed to Donna Rowe, Department of Education.

Work at the graduate level 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 to those listed below, can be developed on an interdisciplinary basis responding to student strengths and needs.

Courses in professional education include: 207, 209, 211, 217, 218, 225, 226, 227, 228, 241, 244, 245, 248, 256, 257, 259, 261, 270, 271, 321, 333, and 343.

Inquiries regarding these programs should be addressed to Darlene Nelligan.

Educational Leadership. This program is designed to prepare leaders for public schools, educational and social agencies, and middle management positions in higher education. The M.Ed. program for licensure usually requires 30 to 36 credit hours of courses including seminars, or area internships, and research experiences. The Certificate of Advanced Study (C.A.S.) Program usually requires 30 to 36 credit hours of study beyond the M.Ed. requirements.

Courses with an administration/planning focus include: 264, 266, 268, 280, 332, 333, 334, 335, 336, 337, 353, 354, 355, 356, and 358.

Inquiries regarding this program should be addressed to Professor Susan Hasazi.

Educational Studies. The Foundations of Education faculty offer graduate courses in foundations of education and a master's degree in Educational Studies. The degree program is a research and scholarship based program for students from a diversity of educational fields including instruction, administration, policymaking and analysis, social services, state departments of education, allied educational professions (counselors, health care personnel, journalists), school boards, and international education. Students study past, present, and future educational problems and practices from the perspectives of the several disciplines; and they make cross disciplinary connections to discover the themes common to all the disciplines as well as to the theory and practice of education. Students study the process of making professional judgments about educational practice that include ethical, political, historical, literary, cultural, and social considerations. They strive to understand more profoundly not only the "what" and the "how" of the education professions, but the "why" as well.

Students in this program learn how to become competent scholars and researchers in the field of education by knowing the pertinent literature, staying abreast of the latest policy developments in the field, and communicating this information effectively to various audiences through competent, discipline-based research, publication, and teaching. Students also strive to acquire the values, understandings, and skills necessary to advance a conception of the good society which includes respect for human dignity, a belief in human rights, and an ethic of service to others.

The master's degree in Educational Studies is tailored to the intellectual and professional interests of the student. Students plan their course of study with a faculty advisor in the program. Students are urged to elect courses and organize their research around problems of interest to them.

Courses applicable to the Educational Studies Program include: 204, 205, 206, 209, 255, 302, 303, 314, 322, 347, 352, and 354.

Inquiries regarding this program should be addressed to Professor David R. Conrad.

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, administrators are responsible for developing programs which will enable every student to attain their maximum proficiency in the use of reading and language. To meet this end, several courses have been devised which focus on classroom reading instruction and reading difficulties. Through the Reading Center, 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, 375, 376, 378, and 379.

Inquiries regarding this program should be addressed to Professor Marjorie Lipson.

Special Education. This master's program is designed to prepare students to collaborate with families, educators, and other professionals and service agencies in the development, implementation and evaluation of instructional programs and supports for learners with disabilities in integrated school and community settings. The program requires that students have appropriate professional experience. Three primary areas of emphasis within the program are Consulting Teacher/Learning Specialist, Essential Early Education and Intensive Special Education. All three areas have State of Vermont approved licensure endorsement tracks, and successful completion leads to a licensure endorsement for special education in Vermont. Students seeking admission to a licensure endorsement track must meet additional requirements. The program requires EDSP 301 and 387 and the appropriate sections of 310 and 311, as well as a full year internship. Additional courses are required specific to each area for a usual total of 36 hours. Contact the Special Education Program for assistance with questions on admissions requirements.

Consulting Teacher. Students are prepared to collaborate with families, educators and other professionals in the design, implementation and evaluation of instruction for learners with mild to moderate disabilities in integrated regular elementary or secondary classrooms.

Essential Early Education. Students are prepared to provide individualized, family-centered special education services to young children with disabilities and their families through both direct and collaborative delivery systems coordinated with social service agencies in integrated home, preschool and community settings in rural areas.

Intensive Special Education. Students are prepared to provide direct and collaborative instruction to learners with severe disabilities on the basis of identified activities, skills, adaptations and transitions needed for learners to function in current and future integrated school, home and other community environments, with services involving learners' parents and a variety of professional disciplines.

Literacy and Special Education. The purpose of this concentration is to prepare elementary and middle level educators in the field of reading and special education. These educators help promote student success both through their specific knowledge of assessment, planning and remediation, as well as their ability to work efficiently with teams of students, parents and teachers to collaboratively plan and deliver an integrated system of services. Graduates of the program earn the Master's of Education Degree or a Certificate of Advanced Study and are recommended for professional licensure and endorsement as a reading teacher/coordinator and consulting teacher/learning specialist in the State of Vermont.

Courses in reading and special education include: 222, 301, 310, 311, 322, 323, 375, 376,

Inquiries regarding this concentration should be addressed to Professors Marjorie Lipson or George Salembier.

In addition, a Certificate of Advanced Study (sixth-year certificate) (see page 59) with a usual total of 36 credit hour program may be arranged for applicants who have already earned a Master's degree.

Additional information on the above should be requested from the Program Coordinator.

II. Integrated Professional Studies:

Counseling Program (Master of Science). This degree program provides professional preparation for individuals who wish to work as counselors in schools, colleges, or community or social service agencies. The program is accredited by the

council for the Accreditation of Counseling and Related Educational Programs (CACREP). It meets the requirements set by the State of Vermont Department of Education for preparing school counselors (K-12) for licensure in Vermont and the academic requirements set by the Vermont Board of Allied Mental Health Practitioners for preparing clinical mental health counselors for licensure in Vermont.

To achieve professional competence, students are expected to become knowledgeable and skilled in the following areas: dynamics of human growth and development; social and cultural foundations; theory and practice of helping relationships; group dynamics and leadership; lifestyle and career development; appraisal techniques; research and evaluation; professional orientation; administrative and planning concepts; personal growth and development (including self-awareness, interpersonal relations, and physical and mental health). Supervised internship in an appropriate field setting is of major importance in the program.

The specific composition of students' programs, designed with the assistance of a faculty advisor, is based on University, College, and Program requirements as well as the individual student's background, current needs and desires, and future goals. Learning experiences consist of a balance between theory and supervised practice.

The Counseling Program offers three specialty tracks: school counseling, community counseling, and mental health counseling.¹ Students may also select the dual track option which includes preparation in two specialty tracks. Fifty-one hours of credit are required for completion of the school counseling track and the community counseling track. Sixty credit hours are required for the mental health counseling track. (*Note: School counselor licensure in Vermont requires that the individual have at least a 30-credit-hour liberal arts concentration at the undergraduate level.*) Successful completion of the program is based on the demonstration of appropriate knowledge, relevant skills, and personal characteristics, as well as the accumulation of credits.

In addition to the general application procedures, a resume and a group interview are required of each qualified applicant. For a more detailed description of the program, contact Department of Integrated Professional Studies, Counseling Program, 405 Waterman Building, Burlington, VT 05405-0160 (802-656-3888).

¹The mental health counseling track is scheduled to be implemented Spring of 1999 (pending official University approval). It has been designed based on CACREP Standards. CACREP accreditation is anticipated Fall, 1999.

Higher Education and Student Affairs Administration. The graduate program in Higher Education and Student Affairs Administration is designed to prepare professionals to apply human development, organizational, and counseling principles to their work with students in higher education. Graduates of the master's degree program possess substantial knowledge in human development, administration and planning, organizational development, higher education policy, and counseling. Graduates assist colleges and universities in attaining the goals of higher education by serving as policy makers, student service providers, educators, activities programmers, consultants, and administrators.

The curriculum, including learning modules, practica internships, and graduate assistantships, combine to integrate conceptual knowledge with administrative practice. This curriculum enables all students in the program to gain an understanding of the student affairs profession, concepts of college student development, history of American higher education, professional ethics, research competencies, and the administration of American colleges and universities. An array of 60 practicum internships in student affairs offices and academic departments helps students to integrate their conceptual knowledge with student affairs practice.

Students in the higher education and student affairs graduate program typically hold a 20 hour per week graduate assistantship in student affairs offices, residential life, or academic support units. Stipends cover tuition and fees for 20 credit hours of study each year and a bimonthly salary.

Courses required for the M.Ed. degree in Higher Education and Student Affairs include: 297, 295, 360, 361, 362, 375, 380, 383, and 385. Forty credit hours are required for the M.Ed. degree.

There is also a Higher Education concentration in the Educational Leadership and Policy Studies doctoral degree (Ed.D.) which requires the same core courses (see Ed.D.) and a program of studies focusing on the administration in higher education.

Inquiries regarding these programs should be addressed to Professor Kathleen Manning.

Interdisciplinary Major. This degree program is for students who wish to pursue an individually designed, integrated program of study. The program draws primarily from graduate courses in Educational Leadership, Counseling, Higher Education and Student Affairs Administration, and Educational Studies but may include courses from other departments within the College and the University. A minimum of 36 credit hours is required for completion of the program. The program is ideally suited for persons whose personal and professional development requires a combination of course work not readily available in other graduate programs, or for individuals who plan to assume new or emerging roles in the fields of education or social and human services.

Applicants should have a clear understanding of how the Interdisciplinary Program will serve their career goals. For this reason, major emphasis in admissions is placed upon the applicant's Statement of Purpose. Applicants are strongly encouraged to contact the Department of Integrated Professional Studies, Waterman Building, prior to making application for admission. Detailed information about the program and admissions criteria will be supplied upon request.

Inquiries regarding this program should be addressed to Professor Robert Nash.

COURSES OFFERED

The College of Education and Social Services offers the following courses on a program basis. Departmental permission is required for enrollment.

200 Contemporary Issues. Designed so that its content and structure may accommodate special issues not especially appropriate within the boundaries of an existing course. *Prerequisites:* Twelve hours in education and related areas. One to six hours. (ECHD, ECSP, EDCO, EDEL, EDFS, EDHE, EDHI, EDLI, EDLP, EDLS, EDPE, EDSC, EDSP, EDSS)

295 Laboratory Experience in Education. Supervised field work designed to give students experience in specialized areas for their professional development. *Prerequisite:* Permission of the Coordinator of Professional Laboratory Experiences. One to six hours. (ECHD, EDCO, EDEL, EDFS, EDHE, EDHI, EDLI, EDLP, EDLS, EDMU, EDPE, EDSC, EDSP, EDSS)

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. Credit as arranged. (ECHD, EDCO, EDEL, EDHE, EDHI, EDLI, EDLP, EDLS, EDPE, EDSC, EDSP, EDSS)

380 Professional Problems in Education. Designed to cover selected educational problems in depth. The major emphasis will be on intensive and critical analysis of the literature and practice in a given area. Three hours. (ECHD,

EDCO, EDEL, EDFS, EDHE, EDHI, EDLI, EDLP, EDLS, EDPE, EDSC, EDSP, EDSS)

382 Teaching Internship. Supervised teaching experiences on a full-time basis, with related seminars in teaching subject. *Prerequisite:* Permission of coordinator of Professional Laboratory Experiences. Three to eight hours. (ECHD, EDEL, EDHE, EDPE, EDSC, EDSP, EDSS)

391 Master's Thesis Research. Thesis topic must be approved by a faculty committee. Credit as arranged. (ECHD, EDCO, EDEL, EDFS, EDHE, EDHI, EDLI, EDLP, EDLS, EDPE, EDSC, EDSP, EDSS)

397 Problems in Education. Individual work on a research problem selected by the student in consultation with a staff member. *Prerequisite:* Twelve hours in education and related areas; endorsement by a sponsoring faculty member. One to six hours. (ECHD, EDCO, EDEL, EDFS, EDHE, EDHI, EDLI, EDLP, EDLS, EDPE, EDSC, EDSP, EDSS)

ECHD—EARLY CHILDHOOD AND HUMAN DEVELOPMENT

(See page 104.)

ECSP—EARLY CHILDHOOD SPECIAL EDUCATION

310, 311 Curriculum and Technology in Special Education. See EDSP 310,311.

386 Teaching Internship: Management of Learning Environments for the Disabled. See EDSP 386.

EDCO—COUNSELING

220 Developmental Perspectives in Counseling. Survey of major and emerging theories of human development and application of theoretical concepts to self and others from a counseling perspective. *Prerequisites:* Graduate standing. Others by permission.

291 Special Topics in Counseling. Special issues in counseling, administration and planning, social work or higher education not appropriate to content of existing courses. Courses reflect the social services orientation of the Department of Integrated Professional Studies. Variable credit.

310 Counseling Strategies for Teachers. Counseling strategies appropriate for use in the classroom for class management assessment and utilization of different learning styles, and promotion of positive behavior change. *Prerequisite:* Permission. Three hours.

340 Developmental Guidance in Schools. An introduction to the role of the school counselor including developmental guidance program planning and implementation, consultation, crisis intervention, parent education and ethical issues. *Prerequisites:* Counseling majors or permission. Three hours.

344 Counseling Children and Adolescents. Students learn theories and will practice counseling children and adolescents: assessment, intervention planning, and play therapy, client-centered, behavioral, cognitive, Gestalt, Adlerian and Transactional Analysis approaches. *Prerequisites:* EDCO 374-Counseling Theory and Practice, EDCO 375-Laboratory Experience in Counseling, Counseling Majors or permission. Three hours.

350 Professional Issues in Counseling. A seminar in which professional, ethical, and legal issues facing counselors in schools and mental health settings are addressed through reading, research, presentation, and discussion. *Prerequisites:* Graduate standing or permission. Three hours.

351 Using Tests in Counseling. Exploration of test and testing process used in counseling and school settings. Includes necessary statistics. Experience in taking, administering, interpreting various tests; study projects for application to any setting. *Prerequisites:* Graduate standing or permission. Three hours.

360 Diagnosis & Treatment Planning in Counseling. Psychosocial, sociocultural, and historical definitions of deviant behaviors; assessment and diagnosis of mental illness according to DSM-IV categories; treatment modalities; referral processes and prevention strategies taught from a counseling perspective. *Prerequisites:* Graduate standing or permission. Three hours.

361 The Practice of Mental Health Counseling. Introduction to issues, needs, models and sociopolitical factors present in community and private-practice mental health counseling, with an emphasis on prevention and wellness. *Prerequisites:* Graduate standing or permission. Three hours.

374 Counseling Theory and Practice. Theoretical and practical approach to understanding the counseling process. Refinement of personal philosophy, theory of counseling, and implementation in practice. *Prerequisites:* Graduate standing or permission. Three hours.

375 Laboratory Experience in Counseling. Students learn and practice basic counseling skills and techniques. Video-taped practice sessions are supervised by course instructor. *Prerequisites:* 374. Counseling majors only. Three hours.

376 Chemical Dependency: Etiology & Treatment. Development (self, family, trauma) and resolution of chemical dependency. Cognitive-behavioral, psychoanalytic, systemic and eclectic orientations. Experiential psychotherapy technique and project required. *Prerequisites:* Graduate standing or permission. Three hours. Cross-listing: Psychology 259.

380 Professional Problems in Counseling. Covers selected counseling and counseling-related problems in depth. Major emphasis on interpersonal and critical analysis of the literature and practice in a given area. Three hours.

381 Counseling for Career and Lifestyle Development. An exploration of the theories, assessment instruments, counseling techniques, and issues most relevant in counseling for career and lifestyle development. *Prerequisites:* 374, 375 and Graduate standing or permission. Three hours.

383 Counseling Practicum. Introductory supervised experience in counseling in a field setting. Includes 100 hours working as a counselor with a minimum of 40 hours of direct service experience. *Prerequisites:* 220, 374, 375, 392 and permission. One hour.

384 Internship in Counseling. Supervised counseling experience in a field setting with direct client work. Minimum of 60 hours in actual counseling relationships. *Prerequisites:* 220, 374, 375, 383, 392, and permission. Variable hours, one to six.

386 Organizational Development for Counseling and Related Services. The concept and practice of organization development, analysis of and laboratory experience in the utilization of intervention methodologies. *Prerequisite:* Permission. Three hours.

388 Family Counseling: Systems. Theory and process of counseling with families, including family theory and current family therapy orientations and intervention skills. Includes practice of counseling interventions. *Prerequisites:* 220, 374, permission. Three hours.

389 Family Counseling: Interventions. Supervised practice in family counseling. *Prerequisites:* 388, permission. Three hours.

390 Advanced Counseling Seminar. Analysis and practice of advanced counseling skills with focus on new developments. Emphasis on integration of theory and technique into a consistent counseling model. *Prerequisites:* 374, 375, and permission. Three hours.

392 Group Dynamics: Theory and Experience. Encounter group experiences for prospective counselors providing increased awareness of self and models relating to others.

Theory, practice of group dynamics. *Prerequisites:* Graduate standing and permission. Three hours.

393 Advanced Group Counseling. Group leadership skills are developed, practiced, and refined through in-class experiences that focus on feedback exchange, group techniques, ethical issues, and group theory. *Prerequisites:* 220, 374, 375, 392 and permission. Three hours.

394 Special Topics in Counseling. Special issues in counseling, administration and planning, social work, higher education not appropriate to content of existing courses. *Prerequisite:* Permission. Variable credit.

397 Independent Study in Counseling. Individual work in counseling or counseling related area selected by student in consultation with faculty. Must follow University and program criteria. *Prerequisite:* Permission. One to six credit hours.

399 Program Completion Seminar. Students are aided in preparation of a scholarly paper to be presented and discussed in seminar and submitted for publication review. *Prerequisites:* Counseling majors in final or next to final semester and permission. One hour.

EDEL—ELEMENTARY EDUCATION

222 Cultivating Children's Literacy in the Elementary/Middle School Classroom. Contemporary research and practice related to the development of strategic, motivated, and independent readers and writers. Emphasis on integrating reading and writing within collaborative environments. *Prerequisites:* Twelve hours in education and/or related areas including an introductory course in reading or permission. Three hours.

234 Literature and Language for Children and Youth. Characteristics, interests, reading habits of children and youth; selection, evaluation of literature. Organizing book units for teaching literature, for content areas. Emphasis on development of oral, written expression. *Prerequisite:* Twelve hours in education and related areas or permission. Three hours.

241 Science for the Elementary School. Examination of elementary school science programs. Emphasis on methods and materials relating to construction, use of science units for children in grades K-6. *Prerequisites:* Twelve hours in education and related areas, or permission. 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. Evolution of mathematical concepts, notations. Meaning of numbers, number-systems. Theory underlying fundamental operations, metric measurements, analysis of modern approach to mathematics. Manipulative approach to teaching mathematics. *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 preschool experiences. *Prerequisite:* Twelve hours in education and related areas. Three hours.

271 Kindergarten Education with Laboratory Experiences. 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.

375 Literacy Assessment: Understanding Individual Differences. Designing and using assessment strategies to improve and adapt instruction. Identify, evaluate, and docu-

ment literacy development, emphasizing students at risk of reading failure. *Prerequisite:* EDEL 222 or permission. Three hours.

376 Laboratory Experiences in Reading and Related Language Instruction. Approaches for prevention, 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:* 375. Three 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. *Prerequisite:* Fifteen hours in education including nine hours in the field of reading and language education or permission. Three hours.

379 Seminar in Reading Instruction. Study of reading relative to total curriculum. Significant trends, concepts related to specific problems, programs in reading and language arts instruction; role of supervisor and reading consultant. *Prerequisite:* Fifteen hours of education including nine hours in the field of reading and language education or permission. Three hours.

EDFS—FOUNDATIONS

203 Social, Historical and Philosophical Foundations of Education. Critical examination of central educational/social issues and values with special emphasis on the struggle for justice and equality. Themes include schooling and social class, race, and gender; the purposes of education; and the responsibilities of teachers. *Prerequisite:* Admission to licensing program. Three hours. Conrad, Glesne, Nash, Shiman.

204 Seminar in Educational History. Selected topics in history of education. Education in democratic and authoritarian social orders. Topics: education of women, black heritage, American higher education in transition. *Prerequisite:* Twelve hours in education and related areas or permission. Three hours.

205 History of American Education. Educational principles and practices in the U.S. as they relate to the main currents of social history. Key ideas of historic and contemporary significance. *Prerequisite:* Twelve hours in education and related areas or permission. Three hours.

206 Comparative Education. Examines educational challenges confronting countries around the world. Explores issues related to sustainable development, diversity, citizenship, and justice in formal and nonformal educational contexts. *Prerequisite:* Twelve hours in education and related areas. Three hours.

209 Introduction to Research Methods in Education and Social Services. Seminars and research projects. Methods of historical, descriptive, experimental, quasi-experimental, field studies, and survey research. Three hours.

255 School as a Social Institution. Examination of the school and related social institutions, focus on themes, including: social class, race, ethnicity, socialization, role of the family, social change. *Prerequisite:* Twelve hours of education and related areas. Three hours.

302 Philosophy of Education. Critical examination of key beliefs and values in current philosophies of helping, e.g. phenomenological, behavioral, holistic, as practiced in a variety of educational and social service institutions. *Prerequisite:* Twelve hours in education and related areas. Three hours.

303 The Ethics of Helping Relationships. Clarification of ethical dimensions of professional rights and obligations for educators, counselors, administrators, other helping professionals. Examination of selected ethical controversies

currently facing the helping professionals. *Prerequisite:* Twelve hours in education and related areas. Three hours.

314 Modes of Inquiry. A critical analysis of the various conceptual and methodological foundations of theory and practice in education and the human services. *Prerequisites:* Twelve hours in education and related areas. Three hours.

322 The Challenge of Multiculturalism for Education and Social Institutions. Critical analysis of social, historical, and philosophical dimensions of multiculturalism. Examination of identity, empowerment, and justice and their relationships to educational/social policies and practices. *Prerequisites:* Twelve hours in education and related areas. Three hours. Shiman

347 Qualitative Research Methods. Introduces students to qualitative methods as a research paradigm and develops skills in ethnographic techniques of field observation, interviewing, and data analysis. Out-of-class fieldwork required. *Prerequisite:* Master's or doctoral level standing or permission. Three hours. Glesne.

352 Aesthetic Education and Social Justice. Exploration of art that deepens understanding of educational and social problems. Focus on artists who challenge dominant powers. Incorporates democratic perspectives on art and aesthetics. *Prerequisite:* Twelve hours in education and related areas. Three hours.

354 Anthropological Perspectives on Education and Social Services. Examination of formal and non-formal education as means to produce and alleviate cultural conflict. Incorporates an autobiographical approach to studying socio-cultural implications of schooling and social services. Emphasis on Third World situations. *Prerequisite:* Twelve hours in education and related areas. Three hours.

369 Ethics in Educational and Social Services Administration. Critical examination of theories of ethical decision making. Implications for leadership in educational, social service settings. Ethical investigation utilizing research, scholarship, actual incidents, case studies, role playing. *Prerequisite:* Ed.D. students have priority. Three hours.

455 Social Processes and Institutional Change. Critical analysis of theory and research related to justice, caring, and change in education and other social institutions. Focus: ideology, diversity, and management of knowledge. *Prerequisite:* Doctoral level standing. Three hours.

EDHE—HEALTH EDUCATION

208 School Health Programs. Organization of the total school health program. Problems and administration in the area of school environment, health services, health education, and school-community relationship. *Prerequisite:* 46 or equivalent. Three hours.

211 Community Health Education. Government and voluntary agencies' sociological, historical, educational, environmental, and medical influences. Role of community health educator in these influences and major American health concerns. *Prerequisite:* EDHE 46 or equivalent. Three hours. Pahnos.

220 Stress Management for Health Professionals. Physiological, psychological, and sociological aspects of stress. Theory, practices, teaching techniques, and application relevant to teaching students and/or clients. *Prerequisites:* EDHE 46 or equivalent. Three hours. Pahnos.

EDHI—HIGHER EDUCATION

332 Adult Development and Education. Critical examination of research on adult learners in higher education, development theory, and reentry issues facing older students. Analysis and application of proposals for new adult-oriented educational programs. Three hours.

360 Higher Education in America. Critical, contemporary overview of the American university. Implications of conflicting value philosophies for theory, practice of higher education. Three hours.

361 The (Un)Changing Academy. This course examines the historical trends that have shaped higher education and the tensions around stability and change affecting colleges and universities. *Prerequisites:* graduate student standing. Three hours.

362 College Students in America. Examination of the diversity of college students today, and the developmental issues arising during the college experience. Three hours.

375 Cultural Pluralism in Higher Education. This course explores cultural pluralism philosophies, racial identity development, racial incidences, and educational practices related to racism and diversity for implementation in higher education. *Prerequisites:* Graduate standing. Three hours. Manning.

383 Higher Education Administration and Organization. Introduction to concepts of administration and organization as applied to contemporary higher education setting. Characteristics of organizations, dynamic elements of administration, and theories and processes of change. Three hours.

385 Student Affairs Profession. Overview of the work of the student affairs profession, including philosophical base, historical development, current practices, and future trends. *Prerequisite:* Enrollment open only to Higher Education and Student Affairs students. 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. One to three hours.

395 Laboratory Experience. Practica internships, offered in various University departments and offices, enable students to integrate conceptual knowledge with professional practices. *Prerequisite:* Graduate standing in HIESA. Two hours.

397 Problems in Higher Education. Research project required for M.Ed. in HESA. Two hours.

EDLI—LIBRARY SCIENCE

272 Managing School Library Media Centers. Overview of administrative issues, including development of policies and procedures, budget preparation, personnel administration, and public relations. Focus on information technology and literacy. *Prerequisite:* Twelve hours in education and related areas, or permission. Three hours. Schubert.

273 Organizing School Library Media Center Collections. Introduction to cataloging of print and non-print materials, Dewey Decimal Classification, application of microcomputers to catalog and circulation services. *Prerequisite:* 272 or equivalent. Three hours. Lanius, MacLennan.

274 Designing Instruction for School Library Media Centers. Designing library instruction for integration with curricula and collaborating to create effective lessons. Issues surrounding active learning, critical thinking, learning styles, and assessment are examined. *Prerequisite:* 272 or equivalent. Three hours. Reit.

275 Developing School Library Media Center Collections. Evaluating and selecting books, periodicals, audiovisuals, software, and other materials for full range of student ages and ability levels. Maintaining collection, weeding, using interlibrary loan, and dealing with censorship. *Prerequisite:* 272 or equivalent. Three hours. Greene.

276 Information Sources and Services for School Library Media Centers. Helping students and teachers find information using print, online, CD-ROM and other resources. Developing interview skills and selecting materials for el-

ementary and secondary core collections. *Prerequisite:* 272 or equivalent. Three hours. Brew, Philbin.

277 Information Technologies for School Library Media Centers. Selecting, using, and maintaining full range of media equipment, including audiovisual and computer based systems. Designing and improving presentation facilities for media. *Prerequisites:* 272 or equivalent. Three hours. Brew, Ross, Whitby.

EDLP – LEADERSHIP AND POLICY STUDIES

264 Evaluation in Education and Social Services. For educational and social service personnel. Overview of the state-of-the-art of evaluation, emerging concepts, related models. Potential applications to settings; systematic data analysis. *Prerequisite:* Twelve hours in education or permission. Three hours.

266 Educational Finance. National, state, and local practices in educational financing and taxation; educational policies and incentives in funding; other revenue sources; financial expenditure procedures. *Prerequisite:* Twelve hours in education or permission. Two to three hours.

268 Educational Law. Legal basis for education. State and Federal statutes; related court cases; Attorney General opinions; Special Education procedures; Vermont State Board and State Education Department policies; regulations. *Prerequisite:* Twelve hours in education or permission. Two to three hours.

280 School Business Management. Analysis of basic management concepts applied to administering schools. Topics include leadership/management trends, types of budgets, risk management, planning, and other personnel and business operations issues. *Prerequisite:* Twelve hours in education. Three hours.

291 Special Topics in Organizational and Human Resource Development. Special issues in counseling, administration and planning, social work, or higher education not appropriate to content of existing courses. Courses will reflect the social services orientation of the Department of Education. Variable hours.

332 Seminar in Administration and Planning. Opportunity for students to experience, apply selected administration and planning concepts, skills through seminar and selected simulations of public school and social service organizational settings. Three hours.

334 Effecting and Managing Change in Educational and Social-Service Organizations. Change processes and models, the dynamics of change within the organization, and external factors affecting change. Managerial, leadership, and organizational factors and conditions impacting on innovations; change phases of initiation, implementation, and institutionization. *Prerequisite:* Twelve hours of graduate study. Three hours.

335 Staff Evaluation and Development. Supervisory roles, behavior, responsibilities, and relationships in educational and social service organizations; processes for evaluating the performance, promoting the development of staff, and increasing organization effectiveness. Three hours.

336 Curriculum Management in Educational and Social Service Organizations. Approaches to coordinating and managing curriculum or programs at the classroom, department, or organizational level; examination of factors effecting design and delivery of curriculum; developing curriculum guides and assessment methods. *Prerequisites:* 18 hours of education and related areas or appropriate professional certification. Three hours.

337 Political Processes in Education and Social Service Organizations. Political and operational relationships between schools, agencies, and other organizations at all governmental levels. Policy development, working with policy

boards, and coordinating organizational and community activities. Three hours.

352 Analysis of Educational and Social Service Organizations. Organizations as open or closed systems; examinations of goals, power, conflict, leadership, decision-making roles, communication; diagnosing causes of organizational problems; factors aiding, impeding organizational change. Three hours.

353 Seminar in Organizational Leadership. Roles, functions, relationships and responsibilities in maintaining and changing organizations; leadership styles and behavior; trends and issues impacting on organizations. Three hours.

354 General and Social Systems Theory. General Systems Theory is analyzed in terms of its utility for examining social systems, macrosystems analysis of research, planning, and interdisciplinary dialogue. Three hours.

355 System 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. Knowledge, values, attitudes relating to concepts about the future; alternative futures, trend analysis, goal setting; 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 Communication Education. Three hours.

367 Human Behavior in Education Systems. This course will enable students in the Doctorate in Education program to understand and assess human behavior as it affects and is affected by education systems. *Prerequisite:* Ed.D. students have priority. Three hours.

372 Leadership and the Creative Imagination. Leadership in societal organizations as presented in literature, other media. Students will demonstrate abilities to integrate leadership theory, principles, personal beliefs, practices with literary and other media models. *Prerequisite:* Ed.D. students have priority. Three hours.

386 Organization and Human Resource Development. The concept and practice of organization development, analysis of and laboratory experience in the utilization of intervention methodologies. *Prerequisite:* One course relating to human relations and one course relating to organizations or equivalent, or permission. Three hours.

387 Collaborative Consultation. (See EDSP 387.)

409 Applied Educational Research. Introduction to philosophical and methodological foundations of interpretive and empirical-analytic research with emphasis on systems change. Preparation of critical readers and synthesizers of research studies. *Prerequisite:* Doctoral level standing. Three hours.

431 Advanced Seminar in Organizational Leadership. Students inquire into new theories on leadership and the cognitive processes that define the intentions, values, beliefs, and future perspectives of themselves as leaders. Three hours. Aiken.

432 Advanced Seminar in Organizational Change and Human Resource Development. Students inquire into new theories, themes, and multicultural dimensions of organizations. Strategies for managing human resources, structural issues, and future trends in organizations are analyzed. Three hours. Aiken.

437 Seminar on Education Policy. An examination of the nature and function of education policy, emphasizing the structure and processes in education policy formulation

and implementation. *Prerequisite:* Doctoral level standing. Three hours.

491 Doctoral Dissertation Research. Credit as arranged.

EDLS—LEARNING STUDIES

212 Child and Adolescent Psychology. Children and adults are emerging individuals. Impacts of sociocultural ethics, values, institutions on individuals. Topics: human needs, values, self concept, personal freedom, bureaucratic society, cross-cultural issues. *Prerequisite:* Twelve hours in education and/or related areas. Three hours.

377 Seminar in Educational Psychology. Personal values, attitudes, beliefs related to learning. Psychological research of the teaching-learning process. Research use in analysis of educational processes. Applications for educational settings. *Prerequisite:* Twelve hours in education and related areas. Three hours.

EDMU—MUSIC EDUCATION

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. *Prerequisite:* Permission. Three hours.

243 Recent Trends in Music Education. Study of recent thought and practices in music education. Examination of current trends. *Prerequisite:* Permission. Credit variable, one to four hours.

253 Practicum in Music Education. Current methodology in music education for music specialist and classroom teacher. Each year emphasis in a different area of concentration. *Prerequisites:* Teaching experience, or permission. Credit variable. Course may be taken for one to four hours each semester and may be repeated for a maximum of eight hours.

290 Basic Concepts in Music Education. Disciplinary backgrounds, historical and philosophical foundations; fundamental consideration of the functions of music in the schools; development of a personal philosophy. Three hours.

390 Organization and Administration of Music Education. Study of the organization and administration of vocal and instrumental music in the public schools. *Prerequisites:* Teaching experience or permission. Three hours.

EDPE—PHYSICAL EDUCATION

201 Administration of Athletic Program. Background for effective administration of the athletic program of schools. Include scheduling, budgeting, management, equipment, policy, public relations, and education justification. *Prerequisite:* Twelve hours of education and psychology. Three hours.

203 Principles of Physical Education. Principles basic to sound philosophy of physical education for appraisal of historical development; relationship to health education, recreation, and other areas; foundation and functions of physical education. *Prerequisites:* Admission to the program and permission. Three hours.

220 Sport in Society. Examines sport as a social institution, emphasizing interrelationships between sport and the social context in which it exists; analyzes functions and dysfunctions of sport in contemporary society. *Prerequisites:* Sociology 1 or 19, or equivalent. Three hours. Wessinger.

240 Principles of Motor Learning and Human Performance. Nature of motor learning; factors affecting motor learning (motivation, emotion, stress); concepts of transfer; retention; alternatives in teaching, coaching methodologies based upon applied principles in motor learning. *Prerequisites:* 166, ECHD 62 or 63, or equivalent. Three hours.

241 Seminar in Physical Education and Athletics. Examination and analysis of contemporary issues and trends in

physical education and athletics not especially appropriate within the boundaries of an existing course. *Prerequisite:* Twelve hours in physical education and related areas. Variable credit (two to four hours).

253 Curriculum Design in Health and Physical Education. Philosophy, techniques of curriculum innovation in health and physical education. Inter-relationships between student needs and interests, teaching methodology, evaluative procedures, community involvement, administrative organization patterns. *Prerequisites:* 104, 105, 46, 155 or equivalent. Three hours.

260 Adaptive Physical Education. Recognition, prevention, correction of functional, structural deviations from normal body mechanics. Organization of programs adapted to needs of handicapped individuals in both special class and mainstreamed settings. *Prerequisite:* 155, 104, 105 or equivalent teaching experience. Three hours.

EDSC—SECONDARY EDUCATION

207 Adolescent Learning from a Behavioral and Cognitive Perspective. In-depth examination of cognitive learning theory and its background in behavioral and other learning theories, with application to teaching in a secondary setting. *Prerequisites:* Acceptance to licensing program. Three hours. Clarke, Fishell, Letteri, Parks.

209 Practicum in Teaching. Working with teachers and students in a secondary school, licensing candidates will assess the needs of students, document effects of direct service and the need for new curriculum. *Prerequisites:* 203, 207 or concurrent enrollment. Three hours. Clarke, Erb, Fishell, Sandoval.

215 Reading in the Secondary School. Design of methods and materials for integrating reading and learning skills in content instruction. Focus on learning support for at risk learners. *Prerequisites:* 203, 207, 209 or concurrent enrollment. Three hours. Clarke, Lang, Mekelsen.

216 General Methods for Secondary Teachers. Development of teaching methods for secondary instruction, adaptation to learning styles, models of teaching with design, lesson planning and assessment, with focus on cross-disciplinary collaboration. *Prerequisites:* 203, 207, 209 or concurrent enrollment. Three hours. Clarke, Erb, Fishell, Griffin, Gross.

217 Secondary School Curriculum. Principles and problems in curriculum development. An analysis of recent curricular innovations in American secondary schools. *Prerequisite:* Twelve hours of 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. Three hours.

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.

226 Teaching Internship. Collaboration with professional teachers in design and implementation of effective instruction, with special focus on developing programs in a high school setting. *Prerequisites:* 203, 207, 209, 215, 216 and Special Methods. Eight to twelve hours. Agne, Clarke, Erb, Fishell, Griffin, Gross, Sandoval.

227 Teaching Science in Secondary Schools. Consideration of science curricula and instructional strategies for grades 7-12. Topics may include: teaching science as prob-

lem solving, research in science teaching, affective education through science. *Prerequisites:* Twelve hours in education and related areas or permission. Three hours.

228 Literature in the Junior-Senior High School Curriculum. (Literary Criticism for Teachers.) Three hours.

229 Communicative Arts in Secondary Schools. (Teaching English in Secondary Schools.) Three hours.

230 Teaching for Results. Analysis of planning, curriculum, design, teaching, evaluation and classroom management from the perspective of research and practice. Special focus on the student with special needs. *Prerequisites:* Concurrent enrollment in 226. Three hours. Agne, Clarke, Erb, Fishell.

257 Teaching Mathematics in Secondary Schools. Contemporary secondary school mathematics curricula and instructional strategies for grades 7–12. Topics may include problem solving, research in mathematics education, use of calculators and computers, manipulatives, and evaluation. *Prerequisites:* Twelve hours in education and related areas or permission. Three hours.

259 Teaching Foreign Language in the School. (Secondary.) Three hours.

282 Seminar for Prospective Teachers of English. (See English 290.)

294 Seminar for Prospective Teachers of Communications. (See Communication Sciences 294.)

EDSP—SPECIAL EDUCATION

201 Foundations of Special Education. Examination of historical, current trends in the treatment of individuals with disabilities, including the effects of litigation, legislation, and economic considerations on educational and residential service delivery systems. *Prerequisite:* Twelve hours in education and related areas, or permission. Three hours.

207 Cooperative Learning. Theoretical and experiential instruction in procedures to increase social acceptance and academic achievement of exceptional learners in mainstream settings through cooperative learning. *Prerequisite:* Permission. Three hours.

216 Meeting the Curriculum and Instructional Needs of All Students. Introduction to curriculum and instruction for all students with a focus on individuals who present academic and behavioral challenges. Emphasis on assessment, evaluation, curriculum, instruction, theories of learning and social development. *Prerequisite:* Permission. Three hours. Salembier, Williams.

217 Instruction for Individuals with Severe Disabilities. Individualized instruction for learners with severe disabilities emphasizing objectives, assessment, task analysis, and behavior analysis. *Prerequisite:* Permission. Three hours.

221 Family Centered Services for Children with Special Needs. An in-depth study of families of children with special needs; family ecology; interaction and life cycle. Development and implementation of family/professional collaboration strategies. Practicum required. *Prerequisites:* Permission. Three hours. Fox, Yuan.

224 Meeting the Instructional Needs of All Students. Students apply principles of learning and social development to improve academic and social skills of all individuals with a focus on academic and behavioral challenges. *Prerequisites:* Permission of instructor. Three hours.

228 Advanced Instruction for Individuals with Severe Disabilities. Students apply advanced principles of behavior analysis in the development and implementation of instructional programs for learners with moderate and severe disabilities. *Prerequisite:* Permission and introductory behavior analysis course. Three hours.

275 Developing Vocational Instruction for Students with Special Needs. Development of instructional strategies for including students with disabilities in vocational education. Procedures for developing, implementing, and evaluating individualized vocational plans. *Prerequisite:* Admission to an approved teacher certification program or permission. Three hours.

280 Assessment in Special Education. Course covers assessment knowledge and skills essential for special educators, including test selection, administration and scoring, and legal issues related to special education assessment. *Prerequisites:* Admission to Graduate Program in Special Education or permission of instructor. Three hours.

290 Meeting the Curriculum Needs of All Students. Study of curriculum and technology areas related to the development, adaptation, and assessment of all students focusing on students with academic and behavioral challenges. *Prerequisite:* Permission. Three hours.

296 Special Education Practica for Classroom Teachers. Credit as arranged.

297 Curriculum for Individuals with Disabilities. Students develop and implement an objectives-based curriculum for learners with learning disabilities, mental retardation, behavior disorders, and/or multidisabilities. *Prerequisite:* Permission.

298 Special Education Practicum. Students provide direct instruction for six learners with learning disabilities, mental retardation, behavior disorders, and/or multidisabilities. *Prerequisite:* Permission. Credit as arranged.

301 History and Systems of Services for Individuals with Disabilities. Historical and current trends in treatment of individuals with disabilities, including effects of litigation, legislation, economic consideration in education, vocational, residential service delivery systems. *Prerequisite:* Acceptance as candidate for M.Ed. degree in special education, or permission. Three hours.

302 Physical and Developmental Characteristics of Individuals with Multidisabilities. Normal development — birth through six years, developmental disorders, disabilities. Medical, health considerations for multidisabled. Management of multidisabilities learner through employment of appropriate handling, positioning, feeding, toileting procedures. *Prerequisite:* Permission. Three hours.

310, 311 Curriculum and Technology in Special Education. Curricular and assessment areas essential to education of students with disabilities. Development, adaptation of curricula and assessment in early education, elementary and secondary and adult levels for mild, moderate, and severe disabilities. *Prerequisite:* Permission. Three hours.

312, 313 Advanced Behavior Principles in Special Education. A survey on behavior theory and research applications for learners with learning disabilities, mental retardation, behavior disorders, and multidisabilities. *Prerequisite:* Acceptance to M.Ed. program or permission. Three hours.

316 Research Seminar in Special Education. Research which addresses key issues in special education is reviewed and evaluated. Students write and present a research review with attention to practitioner needs. *Prerequisites:* EDSP 301, 310, 312, a course in quantitative research design. Three hours.

317 Design and Evaluation of Education for Individuals with Severe Disabilities. Students analyze, adapt curricula for severely disabled, utilizing knowledge of normal, abnormal motor development, feeding techniques, adaptive, prosthetic devices, medial aspects, parent professional partnership, socialization, normalization, legal aspects. *Prerequisite:* Permission. Three hours.

319 Internship for Specialized Personnel in Education. Approved internship reflecting student's interest and

needs. Competency-based instruction in development, implementation of effective programs for learners eligible for special education services. *Prerequisite:* Permission. Credit as arranged.

320 Laboratory Experience in Education: Educational Programming for Students with Severe Disabilities. Students identify, evaluate severely disabled learners, demonstrate competency in handling, positioning, feeding. Current skill levels assessed, educational programs designed, including objectives, teaching/learning procedures, evaluation, measurement. *Prerequisites:* Master's degree or equivalent, permission. Three hours.

322 Internship in Special Education: The Triadic Model of Consultation. Competency-based instruction in oral and written communication, consultation, and workshop level training is provided. Students apply the consultation model in an educational setting. *Prerequisites:* EDSP 310, 312 or permission. Variable credit. One to three hours.

323 Internship in Special Education: Systems Development. Competency-based instruction in planning for system level development and change. Students apply systems theory in an educational setting. *Prerequisites:* EDSP 310, 312 or permission. Variable credit. One to three hours.

384 Teaching-Internship in Special Education: Course Development and Implementation. Instruction in developing competency-based courses in special education for inservice teacher training. Practicum involves team teaching with University special education faculty. *Prerequisites:* Certification as a Consulting Teacher/Learning Specialist and permission. Six hours.

385 Teaching-Internship: Advanced Systems Development and Management in Special Education. Competency-based instruction in developing and adapting technological programs for advanced system-level change. *Prerequisite:* EDSP 319 (six hours), permission. Three to six hours.

386 Teaching-Internship: Management of Learning Environments for the Disabled. Implementation of data-based individualized education in one-to-one, small group, and large group instruction for severely disabled student(s) in special or regular classrooms. *Prerequisites:* EDSP 217, 290, 228 or permission. Variable credit.

387 Collaborative Consultation. Adult development and group dynamics theory provide the knowledge base for collaborating with parents and teachers to meet the diverse needs of students with disabilities. Three hours. Fitzgerald. Cross listings: EDLP 387, EDSS 387.

EDSS—EDUCATION

211 Educational Measurements. The essential principles of measurement in education. Topics include validity, reliability, principles of test construction, item analysis, and analysis of standardized tests as they apply to the classroom. *Prerequisite:* Twelve hours in education and related areas. Three hours.

215 The Gifted Child. Three hours.

238 Teaching with a Global Perspective. Approaches to teaching global and multicultural issues: justice and human rights, peace, and the environment. Development of curriculum materials. Links between local and global concerns. *Prerequisite:* Twelve hours of education and related areas. Three hours. Conrad, Shiman.

245 Applications of Microcomputers in Elementary and Secondary School Curricula. For elementary, secondary educators with experience in simple programming. Design of instructional procedures, integrating computers into school curriculum. Use of computer software to teach basic skills, reasoning, thinking skills. *Prerequisites:* Computer Science 3 or equivalent, permission. 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.

261 Current Directions in Curriculum and Instruction. Current trends, issues, literature, programs, and organizational activities in fields of curriculum and instruction emphasizing areas of individual concern. Focus on elementary and secondary school levels. *Prerequisite:* Twelve credits in education or equivalent. Three hours.

309 Interdisciplinary Seminar: Social Policy, Education, Social Services. Introduction to interdisciplinary study; the field of policy analysis and social change. Core academic experience for Interdisciplinary Majors. *Prerequisites:* Interdisciplinary majors; others by permission. Three hours.

313 Statistical Methods in Education and Social Services. Basic concepts of descriptive and inferential statistics. Topics: frequency distributions; measures of central tendency, dispersion; correlation, hypothesis testing. Application of concepts to educational situations. Three hours.

321 School Improvement: Theory and Practice. Analysis of research and practices pertinent to improvement of American schools. Student assignments include synthesis papers and site-specific research projects derived from course studies. *Prerequisite:* Twelve hours of graduate study in education. Four to six hours.

333 Curriculum Concepts, Planning and Development. Overview of conceptions of curriculum for elementary and secondary education; examination of contemporary curriculum trends, issues; processes for initiating, planning, developing curriculum activities and programs. *Prerequisite:* Twelve hours of education or permission. Three hours.

336 Professional Writing. Problems in writing faced by professionals in educational and human service settings. Students write reports, critiques, reviews; analyze examples of published work; receive detailed critiques of their work. Three hours.

343 The Study of Teaching. Study of the art and science with emphasis on students' own teaching. Current research on teaching and self-study are major foci. *Prerequisites:* Twelve hours of education, teaching experience. Three hours.

363 Seminar in the Analysis of Curriculum and Instruction. A case study analysis of the design, implementation, and evaluation of selected curricular and instructional improvements. *Prerequisites:* Ed.D. students have priority. Three hours.

349 Quasi-Experimentation in Education and Social Services. Quasi-experimental designs are analyzed, compared, and contrasted with "true experiments." Strategies for addressing threats to the validity of quasi-experiments are studied. Design exemplars are evaluated. *Prerequisite:* EDSS 313, or Psychology 340, or Statistics 211, or equivalent. Three hours.

387 Collaborative Consultation. (See EDSP 387.)

Electrical Engineering (EE)

Professors Absher, Mirchandani, Oughstun, Williams; Professors Emeritus Anderson, Evering, Roth; Associate Professors Fuhr, Titcomb, Varhue

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 the entrance qualifications without receiving credit toward graduate studies. The general requirements for admission as outlined under the "Regulations of the Graduate College" must be met. Areas of research expertise are control systems, biomedical engineering, test engineering, computer engineering, solid state physical electronics, electro-optics, information processing, communication theory, semiconductor materials, devices and integrated circuits (VLSI).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An accredited bachelor's degree in an appropriate field.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

An accredited bachelor's degree in electrical engineering or equivalent education.

MINIMUM DEGREE REQUIREMENTS

Advanced courses in electrical engineering, physics, and mathematics (18 to 24) with at least 15 credit hours appropriately distributed in approved areas of study in the Electrical and Computer Engineering Department; thesis research (six to 12 hours).

Although a thesis is normally required in the program leading to the M.S. in Electrical Engineering, the thesis may be waived with departmental approval, in favor of additional courses. In such cases, the student will be expected to have considerable professional experience, or to submit high quality technical reports as evidence of professional maturity.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

A master's degree in electrical engineering or the equivalent.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Successful completion of Ph.D. comprehensive examinations.

The majority of students will have completed a core program comprising graduate courses before taking the comprehensive examination.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

At least 45 credit hours in courses and seminars and 20 credit hours in dissertation. Four courses are to be chosen from a major area of concentration and two from a minor. The requirements specified under the "Policies of the Graduate College" must also be met. A total of 75 credit hours is required.

COURSES OFFERED

201 Linear System Theory (3-0). Basic concepts in system theory; linear algebra; state space representation; stability; controllability; and observability. Applications of these concepts. *Prerequisite:* 171 or permission. Three hours.

209 Transient Phenomena (3-0). Complex variable basis of Laplace and Fourier Transforms; applications to transient behavior of lumped and distributed parameter systems, root locus, Nyquist criterion, two-dimensional field problems. *Prerequisites:* 4, Math. 121 or equivalent. Three hours.

210 Introduction to Control Systems (3-0). Analysis and design of continuous and discrete time control systems; stability signal flow, performance criteria, classical and state variable methods, simulation design tools, computer-based realizations. *Prerequisites:* 171 or permission. Three hours.

221 Principles of VLSI Digital Circuit Design (2-3). The design, layout, and simulation of VLSI digital circuits. Emphasis on custom, laboratory design; typical topics will include memory, PLA, ALU, and elemental arithmetic circuits. *Prerequisites:* 121, 131, 163 or equivalent. Three hours.

222 Principles of VLSI Analog Circuit Design (3-0). The design, layout and simulation of VLSI analog circuits. Emphasis on small signal models and circuits used in operational amplifiers. *Prerequisites:* 121, 163, permission. Three hours. Staff.

224 Principles of VLSI System Design (2-3). Survey of VLSI design. Architecture and partitioning of functions. Design for testability. Simulation including timing. Synthesis. Design verification, manufacturing interface. Required team project and report. *Prerequisites:* 221 or instructor permission. Three hours.

227 Biomedical Measurements, Instrumentation, and Systems (3-0). Biomedical and clinical engineering in research, industry, and healthcare institutions. Measurement techniques and instrumentation. Integrated biomedical monitoring, diagnostic, and therapeutic systems. *Corequisites:* 121, Physiology and Biophysics 101, and permission. Three hours.

228 Sensors (3-0). Sensor design, interrogation and implementation. A wide variety of electrical, electronic, optical, mechanical, and cross-disciplinary devices. System designs, measurement techniques and methodologies. *Prerequisites:* Senior standing in Engineering or Physics. Three hours.

231 Digital Computer Design I (3-0). Hardware organization and realization, hardwired and microprogrammed control units, interrupt and I/O systems. A hardware design language is introduced and used for computer design. *Prerequisites:* 131, and either 134 or CS 101 or permission. Three hours.

232 Digital Computer Design II (3-0). Memory designs, error control, high-speed addition, multiplication, and division, floating-point arithmetic, cpu enhancements, testing and design for testability. *Prerequisite:* 231. Three hours.

233 Microprocessor-Based Systems and Applications (3-3). Basic principles of mini-microcomputers; A/D; D/A; channels, magnetic devices, display devices, mechanical devices; interface designs of analog systems to mini/microcomputers; principles of microprogramming; bit-slice-based microcomputers. *Prerequisite:* Permission. Computer Science 101 desirable. Four hours.

241 Electromagnetic Theory I (3-0). Maxwell-Lorentz theory emphasizing uniqueness and conservation laws. Potential theory with applications to boundary value problems, Green's function techniques, multipole expansions, and numerical methods. *Prerequisites:* 141; Math 272 recommended. Three hours.

242 Electromagnetic Theory II (3-0). Macroscopic Maxwell theory, boundary conditions and dispersion relations for spatio-temporal fields. Electromagnetic wave propagation, reflection and transmission, guides waves, radiation, scattering and diffraction phenomena. *Prerequisite:* 241 or permission. Three hours.

245 Lasers and Electro-Optical Devices (3-0). A theoretical description of light-matter interactions in photon emitting resonant cavities and a practical understanding of laser design and operation. *Prerequisite:* 142, permission. Three hours.

246 Engineering Optics (3-0). Applications of optics to the solution of engineering problems. Optical signal process-

ing, fiber optic sensors, integrated optics. *Prerequisites:* 245 or permission. Three hours.

250 Test Engineering (3-0). Parametric, structural, functional, characterization and stress testing of components and subsystems. Test methods, strategies, planning, and economics. Test equipment hardware and software. *Prerequisites:* 121, 131. Three hours.

251 Digital System Testing and Testable Design (3-0). Circuit failures, fault models, testing and test pattern generation, logic and fault simulation, design for testability, scan design, test interfaces, design for built-in self-test. *Prerequisite:* 131. Three hours.

261 Solid State Materials and Devices I (3-0). Energy band theory, effective mass, band structure effect on electronic properties of solids. Transport of electrons and holes in bulk materials and across interfaces. Homojunctions, heterojunctions, Schottky barriers. *Prerequisite:* 163 or equivalent. Three hours.

262 Solid State Materials and Devices II (3-0). Multi-junction and interface devices. Heterostructure and optical devices. Dielectric and optical properties of solids. High-frequency and high-speed devices. *Prerequisite:* 261. Three hours.

266 Science and Technology of Integrated Circuits (3-0). Science and technology of integrated circuit fabrication, interaction of processing with material properties, electrical performance, economy, and manufacturability. *Prerequisites:* 163 or 261 and concurrent registration in 164 or 262. Three hours.

270 Probability Theory and Stochastic Processes (3-0). Probability theory, random variables, and stochastic processes. Response of linear systems to random inputs. Applications in electrical engineering. *Prerequisite:* 171 or equivalent. Three hours. Cross-listing: Statistics 270.

271 Least Squares Estimation and Filtering (3-0). Foundations of linear and nonlinear least squares estimation, smoothing and prediction, computational aspects, Kalman filtering, nonlinear filtering, parameter identification, and adaptive filtering. *Prerequisites:* 201, 270. Three hours. Cross-listing: Statistics 271.

274 Introduction to Wavelets and Filter Banks (3-0). Continuous and discrete-time signal processing. Continuous wavelet transform. Series expansion of continuous and discrete-time signals. Perfect reconstruction, orthogonal and biorthogonal filter banks. Wavelets from filters. *Prerequisites:* 171, or instructor permission. Three hours.

275 Digital Signal Processing and Filtering (3-3). Sampling, aliasing, and windowing. FIR and IIR filters. DFT and FFT. Linear predictive coding. Vocoder. Digital simulation and implementation using real-time processors and evaluation modules. *Prerequisites:* 171, permission. Four hours.

276 Image Processing and Coding (3-3). Image enhancement techniques by point and spatial operations. Data compression techniques to include scalar quantization, entropy coding, transform and sub-band coding. Labs on PC hardware; PC and Unix-based software. *Prerequisites:* 270 recommended, 275. Four hours.

277 Image Analysis and Pattern Recognition (3-0). Image, shape, and texture analysis. Statistical pattern recognition methods. Pattern recognition and computer vision techniques for machine parts recognition and automatic visual inspection. *Prerequisite:* 276. Three hours.

281 through 284 Seminars (1-0). Presentation and discussion of advanced electrical engineering problems and current developments. *Prerequisite:* Graduate engineering enrollment. One hour.

285 Engineering Design Analysis and Synthesis (3-0). Advanced engineering problem solving, analytical tech-

niques and simulations involving control systems, digital electronics, computer hardware and software; technical writing and documentation emphasized. *Prerequisite:* Permission. Three hours.

295 Special Topics. Formulation and solution of theoretical and practical problems dealing with electrical circuits, apparatus, machines, or systems. *Prerequisites:* 4, permission. Three hours.

310 Digital Control Systems (3-0). Digital control system analysis and design using transform, algebraic, and state space methods. Sampled data systems, stability, quantization effects, sample rate selection, computer-based realization. *Prerequisites:* 210 or permission. Three hours.

312 Introduction to Optimal Control Systems (3-0). Optimal control problem formulation and solution; including the calculus of variations, Pontryagin's maximum principle, Hamilton-Jacob theory, dynamic programming, and computational methods. *Prerequisite:* 210. Three hours.

314, 315 Nonlinear System Theory (3-0). Basic nonlinear methods including computational and geometrical techniques for analysis of nonlinear systems. Describing function methods and bifurcation and catastrophe theory. Sensitivity and stability considerations. *Prerequisite:* 201 or Math. 230. Three hours.

338 Semiconductor Device Modeling and Simulation (3-0). Analysis and application of computer models for semiconductor process and device simulation. Strategies for development of device models for circuit simulation. *Prerequisites:* 262, permission. Three hours.

340, 341 Special Topics in Electromagnetic Field Theory (3-0). For advanced students in the field of electromagnetism. Topics selected from special interests of staff with lectures and readings from current literature. Three hours.

347 Optical Field Theory I (3-0). Electromagnetic theory of the optical field. Molecular optics and the Ewald-Oseen extinction theorem. The eikonal equation, propagation in inhomogeneous media. Diffraction and aberration theory. *Prerequisites:* 241, 242. Three hours.

348 Optical Field Theory II (3-0). Classical theory of coherence and statistical optics. The Van Cittert-Zernike theorem, partial coherence. Rigorous diffraction theory, the optics of metals and crystal optics. *Prerequisites:* 270, 347. Three hours.

352 Advanced Semiconductor Device Physics and Design (3-0). MOSFET, bipolar, and CMOS device parameters, their characterization, and their relation to process technology. Description and use of computer-aided process and device models. *Prerequisite:* 262. Three hours. Alternate years. Spring semester.

354 MOS Analog Integrated Circuit Design (3-0). Analysis and design of MOS analog integrated circuits. Each student will design, layout, test, and document an analog integrated circuit using computer-aided-design techniques. *Prerequisites:* 338, 339. Three hours.

365 Optical Properties of Solids (3-0). Optical and optoelectronic properties of semiconductors. Applications to photodetectors, solar cells, light emitting diodes and lasers. *Prerequisites:* 242, 262, Physics 273. Three hours.

366 Solid State and Semiconductor Theory I (3-0). Energy band theory for electrons and phonons in crystalline solids. Brillouin zones. Conservation laws. Elements of statistical mechanics. Transport properties. Applications to semiconductor electronics. *Prerequisites:* 261, Physics 273 or Chemistry 263. Three hours.

373, 374 Digital Communication (3-0). Source entropy and channel capacity; signal representation; optimal detector for Gaussian channels; digital modulation/demodulation schemes; error probability; block/convolutional codes;

Viterbi algorithm; real channels. *Prerequisites:* 174, 270, 373 for 374. Three hours.

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:* Permission. Three hours.

391 Master's Thesis Research. Credit as arranged.

395 Advanced Special Topics. Advanced topics of current interest in electrical engineering. *Prerequisites:* Permission. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

The following courses are offered infrequently but may be taught when sufficient student interest is demonstrated.

272 Information Theory. Three hours.

317, 318 Theory of Optimum Control Systems. Three hours.

319, 320 Special Topics in Control System Theory. Three hours.

345 Electromagnetic Antennas and Propagation. Three hours.

367 Solid State and Semiconductor Theory II. Three hours.

Engineering Physics

A program of advanced study in physics and engineering to prepare students for research and development positions in mission-oriented organizations. Advanced courses in both physics and engineering are required as is a comprehensive examination and a thesis based upon the application of physical principles to a real or simulated engineering problem. A nonthesis option is available to students who have already demonstrated ability to perform research and report the results in written and oral form.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Students with an accredited bachelor's degree in computer science, engineering, applied mathematics, or physics are normally considered for admission to the program. Submission of scores on the general (aptitude) Graduate Record Examination is required.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

The student is expected to have completed the following courses: Math. 271, 272 (applied mathematics), ME 50 or Physics 211 (intermediate mechanics), ME 101 (materials engineering), Physics 265, ME 41, or ME 115 (thermal science), Physics 213, 214 or EE 143, 144 (electromagnetism), Physics 273 (quantum mechanics), Physics 242 or EE 263, 264 (solid state physics).

Since these are prerequisites to the degree program, and not the program itself, any of these course prerequisites may be replaced by a demonstration of equivalent knowledge of their content, to the satisfaction of the Studies Committee.

Demonstrated ability to program scientific or technical problems in Fortran, or an equivalent language.

MINIMUM DEGREE REQUIREMENTS

Thesis Option

Completion of 30 credits of study approved by the Studies Committee, which must include Physics 341, 342, and 362, not fewer than six credits in graduate engineering courses, and six credits in Physics 391 (thesis research). This option requires submission of a thesis based on an independent investigation demanding the application of physical principles to a real or simulated engineering problem approved by the Studies Committee.

Nonthesis Option

Students who are offered the nonthesis option must elect to replace the requirement of Physics 391 with Physics 381, 382.

Examinations

All students are required to pass the regularly offered Physics Comprehensive Examination, administered annually *circa* the end of May. Students submitting a thesis (Physics 391) must pass the usual Thesis Examination.

English (ENG)

Professors Bradley (Director of Graduate Studies), Broughton, Eschholz, Fuhrer, Gutman (Chairperson), Huddle, Magistrale, Manchel, Poger, Rosa, Shepherd, Stephany, Thompson, Warhol; Associate Professors M.J. Dickerson, Edwards, Simone, Stanton, Sweterlitsch, Winter; Assistant Professors Barnaby, Baruth, Kete, Schnell, Welch, Won.

The research interests of the faculty of the Department of English and library resources permit graduate students to undertake thesis subjects in virtually all fields of the discipline.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS

An undergraduate major in English or its equivalent; satisfactory scores on the general (aptitude) Graduate Record Examinations; demonstration of proficiency in writing by a detailed statement concerning the purpose in pursuing graduate study in English. If admitted conditionally the student must complete satisfactorily a stipulated number of hours (usually six) of graduate level work.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Satisfactory completion of 18 hours of appropriate credit.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

Thesis Option

Completion of 24 hours of course work, including five of the following six: 320, 330, 340, 350, 360, and 370 or 201-296; and at least nine additional hours (at least three of these nine in English or Humanities, at most six in related fields). Candidates must submit a customized reading list, pass a comprehensive exam based on it, and complete six additional hours by writing an acceptable thesis and defending it successfully (ENG 391).

Nonthesis Option

Completion of 30 hours of course work, including five of the following six: 320, 330, 340, 350, 360, and 370 or 201-296; and at least fifteen additional hours (at least nine of these in English or Humanities, at most six in related fields). Candidates must pass a three-part comprehensive examination

based on set Departmental reading lists, and must receive a grade of B+ or better on two seminar papers submitted to an *ad hoc* faculty Reading Committee (ENG 392).

Both Options

All M.A. candidates in English must demonstrate a reading knowledge of a foreign language by examination or by advanced coursework.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS IN TEACHING

See page 21.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN TEACHING

Thirty credit hours of course work; 24 in English (including five of the following six: English 320, 330, 340, 350, 360, and 370 or 201-296; and at least nine additional hours of course work in English or Humanities – up to six of these in a related field), plus a comprehensive examination in English. Additional requirements in Education will differ for those already licensed to teach (at least 6 credit hours) and for those not licensed to teach (up to 33 credit hours). See page 21 for further details.

COURSES OFFERED

At the 200 level, the Department of English offers several seminars each semester which are numbered as described below. The specified topics vary each semester, depending on the instructors assigned. Graduate students must obtain the permission of the Director of Graduate Studies in English to enroll in 200-level courses and will only participate in these undergraduate seminars under special circumstances.

201, 202 Seminar in English Language or Critical Theory.

211, 212 Seminar in Composition and Rhetoric.

221, 222 Seminar in Literature to 1800.

241, 242 Seminar in 19th Century Literature.

251, 252 Seminar in 20th Century Literature.

281, 282 Seminar in Literary Themes, Genres, and Folklore.

290 Seminar for Prospective Teachers of English. Approaches to teaching composition, literature, and the English language in secondary school. Three hours.

295, 296 Advanced Special Topics. Advanced special-topics seminars in English beyond the scope of existing formal courses. *Prerequisites:* Graduate or advanced undergraduate standing. Permission. Three hours.

At the 300 level, enrollment is restricted to students with graduate standing. Permission of the Director of Graduate Studies in English is required for enrollment. Topics vary each semester. Courses may be repeated for credit, when the subject matter differs.

320 Seminar: Major Author. In-depth study of the works, critical reception, and context of an author writing in English. Representative topics: Chaucer; Shakespeare; Milton; Austen; Dickinson; Morrison. Three hours.

330 Seminar: Literary Period. Advanced survey of authors, themes, genres, and/or cultural context in a British or American literary period. Representative topics: British Renaissance; Restoration and Eighteenth Century; Victorian; American Renaissance. Three hours.

340 Studies in Rhetoric and Composition. Introduction to current issues in the field. Representative topics: Rhetorical theory; gender, class, and composing; writing across the curriculum; collaborative learning; literature and composition. Three hours.

350 Survey of Literary Theory and Criticism. Introduction to contemporary approaches, including marxist, feminist, psychoanalytic, structuralist, deconstructionist, reader-response, new-historicist, and/or post-colonial literary theory. Three hours.

360 Seminar: Special Topics. Topic varies, based on faculty research. Representative topics: orality and literacy in medieval literature; feminist theory; anthropological approaches to literature; narrative theory and Victorian novels. Three hours.

370 Principles of Literary Research. Methods of literary study, research, and scholarship, including bibliographic, manuscript, and archival work. Three hours.

391 Master's Thesis Research. Credit as arranged.

392 Seminar Paper Review. Zero hours.

397 Special Readings and Research. Directed individual study of areas not appropriately covered by existing courses. Permission of Graduate Director. Not to exceed three hours.

Environmental Studies (See page 107.)

Forestry

For descriptions of the M.S. Program in Forestry, see NATURAL RESOURCES, page 86.

French (FREN)

Professors Carrard, Kuizenga, Senécal, Van Slyke, Whatley (Director of Graduate Studies); Associate Professor Crichfield; Assistant Professor Whitebook.

Opportunities for thesis research in French and French Canadian literature and culture are offered in all periods, from the Middle Ages through the 20th Century.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS AND MASTER OF ARTS IN TEACHING

An undergraduate major in French or equivalent. Satisfactory scores on the general (aptitude) Graduate Record Examinations.

MINIMUM DEGREE REQUIREMENTS

Master of Arts

Twenty-four credit hours of course work, including the Graduate Humanities Seminar and EDSC 259 (Teaching Foreign Language in the Schools). In addition, six hours of directed research, with the following options:

Plan A: Thesis research (six hours)

Plan B: Two research papers (six hours)

Candidates must pass an examination in four areas of their study.

Master of Arts in Teaching

If you are already a licensed teacher: Twenty-one credit hours in French (including the Graduate Humanities Seminar) and a comprehensive examination, plus six credit hours in education courses.

If you do not presently have licensure: Twenty-one credit hours in French (including a 3-credit interdisciplinary Graduate Humanities Seminar) and a comprehensive examination. In addition, thirty hours of professional education course work, including a year's internship in a Professional Development School, production of a Licensure Portfolio, and Teacher Licensure.

COURSES OFFERED

The following courses are available for graduate credit. For more detailed information on specific courses, consult with the department chairperson and the course instructor.

French Language

209 Advanced Grammar. Comparative grammatical study centered on the specific problems encountered by Anglophones in written and spoken French. Three hours. Carrard, van Slyke.

211 History of the French Language. The development of French through sound and structure, from late Latin through the twelfth century. Alternate years. Three hours. Whitebook.

215 Methods of Text Analysis. Introduction to procedures and terminology used in analysis of texts of various genres. Three hours. Carrard.

216 Stylistics. Study of idiomatic difficulties faced by people who learn French; translation; analysis of the various "levels of speech" in French, with their stylistic features. Three hours. Carrard.

French and Francophone Literature and Culture

225 Medieval French Literature. First semester; Old French Language; 12th century epics, e.g. *La Chanson de Roland*, *Le Pèlerinage de Charlemagne*, Breton lays; Marie de France. Three hours. Whitebook.

226 Medieval French Literature. Second semester: Romances: Chrétien de Troyes, Guillaume de Lorris and Jean de Meung; lyric poetry, Machaut; Pisan; Charles d'Orléans; farces and miracles. *Prerequisite:* 225. Three hours. Whitebook.

235 Literature of the French Renaissance. Readings in fiction, poetry, and essays: Rabelais; the lyric poets Louise Labé, Ronsard, and Du Bellay; the tales of Marguerite de Navarre; Montaigne. Three hours. Kuizenga, Whatley.

245 The Baroque Age, 1600–1650. The literature after France's civil wars, up to the triumph of classicism: religious, lyric, and political poetry; idealistic, picaresque and fantastic novels; baroque drama; Pascal. Three hours. Whatley.

246 Seventeenth Century Prose. Creation of the modern novel, evolution of psychological and ethical writing. Topics include women writers, the *moralistes*, memoirs, relationships between socio-political structures and literary production. Three hours. Kuizenga.

247 Seventeenth Century Theatre. Works of Corneille, Molière and Racine studied in the context of the evolution of seventeenth century thought. Three hours. Kuizenga.

255 18th Century Literature. Writers of the early Enlightenment. Possible topics: the impact of the new science; the literary reflection of new social types; the "pursuit of happiness." Three hours. Whatley.

256 18th Century Literature. Rousseau, Diderot, Laclos, Sade: the generation before the Revolution. Possible topics: the attempts to define "natural man;" the relationship between the arts and morality, between liberty and libertinism. Three hours. Whatley.

265 Romanticism, Symbolism, Decadence in 19th Century Literature. Evolution of the idealist tradition: the Romantic movement (Staël, Chateaubriand, Sand, Hugo, Musset, Flaubert); the Symbolists (Baudelaire, Verlaine, Rimbaud, Mallarmé); fin de siècle Decadents (Huysmans). Three hours. Crichfield.

266 Revolution and Reaction in 19th Century Narrative. Study of the representations of major social issues of the period, such as power, class, money and women. Representative authors: Balzac, Flaubert, Sand, Stendhal, Zola. Three hours. Van Slyke.

275, 276 20th Century Literature. Selected topics dealing with poetry and/or narrative related either to an historical period or a literary movement. Three hours. Carrard.

277 Topics in 20th Century French Theatre. Subjects may include: *le théâtre traditionnel*, *le théâtre "de l'absurde"*, *le théâtre de la marge*, a combination of all the above. Each may be repeated up to six hours. Three hours.

285 Québec Literature I. A study of contemporary (1960–1985) major works of fiction, poetry, and drama. Authors studied include Anne Hébert, Michel Tremblay, Jacques Godbout, Gaston Miron. Three hours. Senécal.

289 African Literature of French Expression. Study of West African poetry, theatre, novel, and civilization as an expression of the Black experience in the language of the French colonizer. Three hours.

290 Contemporary French Thought: The Linguistic Model. Study of the model of structural analysis established by Saussure and its adaptation to other domains of contemporary thought such as anthropology, psychoanalysis and philosophy. Taught entirely in French. Three hours. Van Slyke.

292 Topics in French Culture. In-depth study of a major aspect of French culture. See Schedule of Courses for specific offering. *Prerequisites:* FREN 191, or HIST 135, or HIST 136, or permission of instructor. Three hours.

293 Québec Culture. Sociocultural study of the French civilization of Canada. Three hours. Senécal.

295, 296 Advanced Special Topics.

297, 298 Advanced Readings and Research.

391 Master's Thesis Research. Credit as arranged.

Geography (GEOG)

Professors Bodman, Gade; Associate Professors Barnum, Seager (Chair); Assistant Professors Carmody, Dupigny-Giroux, Elder, Hannah.

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

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS

Evidence of a strong interest in geography. Satisfactory scores on the general (verbal and quantitative) portion of the Graduate Record Examination.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

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

MINIMUM DEGREE REQUIREMENTS

Twenty-one hours in geography courses including 201, 287, or a reading knowledge of a foreign language, and six hours of thesis research (391); nine additional hours in geography or a related field. For additional information, please write to the Graduate Program Coordinator, Department of Geography.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS IN TEACHING

See page 21.

COURSES OFFERED

Admission to the following courses for graduate credit requires the approval of the Graduate Program Coordinator in geography.

202 Research Methods. A systematic overview of the art and science of geographical inquiry. This seminar examines key research and methodological approaches in the discipline. *Prerequisites:* Nine hours in geography. Three hours.

203 Contemporary Geographic Thought in Context. A survey of paradigms and issues in contemporary geography. Attention paid to the social and historical contexts of geographic thought. *Prerequisites:* Nine hours in geography or permission of instructor. Three hours.

210 Special Topics in Regional Geography. Specialized study of a particular region. *Prerequisite:* Permission. Three hours.

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.

233 Rural Planning. Study of rural, regional, water, and natural resource planning concepts and principles. Field exercises in plan evaluation, carrying capacity, agricultural land protection, growth control. *Prerequisite:* 61 or equivalent. Three hours. Cross-listing: Community Development and Applied Economics 233.

242 Problems in Physical Geography. Three hours. Dupigny-Giroux, Gade.

261 Problems in Vermont Geography. Three hours.

270 Problems in Human Geography. Three hours.

278 Gender, Space and Environment. Examination of the ways in which human relationships to both the built environment and the natural environment are mediated by gender. *Prerequisites:* At least nine hours in Geography or Women's Studies and permission. Three hours. Seager.

281 Problems in Cartography. Special laboratory projects. *Prerequisite:* 81 or equivalent. Three hours. Carmody.

285 Remote Sensing and Environmental Problems. Research projects in remote sensing; application of multispectral data for environmental studies. *Prerequisite:* 85 or equivalent. Three hours.

287 Spatial Analysis. (Same as Community Development and Applied Economics 287.) Analysis of spatial pattern and interaction through quantitative models; introduction to measurement, sampling, and covariation in a spatial framework. *Prerequisite:* Graduate standing in geography or planning. Three hours. Bodman.

295, 296 Advanced Special Topics. Advanced courses or seminars beyond the scope of existing departmental offerings. Three hours. Staff.

297, 298 Readings and Research. Credit as arranged.

300 Graduate Tutorial. Readings and research on topics arranged individually by students with instructors; attendance in appropriate undergraduate courses may be required. *Prerequisite:* Permission. Three hours.

391 Master's Thesis Research. Credit as arranged.

Geology (GEOL)

Professors Cassell, Hunt (Emeritus), Mehrkens, Stanley; Associate Professors Bierman, Bucke, Doolan (Chairperson), Drake; Assistant Professors Lini, Rushmer; Lecturer Wright; Adjunct Professors Jaffe, Stein.

Research programs include environmental geology, geomorphology, and water resources; sedimentary, igneous and metamorphic environments and structural evolution of the northern Appalachians. Specific faculty interests include geologic history and recent sedimentation in the Lake Champlain Basin, processes and chronology of glaciation, stable and cosmogenic isotopic studies, water quality and pollutant transport, tectonic evolution of deformed continental margins, petrofabric and structural analysis of deformed rocks, stratigraphy and sedimentary environments of lower Paleozoic sandstones and carbonates.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in an appropriate field: 12 semester hours in geology; satisfactory scores on the general (aptitude) Graduate Record Examination. Year courses in chemistry, physics or biology, and calculus or in an approved ancillary science strongly recommended.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of one year of graduate study plus a comprehensive examination.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Thesis and advanced courses in geology must total at least 30 semester hours, including at least one 300-level course. 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 graduation. This can be satisfied by Geology 201, or a comparable course at another institution, or 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.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS

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 (general portion).

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS

Satisfactory completion of one year of graduate study plus departmental recommendation.

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

Thirty hours of course work that will strengthen the student's 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 an advisor, will develop a program suited to his/her 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 (see page 21).

COURSES OFFERED

201 Advanced Field Geology (1-6). Advanced field mapping techniques, analysis of field data, preparation of geological maps and reports. *Prerequisite:* 260 or equivalent. Three hours. Doolan, Mehrtens, Stanley.

210 Systems Dynamics and Earth Science. Analysis of generic systems with examples from physical and natural sciences. Geological systems emphasized. Laboratories involve computer analysis of system structure and behavior over time. *Prerequisites:* Major or minor in science, mathematics, natural resources, engineering, or permission. Three hours. Stanley. Cross-listing: EDSS 200.

230 Advanced Igneous and Metamorphic Petrology (3-3). Application of phase equilibria, elemental and isotopic data, and textural interpretations to problems in igneous and metamorphic petrology, stressing modern theories of tectonics and petrogenesis. *Prerequisites:* 131 or equivalent. Four hours. Doolan, Rushmer.

233 Environmental Isotope Geochemistry. Course focuses on stable isotope chemistry of low temperature processes occurring on and near the earth surface. Divided in three parts: lecture, laboratory, and seminar. *Prerequisites:* Introductory Chemistry. Three hours. Lini.

234 Global Biogeochemical Cycles. Integrated perspective on biogeochemical cycles describing the transformation and movement of chemical substances in the natural environment, as seen on the global context. *Prerequisites:* Introductory Chemistry. Three hours. Lini.

235 Geochemistry of Natural Waters. Basic concepts of chemical equilibria applied to natural waters, including thermodynamics, pH, oxidation-reduction, weathering, and solution equilibria. *Prerequisites:* 110, Chemistry 1, 2 or permission of instructor. Three hours. Drake.

240 Tectonics. Application of igneous and metamorphic petrology to problems in tectonophysics, including petrochemistry of the earth's crust and upper mantle and the internal structure of orogenic belts. *Prerequisite:* 101, 102, or permission. Three hours. Doolan, Rushmer.

241 Clastic Depositional Systems. Selected readings and field studies emphasizing the interpretation of clastic sedimentary deposits including transportation, processes of sedimentation, and geomorphology of ancient and recent sedimentary environments. *Prerequisites:* 153 or equivalent. Three hours. Mehrtens. Alternate years.

243 Clastic Petrology Laboratory. The study of clastic rocks in hand specimen and thin section. *Prerequisite:* Concurrent enrollment in 241. One hour. Mehrtens.

245 Carbonate Depositional Environments. Paleoenvironmental analysis of carbonate rocks including selected readings, field investigations, and petrographic studies. *Prerequisite:* 153 or equivalent. Three hours. Mehrtens. Alternate years.

247 Carbonate Petrology Laboratory. The study of carbonate rocks in hand specimen and thin section. *Prerequisite:* Concurrent enrollment in 245. One hour. Mehrtens.

255 Geohydrology (3-3). Field-based projects examine hydrologic processes in geologic context: precipitation, runoff, groundwater, rivers, and hillslope stability. Data analysis, writing, and practical approaches to water-related environmental problems. *Prerequisites:* Major in Science of Engineering or permission. Four hours. Bierman.

260 Structural Geology (3-3). Rock deformation, description, and geometry of structural types, and the interpretation of structures of all sizes in terms of finite strain and causal stress fields. *Prerequisite:* 101, 110, Physics 11 or permission. Four hours. Stanley.

272a, b Regional Geology. 272a (one credit): Discussion of the geology of a selected region of North America; 272b

(three credits): A four-week summer field trip to the area in question. *Prerequisites:* 101, 110; 272a for 272b or equivalent. Four hours.

273 Geology of the Appalachians. Origin of mountain belts; the Appalachian mountain system discussed in terms of tectonics and geologic processes active in modern continental margins. *Prerequisites:* 101, 131 or equivalent. Three hours. Doolan.

278 Principles of Aquatic Systems. (See Natural Resources 278.) Three hours.

295, 296 Special Topics. Special topics or seminars in Geology beyond the scope of existing formal courses. Maximum of six hours toward graduate degree.

301, 302 Introduction to Graduate Studies in Geology. For first year graduate students in Geology. Includes orientation to faculty, abstract and grant writing, comprehensive exams, talk preparation and scientific method in the Geosciences. *Prerequisites:* Graduate standing in Geology. One hour. Staff.

350 Paleogeography. Paleopositions of continents and the distribution of land areas and ocean basins through geologic time in the context of plate tectonics. *Prerequisite:* Permission. Three hours. Mehrtens.

351 Surface Processes and Quaternary Geology Seminar. Discussion and critique of scientific literature pertaining to Earth surface history and processes. Critical examination of author's methods, data, and assumptions. Student-led discussions. Specific focus changes yearly. *Prerequisites:* Graduate standing in Science, Natural Resources or Engineering or permission. One to three hours. Bierman.

352 Environmental Geology Seminar. Geologic constraints on environmental problems including: groundwater flow, contaminant transport, slope stability, climate change, sedimentation, deforestation and earthquake hazards. Extensive readings and student-led discussions. *Prerequisites:* Graduate standing in Science, Natural Resources or Engineering or permission. One to three hours. Bierman.

360 Structural Analysis of Deformed Rocks. Mechanisms of rock deformation; fracture phenomena and analysis; fault zone characteristics; fold generation analysis. Stress and strain interpretation of deformational features in rocks and minerals. Field work. *Prerequisite:* 260 or equivalent. Four hours. Stanley.

361 Advanced Structural Geology. Selected topics in analytical structural geology. *Prerequisite:* 260 or equivalent. Three hours. Stanley.

371 Advanced Readings. Readings and research problems intended to contribute to the program of graduate students in areas of geology for which formal courses are not available. *Prerequisite:* Graduate standing in geology. One to three hours.

391 Master's Thesis Research. Credit as arranged.

German (GERM)

Professors Mahoney, Mieder (Chairperson), Scrase; Associate Professor Schreckenberger.

Current research interests include East German literature; history of the German language; medieval literature; literature of the 18th, 19th, and 20th centuries; and folklore.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES 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 general (aptitude) section.

MINIMUM DEGREE REQUIREMENTS

Thirty hours of graduate level courses including German 281, 282 or 295, 296; additional courses in German, which may include two advanced courses in a related field (six hours), thesis research (six to 12 hours).

The department also offers a program leading to the degree of Master of Arts in Teaching (see page 21). Satisfactory scores on the Graduate Record Examination general (aptitude) section are prerequisite to acceptance to candidacy for this degree.

COURSES OFFERED

201 Methods of Research and Bibliography. Introduction to tools and methods of research, including major bibliographical sources, reference works, dictionaries, editions, and journals concerned with German literature, language, and folklore. *Prerequisites:* Two 100 level courses or permission. Three hours. Mieder. Alternate years.

202 Expository Writing. Improvement of writing skills through work with authentic texts from different content areas (literature, media, science, business). Emphasis on stylistic development and sophisticated vocabulary-building. *Prerequisites:* Two 100 level courses or permission. Three hours. Mieder, Schreckenberger. Alternate years.

213 History of the German Language. Historical and linguistic development of the German language from Indo-European to the present, with emphasis on sound shifts, the 16th century, and the modern age. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mieder. Alternate years.

214 Middle Ages. Analysis and discussion of several "Minnesang" poets (esp. Walther and Neidhart), the *Nibelungenlied*, the courtly epics *Erec*, *Parzival* and *Tristan*, and the satirical epic *Helmbrecht*. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mieder. Alternate years.

225 Goethe. Study of Goethe's accomplishments in poetry, drama, and the novel during major phases of his literary career: "Sturm und Drang," Classicism, and Romanticism. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mahoney. Alternate years.

226 Schiller. Major attention will be paid to Schiller's development as a dramatist (from *Die Räuber* to *Wilhelm Tell*) as well as to his contributions to German Classicism. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mahoney. Alternate years.

237 19th-Century Prose. Literary and stylistic analysis of prose works by Tieck, Kleist, Stifter, Goethe, Drost-Hülshoff, Storm, Keller, and Hauptmann with emphasis on Romanticism, Poetic Realism, and Naturalism. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mieder. Alternate years.

238 19th-Century Drama. Analysis of plays by Tieck, Kotzebue, Kleist, Büchner, Grillparzer, Nestroy, Hebbel, and Hauptmann. Consideration of traditional Viennese "Volkstheater" and the period's major literary movements. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Alternate years.

247 German Literature from 1890 to 1945. Naturalism, Symbolism, Expressionism and subsequent trends through readings of authors such as Hauptmann, Rilke, Kaiser, Kafka, Mann, and Brecht. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Schreckenberger, Scrase. Alternate years.

248 Contemporary German Literature. Literary movements and their major representatives from 1945 to the present, including relevant socio-political, intellectual, and cultural aspects. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Schreckenberger, Scrase. Alternate years.

251 German Folklore. Verbal folklore genres (fairy tales, legends, folk songs, and proverbs) treated in their relation to literature, mass media, and popular culture. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mieder. Alternate years.

252 Faust. Focus on one of the major themes of world literature. Readings include the "Volksbuch" of 1587, and works by Marlowe, Goethe and Thomas Mann. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Alternate years.

263 German Romanticism. Study of major works by authors such as Friedrich Schlegel, Novalis, Brentano, Hoffmann, and Eichendorff in their literary, artistic, philosophical, and socio-political contexts. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mahoney. Alternate years.

264 German Lyric Poetry. The lyric genre and the historical development of German poetry from the age of Goethe to the present. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Scrase. Alternate years.

271 Proverbs. Diachronic and synchronic survey of German proverbs, proverbial expressions, and wellerisms, emphasizing their use and function in literature, art, mass media, advertisements and oral communication. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mieder. Alternate years.

273 German Intellectual Movements. A survey of developments in art, music, philosophy, and social thought from the Enlightenment to 1945, with particular attention to their impact on German literature. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Mahoney. Alternate years.

275 Fin-de-Siècle. Prevalent literary and intellectual movements at the turn of the 20th century in their historical, socio-political, and cultural contexts. Study of Nietzsche, Freud, Rilke, Hofmannsthal, Schnitzler, and Mann. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Schreckenberger. Alternate years.

276 Brecht and the Modern Drama. Brecht's revolutionary concept of "epic theatre" in theory and practice and its influence on subsequent dramatists, including Dürrenmatt, Frisch, Handke, Hochhuth, Müller, and Weiss. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Alternate years.

278 GDR Fiction. GDR fiction in its literary, historical, and social contexts, with reference to major developments in the GDR from 1949-89. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Scrase. Alternate years.

279 The German Short Story After 1945. Aesthetic and thematic evolution of the short story and its relation to historical, political, and cultural developments from 1945 to the present. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Schreckenberger. Alternate years.

281 Seminar on Literary Genre, Period, or Theme. Study of a literary genre, period, or theme through close readings of representative texts supplemented by lectures and reports on socio-cultural context. May be repeated. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Alternate years.

282 Seminar on a Particular Author or Authors. Study of author(s) through close readings of representative texts supplemented by lectures and reports on the works' socio-cultural context. May be repeated. *Prerequisites:* 155 or 156 and one other 100 level course or permission. Three hours. Alternate years.

295, 296 Advanced Special Topics. Advanced courses or seminars on topics beyond the scope of existing departmental offerings. See Schedule of Courses for specific titles.

391 Master's Thesis Research. Credit as arranged.

Historic Preservation (HP)

Associate Professor Visser (Interim Director); Assistant Professor Brown; Lecturer McCullough; Distinguished Visiting Faculty Gilbertson, Lang, Wadhams

An interdisciplinary graduate program leading to a Master of Science in Historic Preservation is offered by the History Department in cooperation with the Departments of Art, Anthropology and Community Development and Applied Economics, and the Environmental Studies Program. Enrollment is limited to a small number of qualified participants who are seeking an intensive, community-oriented educational experience which effects a balance between academic and professional training. As its underlying philosophy, the program recognizes the diverse contributions, both high-style and vernacular, that every generation has made to the built environment and views historic preservation as a form of management which keeps these contributions in balance. The program is designed to develop future leaders to help foster economic growth through the stewardship of historic resources and to provide a focus within northern New England for research on and public awareness of the region's outstanding built environment. The program sponsors summer courses in Historic Preservation. Through its Architectural Conservation and Education Service, it also provides technical preservation and educational services on a contract basis. The program has been certified as meeting standards for professional training established by the National Council for Preservation Education.

Applicants desiring financial aid may be nominated for Graduate College Fellowships or for Graduate Teaching Fellowships in the History Department.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE IN HISTORIC PRESERVATION

(1) A baccalaureate degree with a major in a preservation-related field such as architecture, architectural history, history, planning, business administration, economics, engineering, interior design, law, or environmental studies. (2) Applicants must take the general (aptitude) portion of the Graduate Record Examination and submit a sample independent research paper, design project, or other evidence of preservation-related professional ability. Almost all successful applicants have spent at least a year in a preservation-related job or volunteer work after the baccalaureate.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Admission to this highly competitive program constitutes acceptance to candidacy as well.

MINIMUM DEGREE REQUIREMENTS FOR THE MASTER OF SCIENCE

(1) Thirty-six credit hours of course work. A minimum of

24 credit hours (including an internship or thesis) must be taken in historic preservation. Participants are urged to choose electives that will fill in gaps in their previous training. (2) A comprehensive examination given during the third semester. (3) An internship in a preservation agency, or a written thesis. This may be undertaken upon completion of two or three semesters of concentrated course work. At the conclusion of the internship, an oral presentation describing work accomplished will be given before a jury of practicing professionals for evaluation. (4) Historic Preservation 201, 203, 204, 205, 301, 302 and 303 or 304 are required courses for the degree. Students will also normally take Historic Preservation 202 (American Architectural History), and Historic Preservation 307 (Advanced Architectural Conservation), History 351 (Proseminar in American Cultural History) unless they have had sufficient backgrounds in these areas.

COURSES OFFERED

201 Architecture, Landscape, and History. An examination of methods for deciphering the underlying cultural and environmental forces that have shaped the nation's buildings, towns, cities, and rural landscapes. *Prerequisites:* An advanced course in one of the following areas: American History, Architectural History, Historical or Cultural Geography, Archeology, or by permission. Three hours. McCullough.

202 Special Topics. Courses are offered yearly by visiting faculty under this number, in specialized areas of historic preservation, through Continuing Education.

203 Conservation Techniques for Historic Structures. Structural systems, materials found in historic resources; methods for conservation. Preservation of brick, stone, wood, plaster, metals, paints, etc. Introducing new systems into structures without violating historical integrity. Three hours. Visser.

204 Historic Preservation: Development Economics. Survey of economic, financial aspects of real estate development pertaining to preservation and adaptive use (market studies, proformas). Field trips. Actual proposal development for under-utilized historic properties. Three hours. Lang.

205 Historic Preservation Law. Legal issues in conservation of the built environment. Basic legal techniques for protection of historic structures (historic districts, protective legislation, easements, covenants). Study of significant court decisions. Three hours. McCullough.

301 Historic Preservation Contemporary Practice. Detailed study of current historic preservation practice through field trips, seminars with practicing professionals; technical training in architectural taxonomy, environmental impact review, funding solicitation, preservation agency administration. Six hours. Gilbertson, McCullough, Visser, Wadhams, and distinguished visiting lecturers.

302 Community Preservation Project. Third-semester graduate students apply developed professional skills to actual community preservation problems. Projects include strategy development, securing and allocating funds, research, advocacy, and implementation. *Prerequisites:* 301, graduate status in the Historic Preservation Program. Three hours. McCullough, Wadhams.

303 Internship. Participants will devote a semester to preservation within an appropriate institution or agency. Three hours. Visser.

307 Advanced Architectural Conservation. An integrated examination of historic preservation and architectural conservation emphasizing practical applications, professional skills, and advanced analysis through field and laboratory research projects and seminars. *Prerequisite:* 203. Three

hours. Visser.

391 Master's Thesis Research. Credit as arranged.

395 Special Topics. Credit as arranged. Visser.

397 Special Readings and Research. Credit as arranged.

History (HST)

Professors Emeriti Daniels, Davison, Felt, Hand, Liebs, Metcalfe, Schmokel, Schultz, Spinner; Professors Andrea, Grinde (Director ALANA Studies Program), Hutton (Chairperson), Overfield, Seybolt, Steffens, Stoler, Stout; Associate Professors Coleman, Rodgers, True, Visser (Interim Director, Historic Preservation Program), Youngblood; Assistant Professors Brown, Gustafson (Director of Graduate Studies), Huener, McIsaac; Adjunct Assistant Professors Feeney, Krueger; Visiting Assistant Professor Massell; Lecturer McCullough.

The History Department offers a comprehensive program of courses in the history of the Western Hemisphere, European history, and non-Western history.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF ARTS AND MASTER OF ARTS IN TEACHING

Applicants should have an undergraduate major in history, or in a related field of the social sciences or humanities with the equivalent of a minor in history. They must take the Graduate Record Examination and submit with the application a sample of writing, such as a research paper done in the course of undergraduate study.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

Each student's Studies Committee will certify admission to candidacy when it has approved a course of study (which may include remedial work such as courses in appropriate foreign languages) and a tentative thesis topic.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS IN TEACHING

See page 21.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

Thirty hours in History, including six hours of thesis research. Candidates for the MA in history must pass a comprehensive exam in two areas of historical knowledge (choice of oral or written), then complete a masters' thesis and defend it in an oral examination.

ACCELERATED MASTER'S PROGRAM (AMP)

History majors in their third year of undergraduate standing at UVM may apply to the department for the AMP in history. Students accepted into the program will during their senior year work simultaneously on their B.A. and M.A. requirements, toward which they may count up to six concurrent credits. Application forms and further information may be obtained from the Director of Graduate Studies, Department of History.

COURSES OFFERED

The specific subject matter of each seminar will vary according to the instructor's interests. Graduate work in seminars, however, generally consists of extensive reading in the secondary literature of the field and the application of that material in a major research paper.

201 Architecture, Landscape, and History. (Same as Historic Preservation 201.) Three hours. Visser.

209, 210 Seminar in Global History. Selected topics on the nature and results of interactions among the world's peoples. History 209: to 1500, History 210: since 1500. Three hours. Andrea, Overfield.

221, 222 Seminar in Ancient History. Selected aspects of Near Eastern, Greek, or Roman history (e.g. trade and colonization, imperialism, social and political institutions, cultural and intellectual developments). Three hours. Rodgers.

224 Seminar in Medieval Europe. Selected topics on Europe from the fall of Rome to the Renaissance. Three hours. Andrea.

225 Seminar in Early Modern Europe. Selected topics on European history from the Renaissance to the French Revolution. Three hours. Overfield, Steffens.

226, 227 Seminar in Modern Europe. Three hours. Bergen, Feeney, Huener, Hutton, Steffens.

228 Seminar on Popular Culture. History of the attitudes of ordinary people towards everyday life in European society from the Middle Ages to the present. Three hours. Hutton.

237 Seminar in Russian History before 1917. Selected topics in Russian intellectual, social, and cultural history focusing on the period 1825–1917. Three hours. Youngblood.

238 Seminar in Soviet History. Selected topics in Soviet social and cultural history from the Bolshevik Revolution to the death of Stalin (1917–53). Three hours. Youngblood.

245 Islamic Intellectual History. In-depth study of Islam, focusing on ideas rather than events. Topics include law, Sufism, art, philosophy and resurgent Islam. *Prerequisite:* 145 or permission. Three hours.

246 Seminar on Modern Middle East. Historical analysis of the major conflicts in the region, emphasizing the roles of nationalism, religion, foreign influences, and war. *Prerequisite:* 146 or permission. Three hours.

250 Seminar in East Asian History. Topics in the history of East Asia. Three hours. McIsaac, Seybolt.

252 Seminar on China. Selected topics in the history of China. *Prerequisites:* 150 or equivalent. Three hours. McIsaac, Seybolt.

261, 262 Seminar in Latin American History. Selected topics in Latin American History. 261: Early Latin America; 262: Modern Latin America. Three hours. True.

265 Seminar in Canadian History. Topics in 19th and 20th-century Canadian history: national development, regionalism, multiculturalism, and international relations. Three hours.

271, 272 Seminar in U.S. Social History. Topics in U.S. Social History. 271: to the Civil War; 272: Civil War to the Present. Three hours. Gustafson.

273, 274 Seminar in Modern U.S. History. Selected topics in U.S. history, among them foreign relations, the role of the presidency, World War II, and the Cold War. Three hours. Gustafson, Stoler.

277 Colonial Origins of American Society. How European patterns of life and systems of belief eroded in 17th and 18th century America and evolved into a distinctly American society. *Prerequisites:* Permission, 4 courses in the social sciences including at least 2 in history (25 and 177 recommended) and at least 1 from anthropology, economics, geography, religion, or sociology. Three hours. Stout

278 Colonial Origins of U.S. Government. Evolution of government (local to national levels) from English background through establishment of the U.S. Constitution,

emphasizing political and constitutional aspects of the American Revolution. *Prerequisites:* Permission, 4 courses in the social sciences including at least 2 in history (at least 1 above 100, 177 or 277 recommended) and 1 political science. Three hours. Stout.

284 Seminar in Vermont History. Topical approach to Vermont history through original research utilizing primary sources available at UVM, the Vermont Historical Society, and the Vermont State Archives. *Prerequisites:* Permission, 184. Three hours. Brown.

285 Seminar in History of Science. Selected topics in the history of science. Three hours. Steffens.

287 Seminar in Historiography. Topics and methods in contemporary historical writing. Three hours. Hutton, Youngblood.

295, 296 Special Topics Seminar. Seminars on topics beyond the scope of existing departmental offerings. See Schedule of Courses for specific titles. Three hours.

300 Graduate Tutorial. Readings and research in a specific area; topics to be individually arranged; attendance in appropriate undergraduate courses may be required (see undergraduate catalogue). *Prerequisite:* Permission. Variable credit.

301 Introduction to Graduate Study in History. Historical methods, philosophy of history, the history of history writing. Three hours. True.

351 Proseminar in American Cultural History. Intended primarily for students in Historic Preservation, but open to other graduate students. Three hours. Brown.

391 Master's Thesis Research. Required of all candidates for the M.A. Normally arranged for two semesters at three hours each.

397 Special Readings and Research. Directed individual study of areas not appropriately covered by existing courses. Variable credit.

Humanities (See page 107.)

International Studies (See page 107.)

Materials Science (Multidisciplinary)

Steering Committee Members: Director W. Varhue (Electrical Engineering); D. Durham (Mechanical Engineering); W. Leenstra (Chemistry); J.R. Wu (Physics). *Faculty:* Professors Allen, Anderson, Flanagan, Smith, Von Turkovich; Associate Professors Clougherty, Durham, Fuhr, Keller, Leenstra, Titcomb, Varhue, Wu; Assistant Professors Anderson, Yang.

Participating faculty are from the following departments: Computer Science and Electrical Engineering, Civil and Environmental Engineering, Mechanical Engineering, Physics, and Chemistry.

The program in Materials Science is multidisciplinary. It is involved with the mechanical, electrical, chemical, and physical properties of materials — primarily solids — and applications of these materials. It is multidisciplinary in the sense that it combines the theoretical and experimental capabilities of a variety of disciplines and applies them to the solution of complex scientific and engineering problems. Problems such as corrosion, analysis and synthesis of electronic materials, development of bulk and thin film electronic devices and integrated circuits, optimization of

mechanical properties of structural materials, and failure analysis are typical examples requiring such an interdisciplinary approach. The course program gives a broad background in materials. It also provides flexibility allowing specialization in particular areas of interest.

The program in Materials Science offers the Master of Science degree and the Doctor of Philosophy degree. Each student must meet the general requirements for admission as outlined under the Regulations of the Graduate College. Students in the program are sponsored by the participating department which best reflects the students' backgrounds and interests.

ACCELERATED MASTERS PROGRAM IN MATERIALS SCIENCE

The program offers an Accelerated Masters Program leading to both B.S. and M.S. degrees in five years. The program is open to undergraduate chemistry, physics, electrical engineering, and mechanical engineering majors. Interested students should contact the Materials Science Director by the beginning of their junior year.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

A bachelor's degree in physics, chemistry, metallurgy, engineering, materials science, or mathematics. Applicants with other backgrounds will be evaluated individually.

MINIMUM DEGREE REQUIREMENTS

The above requirements for admission must be supplemented in either of the following ways:

Plan A

With Thesis: 30 graduate credit hours of an approved program of study including at least 18 credit hours of course work; completion of at least one three-credit hour course in each of the following categories; solid state theory, quantum mechanics, applied mathematics, and materials properties of solids; satisfactory completion of a comprehensive examination, and satisfactory completion of an M.S. thesis including its defense at an oral examination.

Plan B

Without Thesis: 30 credit hours of an approved program of study; completion of at least one three-credit hour course in each of the following categories: solid state theory, quantum mechanics, applied mathematics, and materials properties of solids, and satisfactory completion of a comprehensive examination.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

An accredited master's degree (or equivalent) in physics, chemistry, metallurgy, engineering, mathematics, or materials science.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Successful completion of a Ph.D. comprehensive examination in Materials Science and demonstrated competence in computer programming. The comprehensive examination includes the areas of quantum mechanics, solid state theory, applied mathematics, thermodynamics, and materials properties of solids.

MINIMUM DEGREE REQUIREMENTS

In addition to the above, the following are required:

A minimum of 75 graduate credit hours including a minimum of 20 in dissertation research. An overall grade-point average in graduate courses of 3.25 or better. Completion of at least one three-credit hour course in each of the following categories: solid state theory, quantum mechanics, applied mathematics, thermodynamics and kinetics, and one course in each of two categories dealing with materials properties of solids. Satisfactory completion of a Ph.D. dissertation including its defense at an oral examination.

COURSES OFFERED

The program of Materials Science will offer a thesis or dissertation research course each semester. All other courses in a student's program are offered by the individual departments — primarily Chemistry, Electrical Engineering, Mathematics, Mechanical Engineering, Physics, and Statistics.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Mathematics (MATH)

Professors Archdeacon, Ashikaga, Burgmeier, Cooke, Costanza, Dinitz, Dummit, Foote, Golden, Gross, Haugh, Lakin (Chair), Oughstun, Pinder, Son, Wright; Research Professor Aleong; Associate Professors Bentil, Mickey, Sands, Wilson, Yu; Assistant Professors Buzas, Yang; Lecturers Brown, Johansson, Karstens, Kost, Larson, Lawlor, MacPherson, Morency, Puterbaugh, Read.

The Department of Mathematics offers programs towards the Master of Science, Master of Science in Teaching, Master of Arts in Teaching, and the Doctor of Philosophy in Mathematical Sciences. There are two areas of concentration: pure mathematics and applied mathematics. The programs emphasize the interaction between these two areas and the common role of scientific computation. Students can take courses common to both areas, enabling them to gain an appreciation of the mathematical techniques and the connections between theory and applications.

The department offers an Accelerated Master's Program (AMP) leading to a B.S. and M.S. degree in five years. Interested students should contact the department by the end of their sophomore year.

Department research interests include classical analysis, harmonic analysis, Fourier analysis, approximation theory, algebra, number theory, graph theory, combinatorics, fluid mechanics, biomathematics, differential equations, numerical analysis, and modeling.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY

Because of the breadth of pure and applied mathematics, it is recognized that applicants for admission will have diverse backgrounds. Admission requirements are therefore flexible. Applicants should have demonstrated strength in either pure or applied mathematics, a bachelor's degree with a major in mathematics or a closely related discipline, and satisfactory scores on both the general and subject (mathematics) sections of the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

Each student must complete one of the following options:

- Twenty-four semester hours of acceptable graduate credits in advanced mathematics courses; six semester hours of thesis research culminating in a master's thesis, or
- Thirty semester hours of acceptable graduate credits in advanced mathematics courses; no thesis required.

Under either option students must take, or acquire knowledge of the content in, the following courses: Math. 251, 331, 333, and either 252, 273, 274 or 339. Students must satisfactorily complete at least four 300-level mathematics courses and the seminar 382. By approval of the student's advisor, up to six hours from an area of minor concentration may be used to fulfill the degree requirements.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Successful completion of four qualifying examinations, three written and one oral, in one of the areas of concentration.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Each student must complete the four qualifying exams and an approved plan of study including at least 75 credit hours in course work or dissertation research. The student is required to write a doctoral dissertation and pass a final oral defense of that dissertation. The Department requires two semesters of college-teaching experience. Students are expected to demonstrate appropriate proficiency in the use of computers. There is no formal language requirement.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES AND ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE FOR TEACHERS

A bachelor's degree from an accredited institution and certification as a teacher of mathematics. Experience teaching secondary school mathematics. Satisfactory scores on the Graduate Record Examination.

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

Thirty hours of course work in mathematics. With the approval of their advisor, students may choose courses from the 100-level or from closely related fields. The student must pass an oral comprehensive examination. No thesis is required.

REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN TEACHING

Thirty hours of course work, including at least 21 in mathematics and six in education. Students must be certified to teach. With the approval of their advisor, students may choose courses from the 100-level or from closely related fields. The student must pass an oral comprehensive examination in mathematics and additional required examinations in education. No thesis is required.

COURSES OFFERED

207 Probability Theory. (Same as Statistics 251.)

221 Deterministic Models in Operations Research. The linear programming problem. Simplex algorithm, dual problem, sensitivity analysis, goal programming. Dynamic programming and network problems. *Prerequisites:* 124; 121 desirable or equivalent. Three hours.

222 Stochastic Models in Operations Research. Development and solution of some typical stochastic models.

Markov chains, queueing problems, inventory models and dynamic programming under uncertainty. *Prerequisites:* 207 or Statistics 151, or permission. Three hours.

224 Analysis of Algorithms. (Same as Computer Science 224.) *Prerequisites:* CS 103, 104; Math 173.

230 Ordinary Differential Equations. Solutions of ordinary differential equations, the Laplace transformations, series solutions of differential equations. *Prerequisites:* 121, corequisite 124 or permission of instructor. Credit will not be granted for more than one of the courses 230 or 271. Credit will not count toward a graduate degree in Mathematics. Three hours.

236 Calculus of Variations. Necessary conditions of Euler, Legendre, Weierstrass, and Jacobi for minimizing integrals. Sufficiency proofs. Variation and eigenvalue problems. Hamilton-Jacobi equations. *Prerequisite:* 230. Three hours. Alternate years.

237 Introduction to Numerical Analysis. Error analysis, root-finding, interpolation, least squares, quadrature, linear equations, numerical solution of ordinary differential equations. *Prerequisites:* 121, and 124 or 271, knowledge of computer programming. Three hours.

238 Numerical Differential Equations. Numerical solution of differential equations: initial-value and boundary-value problems; finite difference and finite element methods. *Prerequisites:* 237, either 230 or 271 recommended. Three hours.

240 Fourier Series and Integral Transforms. Fourier series, orthogonal functions, integral transforms, and boundary value problems. *Prerequisite:* 230 or 271. Three hours.

241 Analysis in Several Real Variables I. Properties of the real numbers, metric spaces, infinite sequences and series, continuity. *Prerequisites:* 121, 124, or equivalent. Three hours.

242 Analysis in Several Real Variables II. Differentiation in \mathbb{R}^n , Riemann-Stieltjes integral, uniform convergence of functions, Inverse and Implicit Function Theorems. *Prerequisite:* 241. Three hours.

243 Theory of Computation. (Same as Computer Science 243.) *Prerequisite:* CS 104.

251 Abstract Algebra I. Basic theory of groups, rings, fields, homomorphisms, and isomorphisms. *Prerequisites:* 124 or permission. Three hours.

252 Abstract Algebra II. Modules, vector spaces, linear transformations, rational and Jordan canonical forms. Finite fields, field extensions, and Galois theory leading to the insolubility of quintic equations. *Prerequisite:* 251. Three hours.

255 Elementary Number Theory. Divisibility, prime numbers, Diophantine equations, congruence of numbers, and methods of solving congruences. *Prerequisite:* 52 or 104, or equivalent. Three hours.

257 Topics in Group Theory. Topics may include abstract group theory, representation theory, classical groups, Lie groups. *Prerequisite:* 251. Three hours. Alternate years.

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:* 52 or 104, or equivalent. Three hours.

264 Vector Analysis. Gradient, curl and divergence, Green, Gauss and Stokes Theorems, applications to physics, tensor analysis. *Prerequisites:* 121, and 124 or 271, or equivalent. Three hours. Alternate years.

271 Applied Mathematics for Engineers and Scientists. Matrix theory, Linear Ordinary Differential Equations. Em-

phasis on methods of solution, including numerical methods. No credit for mathematics majors. Credit will not be granted for more than one of 230 or 271. *Corequisite:* 121 or equivalent. Three hours.

272 Applied Analysis. Partial differential equations of mathematical physics, calculus of variations, functions of a complex variable, Cauchy's Theorem, integral formula, conformal mapping. *Prerequisite:* 230 or 271. Three hours.

273 Combinatorial Graph Theory. Paths and trees, connectivity, Eulerian and Hamiltonian cycles, matchings, edge and vertex colorings, planar graphs, Euler's formula and the Four Color Theorem, networks. *Prerequisite:* 102 or 104 or equivalent. Three hours.

274 Numerical Linear Algebra. Direct and iterative methods for solving linear equations, least square factorization methods, eigenvalue computations, ill-conditioning and stability. *Prerequisite:* 237. Three hours.

275, 276 Advanced Engineering Analysis I, II. See Mechanical Engineering 304, 305. *Prerequisites:* 271 or 230; 275 for 276. Cross-listings: Mechanical Engineering 304, 305; Civil Engineering 304, 305.

295 Special Topics. Lectures, reports, and directed readings on advanced topics as announced. *Prerequisite:* Permission. Credit as arranged. Offered as occasion warrants.

330 Advanced Ordinary Differential Equations. Linear and nonlinear systems, approximate solutions, existence, uniqueness, dependence on initial conditions, stability, asymptotic behavior, singularities, self-adjoint problems. *Prerequisite:* 230. Three hours.

331 Theory of Functions of Complex Variables. Differentiation, integration, Cauchy-Riemann equations, infinite series, properties of analytic continuation, Laurent series, calculus of residues, contour integration, meromorphic functions, conformal mappings, Riemann surfaces. *Prerequisite:* 242. Four hours.

332 Approximation Theory. Interpolation and approximation by interpolation, uniform approximation in normed linear spaces, spline functions, orthogonal polynomials. Least square, and Chebychev approximations, rational functions. *Prerequisites:* 124, 237. Three hours.

333 Theory of Functions of Real Variables. The theory of Lebesgue integration, Lebesgue measure, sequences of functions, absolute continuity, properties of L^p -spaces. *Prerequisite:* 242. Four hours.

335, 336 Advanced Real Analysis. L^2 -spaces, L^p -spaces; Hilbert, Banach spaces; linear functionals, linear operators; completely continuous operators (including symmetric); Fredholm alternative; Hilbert-Schmidt theory; unitary operators; Bochner's Theorem; Fourier-Plancherel, Watson transforms. *Prerequisites:* 333; 335 for 336. Three hours.

339 Partial Differential Equations. Classification of equations, linear equations, first order equations, second order elliptic, parabolic, and hyperbolic equations, uniqueness and existence of solutions. *Prerequisites:* 230, 242. Three hours.

351 Topics in Algebra. Topics will vary each semester and may include algebraic number theory, algebraic geometry, and the arithmetic of elliptic curves. Repeatable for credit with permission. *Prerequisite:* 252. Three hours.

353 Point-Set Topology. Topological spaces, closed and open sets, closure operators, separation axioms, continuity, connectedness, compactness, metrization, uniform spaces. *Prerequisite:* 241. Three hours.

354 Algebraic Topology. Homotopy, Seifert-van Kampen Theorem; simplicial, singular, and Čech homology. *Prerequisite:* 353. Three hours.

382 Seminar. Topical discussions with assigned reading.

Required of M.S. degree candidates. One hour.

391 Master's Thesis Research. Credit as arranged.

395 Special Topics. Subject will vary from year to year. May be repeated for credit. *Prerequisite:* Permission. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Mechanical Engineering (ME)

Professors Beliveau, Flanagan, Francis, Hermance, Hundal, Wu; Associate Professors Durham, Huston, Keller; Research Professor Stokes; Research Associate Professor Beynon.

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 is normally necessary for students to complete the entrance qualifications without receiving credit toward their graduate studies. In all courses, general requirements for admission, as outlined under the Regulations of the Graduate College, must be met. Areas of research interest include biomechanics; combustion; computer-aided design, continuum mechanics; design methodology, fluids mechanics; heat transfer; manufacturing processes; mechanical and thermal processing of metals; physical and mechanical metallurgy; solidification; vibrations.

An Accelerated Master's Program (AMP) is available for students majoring in Mechanical Engineering. Further details can be obtained from the Department of Mechanical Engineering, 201 Votey Building, (802) 656-3320.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An accredited bachelor's degree in Mechanical Engineering or its equivalent.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

One semester of satisfactory performance in graduate courses.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

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

Plan A

Completion of advanced courses in mechanical engineering; mathematics, other approved courses and six to nine hours of thesis research for a total of 30 hours.

Plan B

Completion of 30 credit hours of advanced courses in mechanical engineering, mathematics, and other approved courses in lieu of thesis.

Students should decide which option they intend to pursue at the beginning of their program. Part-time students normally use Plan B.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

An accredited master's degree in mechanical engineering or its equivalent.

REQUIREMENTS FOR ADVANCEMENT 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 75 credit hours to be earned in course and in dissertation research. At least 40 credit hours must be earned in courses and seminars and a minimum of 25 credit hours must be earned in dissertation research. Candidates must be able to comprehend the literature of their field in at least one foreign language provided it is required for their dissertation work. The requirements specified under "Policies of the Graduate College" must also be met.

COURSES OFFERED

203 Machinery Analysis and Synthesis. Kinematic and kinetic analysis of two and three dimensional machines; kinematic synthesis; electromechanical and servo mechanisms; application to robotic mechanisms. Three hours.

207 Biomechanics I. Introduction to the structure and mechanics of the musculoskeletal system. Application of mechanics to bone, tendon, ligaments and other biological materials. *Prerequisites:* Graduate standing in ME, or permission. Three hours.

208 Biomechanics II. Introduction to biomaterials and the mechanical behavior of bioviscoelastic fluids or solids. *Prerequisites:* 207 or permission. Three hours.

235 Turbomachinery Vibration Analysis and Testing. Vibration in rotating machines; vibration measurement techniques; machinery condition and degradation; condition monitoring and predictive maintenance; industrial vibration techniques including proximity probes, accelerometers, FFT analyzer. *Prerequisite:* 244. Two hours. Francis, Hundal, Japikse.

241 Combustion Processes. Combustion thermodynamics; chemical kinetics; laminar flames, premixed and diffusion; turbulent flames; ignition, explosion, and detonation; droplet combustion; flame spread; large scale fires; rocket combustion. Three hours.

242 Advanced Engineering Thermodynamics I. Foundations of statistical mechanics. Gases and Crystals. Chemical equilibrium. Irreversible processes. *Prerequisite:* Permission. Three hours.

243 Fluid Dynamics (3-0). Inviscid incompressible flows; compressible flows; open-channel flows; turbomachinery. *Prerequisites:* 143 and Math. 271 or equivalent. Three hours.

244 Introduction to Turbomachinery Analysis. Fundamental turbomachinery principles of fluid mechanics, thermodynamics, and structural analysis; basic equations and computational techniques for analysis and design and evaluate turbomachinery. *Prerequisites:* 243 and Math. 271. Two hours. Francis, Japikse.

245 Advanced Heat Transfer I. Transient heat conduction; integral methods; convection; formulation and solution; boiling, condensation; radiant heat exchange in enclosures and with emitting-absorbing gases, advanced view factors. *Prerequisite:* Permission. Three hours.

246 Centrifugal Compressors. Fluid dynamic and thermodynamic principles of centrifugal compressor design and design practice; limits of stable operation and instability prediction and control. *Prerequisite:* 244. Two hours. Francis, Japikse.

247 Centrifugal Pumps. Centrifugal pump design principles and practice; performance limits; cavitation; design

tools and pump design optimization. *Prerequisite:* 244. Two hours. Francis, Japikse.

248 Turbomachinery Special Topics. Content in axial fans/compressors; axial, radial or steam turbines; CFD, dynamics/rotordynamics, or materials for turbomachinery; power plant or refrigeratio cycle developments; turbo-charged and compound IC-engines. *Prerequisite:* 244. One or two hours. Francis, Japikse.

252 Mechanical Behavior of Materials. Elastic and plastic behavior of single crystals, polycrystals; dislocations; approximate plastic analysis; anisotropic materials; hardness; residual stress; brittle, transitional, ductile fractures; fatigue; damping; creep, surface phenomena. *Prerequisites:* 101, permission. Three hours.

253 Corrosion of Materials. Corrosion principles: electrochemical, environmental, and metallurgical aspects. Corrosion testing. Corrosion prevention. Seawater corrosion. Biological corrosion. Material selection. *Prerequisite:* 102 or equivalent. Three hours.

255 Advanced Engineering Materials. Phase diagrams. thermodynamics of crystals, alloys. Defects. Phase transformations. Heat treatment of steels. *Prerequisites:* Senior or graduate standing or permission. Three hours.

257 Composite Materials. Fibers, matrices. Unidirectional and short fiber composites. Analysis of orthotropic lamina. Analysis of laminated composites. Experimental characterization. *Prerequisite:* 102 or equivalent. Three hours.

265 Integrated Product Development. Project-based course focusing on the entire product life cycle. Team dynamics, process and product design, quality, materials, management, and environmentally conscious manufacturing. *Cross-listings:* BSAD 293, Stat 265. Durham.

281, 282 Seminar. Presentation and discussion of advanced mechanical engineering problems and current developments. One hour.

283 Laboratory Techniques for Turbomachinery Development. Instruments and transducers for performance, flow, and structural measurements in turbomachinery; the role of test data in design and development; experimental data acquisition and processing. *Prerequisite:* 244. Two hours. Francis, Japikse.

295 Special Topics. Special topics in recently developed technical areas. One to three hours with instructor approval.

301 Introduction to Biomedical Engineering (3-0). Introduction to basic biomedical engineering science; biomedical computing and pattern recognition, biomedical instrumentation and signal analysis, biomechanics, biomaterials, rehabilitation engineering, physiological transport phenomena, intelligent systems. Three hours.

304, 305 Advanced Engineering Analysis I, II. Problems in analysis in engineering, including ordinary and partial differential equations, special functions, matrices, tensor analysis, variational calculus, complex variables, perturbation methods. *Prerequisites:* Math. 271 or Math. 230; ME 304 for ME 305. Three hours. *Cross-listings:* CE 304, 305; Math 275, 276.

320 Special Problems in Elasticity. Advanced topics in the theory of elasticity in which there is a particular student and staff interest. Three hours.

321 Special Problems in Fluid Mechanics (3-0). Advanced topics in fluid mechanics in which there is a particular student and staff interest. Three hours.

322 Special Problems in Dynamics. Advanced topics in dynamics in which there is a particular student and staff interest. Three hours.

323 Special Problems in Thermodynamics. Advanced topics in thermodynamics in which there is a particular student and staff interest. Three hours.

324 Special Problems in Heat Transfer. Advanced topics in heat transfer in which there is a particular student and staff interest. Three hours.

325 Special Problems in Materials. Advanced topics in behavior of materials in which there is a particular student and staff interest. Three hours.

330 Matrix Methods in Structural Dynamics. Matrices, eigenvalue problems, forced vibration, wave propagation. Three hours. *Cross-listing:* Civil Engineering 372.

332 Engineering Elasticity. Tensors, complex variable, variational methods. Three hours.

333 Stress Analysis (Theory and Experiment) (3-0). Theory and experimental method of measuring static and dynamic stress and strain. Three hours.

336 Continuum Mechanics (3-0). Tensors, conservation laws, field equations for solids and fluids. Three hours.

338 Advanced Dynamics. Application of Lagrange's equation, Hamilton's principle to mechanical systems. Systems with constraints. Matrix formulation of problems in kinematics, dynamics. Stability of linear, nonlinear systems. Three hours.

342 Advanced Combustion. Equations of reacting mixtures; modeling of steady and unsteady combustion, homogeneous/heterogeneous systems; ignition, explosions, detonations; combustion aerodynamics: turbulence, swirl, sprays. *Prerequisite:* 241 or equivalent. Three hours.

343 Advanced Fluid Dynamics. Stress in continuum; kinematics, dynamics; potential fields; Wing theory; Navier-Stokes equation; hydrodynamic stability; turbulence; laminar, turbulent boundary layer theory; transient flows; free laminar, turbulent flows; mixing. Three hours.

344 Advanced Engineering Thermodynamics II. Microscopic thermodynamics; Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac statistics; kinetic theory of gases; transport properties, compressed gases, liquids, solid states; chemical systems; irreversible processes; fluctuations. Three hours.

345 Advanced Heat Transfer II. Generalized equation of heat conduction; classical integral transforms, approximate solutions; thermal boundary layers; forced and free convection; condensation, boiling, ablative cooling; radiation, statistical theory; mass transfer. Three hours.

346 Advanced Gas Dynamics. Compressible flow in ducts; friction, heat transfer; shock waves; small perturbation theory; high speed flows; transonic, supersonic, hypersonic flows; methods of characteristics. Aerodynamic heating; rarified gas flows. Three hours.

371 Advanced Engineering Design Analysis and Synthesis. Application of fundamental concepts, principles of advanced mathematics, physics, mechanics, electricity, thermodynamics, fluid dynamics, heat transfer, and decision-making processes to design, analysis, synthesis of complex engineering systems. Four hours.

372 Systems Engineering. Advanced course in systems engineering, reliability, maintainability, safety, and human factors engineering. Case studies. *Prerequisites:* 371 or permission. Three hours.

373 Integrated Mechanism Design Analysis. Application of system analysis, rigid body dynamics, finite elements, fatigue analysis and structural dynamics to an integrated approach to mechanisms design. *Prerequisites:* 371 or permission. Three hours.

391 Master's Thesis Research. Credit as arranged.

395 Advanced Special Topics. Advanced topics in recently developed technical areas. *Prerequisite:* One to three hours with instructor approval.

491 Doctoral Dissertation Research. Credit as arranged.

Microbiology and Molecular Genetics (MMG)

Professors Albertini, Bramley, Burke, Fives-Taylor, Kurjan, Novotny, Schaeffer, Wallace (Chairperson); Associate Professors Francklyn, Gilmartin, Heintz, Johnson, Morrical, Pederson, Tierney; Assistant Professors Doublé, Stein, Ward; Research Associate Professors Bateman, Raper; Research Assistant Professors Bond, Froeliger, Hatahet, Heckman, Meyer; Lecturers Silverstein, Tessman.

Research activities include: The enzymology and regulation of cellular DNA replication and repair processes; molecular mechanisms of genetic recombination; somatic-cell genetic mutations; protein-DNA interactions at eukaryotic origins of replication; self-splicing mechanisms of RNA; RNA polymerase II/DNA interactions in eukaryotic cells; mRNA processing in mammalian cells; cell cycle control of transcription and replication in yeast; cloning and regulation of yeast *ras*/rho homologs; cloning and regulation of schizopyllum mating type genes; function and regulation of *ras* superfamily of GTP-binding proteins; eukaryotic cell cycle; molecular mechanisms of bacterial adhesion; molecular and cellular mechanisms of host-pathogen interactions.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR EITHER THE MASTER OF SCIENCE OR THE DOCTOR OF PHILOSOPHY DEGREES

One year of biological science; one year Physics (equivalent of Physics 11 and 12); Chemistry including one year of inorganic chemistry and one year of organic chemistry (equivalent of Chemistry 1, 2, 141 and 142), mathematics through calculus (equivalent of Math 19 and 20); additional courses required by the Department depending on the aims of the student. A student may be admitted pending satisfactory completion of one or two of the above courses during the first semester(s) of graduate study. Satisfactory scores on the general aptitude portion of the Graduate Record Examination. Subject GRE tests are recommended but not mandatory.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Applicants may be accepted concurrent with admission, or candidacy may be deferred pending a period of satisfactory graduate study at The University of Vermont. Acceptance to candidacy is granted only to those students who have met all undergraduate course prerequisites.

MINIMUM DEGREE REQUIREMENTS

Thirty total credits to include six credit hours of Dissertation Research (MMG 391) and 24 course credits, including the Microbiology and Molecular Genetics core curriculum (six course credits each in Biochemistry, Genetics, and Microbiology); at least two credits in current Topics in Molecular Genetics (MMG 310); other approved courses such that at least 16 course credits are taken from courses offered by the Department of Microbiology and Molecular Genetics; qualifying exam; successful completion of dissertation.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Completion of one full year of graduate study at The University of Vermont, satisfactory performance on teaching assignments, successful completion of the Department qualifying exam, and approval of the student's thesis advisor and

Studies Committee, The Faculty of the Department of Microbiology and Molecular Genetics, and the Dean of the Graduate College.

MINIMUM PH.D. EGREE REQUIREMENTS

Seventy-five total credits to include at least 30 credit hours of Dissertation Research (MMG 491) and at least 30 course credits, including the Microbiology and Molecular Genetics core curriculum (six course credits each in Biochemistry, Genetics, and Microbiology); at least four credits in Current Topics in Molecular Genetics (MMG 310); other approved courses such that at least 20 course credits are taken from courses offered by the Department of Microbiology and Molecular Genetics; teaching assignments as arranged by Department; proficiency in computer applications; qualifying exam; successful completion of dissertation.

COMBINED MEDICAL COLLEGE AND GRADUATE COLLEGE DEGREE PROGRAMS

Qualified students, following acceptance into the medical college, may simultaneously enroll in the Graduate College for a Master of Science or Ph.D. degree program in Microbiology and Molecular Genetics. The program would be developed with concurrence of the Dean for Student Affairs in the College of Medicine.

COURSES OFFERED

201 Molecular Cloning Lab. An intensive one-semester advanced laboratory course in which students will learn the fundamentals of recombinant DNA technology through the isolation and characterization of an eukaryotic gene. *Prerequisite:* 101 or 102, or equivalent. Three hours. Coordinator: Silverstein. Fall semester.

203 Mammalian Cell Culture in Molecular Biology. Students will analyze gene expression in mammalian tissue culture cell lines learning the basic principles and techniques of mammalian cell culture, basic animal virology as well as somatic cell and mammalian molecular genetics. *Prerequisite:* Biochemistry, Genetics and/or Cell and Molecular Biology courses, permission of coordinator. Four hours. Coordinator: Schaeffer. Alternate years, Spring 1999.

211 Prokaryotic Molecular Genetics. The organization, replication, and expression of genes in prokaryotes. Focus on the genetics of *Escherichia coli* and its viruses. *Prerequisite:* Introductory Microbiology, Biochemistry, Genetics, and/or Cell and Molecular Biology courses. Three hours. Coordinator: Novotny. Fall semester.

220 Environmental Microbiology. The activities of microorganisms, primarily bacteria, in air, soil, and water. *Prerequisite:* A previous course in microbiology. Three hours. Alternate years, Spring 2000.

222 Clinical Microbiology. Comprehensive study of human pathogenic microorganisms and their disease states in the human. Collecting, handling specimens, pathogenic bacteriology, medical mycology, and virology. Laboratory sessions provide practical experience in handling and identifying these pathogens. *Prerequisite:* 65 or 66, or equivalent. Immunology recommended but not required. Four hours. Coordinator: Tessmann. Spring semester.

223 Immunology. Analysis of the immune response with respect to structure and function of immunoglobulins and the T cell receptor, tolerance, innate and adaptive immunity, the Major Histocompatibility Complex, hypersensitivity states, cancer, and AIDS. *Prerequisite:* Permission of Coordinator. Three hours. Coordinator: Silverstein. Alternate years, Fall 1999.

225 Eukaryotic Virology. An in-depth analysis of eukaryotic virus-mammalian cell interactions with particular emphasis on mechanisms by which viruses modulate gene ex-

pression in infected cells. *Prerequisite:* 65 or 66, or equivalent. Three hours. Coordinators: Gilmartin, Silverstein. Alternate years, Fall 1998-2000.

254 Protein: Nucleic Acid Interactions. Structure of DNA and RNA, and the structure and assembly of nucleoprotein complexes will be described using examples from prokaryotes, yeast, viruses, and mammalian cells in culture. *Prerequisite:* 211 or equivalent, Agricultural Biochemistry 201 or Biochemistry 301 and 302 or equivalent. Three hours. Coordinator: Pederson. Alternate years, Spring 1999.

295 Special Topics. Supervised investigations in microbiology and molecular genetics. Credit as arranged.

302 Medical Microbiology. Fundamentals of pathogenic microbiology emphasizing mechanisms of disease production and mechanisms of resistance to infection. The ecological rather than taxonomic approach is stressed. Primarily for medical students. *Prerequisite:* Departmental permission. Four hours. Coordinator: Silverstein. Spring semester.

310 Graduate Seminar. Seminar to focus on specific issues at the forefront of current research in molecular genetics. Meetings will involve student presentation and discussion of research articles. *Prerequisite:* Permission of Coordinator. Two hours.

312 Yeast Molecular Genetics. The use of lower eukaryotes, such as the yeasts *Saccharomyces cerevisiae* and *Schizosaccharomyces pombe*, as model genetic systems to answer questions of basic biological importance. *Prerequisite:* Introductory Microbiology, Biochemistry, Genetics and/or Cell and Molecular Biology, and permission of Coordinator. Three hours. Coordinator: Johnson. Alternate years, Spring 2000.

332 Critical Reading. Students will participate in group discussions to critically evaluate and interpret the experimental data from one assigned paper from the scientific literature per week. *Prerequisite:* Permission of coordinator. One hour. Coordinator: Kurjan.

390 Research Proposal Writing. Designed to instruct students in the preparation and defense of an original research proposal. Students will defend their grant by oral examination. *Prerequisite:* Permission of Coordinator. Two hours. Coordinator: Stein. Fall 1998.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Molecular Physiology and Biophysics (MPBP)

Professors Alpert, Evans, Low, Lowey, Nelson, Osol, Patlak, Poehlman, Warshaw (Chair); Associate Professors Haerberle, Stirewalt, Trybus; Assistant Professors Berger, Dostmann, Schneider, Van Buren; Research Professor Maughan; Research Associate Professor Mulieri; Research Assistant Professors Mitchell, Rovner, Woodcock-Mitchell.

Specific areas of research involve: the molecular basis of contraction in smooth, skeletal and cardiac muscle, including muscle mechanics, energetics, molecular biology, contractile protein biochemistry and regulation, electrophysiology, excitation-contraction coupling, and protein synthesis and turnover; cellular and mechanical regulation of lung function, including properties of cells in vascular, bronchial and alveolar tissue; control of cellular growth and differentiation, including regulation of gene expression by growth factors, hormones and mechanical stretch; chemical signaling in cellular communication, including kinetics of single sodium and calcium channels, cholinergic and adrenergic receptor function, and the neurochemical correlates of hyperactive behavior and hypertension in rodent models; cardiovascular regulation, including changes in pregnancy and

changes in cation transport associated with human hypertension.

Except under special circumstances, admission and award of financial support will be restricted to Ph.D. applicants.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory performance on general (aptitude) section of Graduate Record Examination. Year courses in biology, organic chemistry, and physics. These requirements must be completed by the end of the first year of residency.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory completion of basic courses and comprehensive exam; formation of studies committee.

MINIMUM DEGREE REQUIREMENTS FOR MASTER OF SCIENCE

PSLB 301, 303, 308, 323; Biochemistry 301-302; other graduate courses as arranged (three hours minimum); thesis research (six to 15 hours).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Biology, one year; chemistry, organic and physical; physics, one year; mathematics, through calculus. These requirements must be completed by the end of the first year of residency. Satisfactory performance on general (aptitude) section of Graduate Record Examination. A master's degree is not a prerequisite for the Ph.D. degree.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Satisfactory completion of basic courses and comprehensive exam; formation of dissertation committee.

MINIMUM DEGREE REQUIREMENTS

PSLB 301, 303, 308, 323; Biochemistry 301-302; in addition, 21 elective credits, six of which must be in the Department; dissertation research, minimum 20 hours. Other requirements are flexible and will be determined for each individual after consultation with the Studies Committee.

COURSES OFFERED

301 Medical Physiology and Biophysics. Function in the whole human organism, and at the cellular, tissue, and organ levels, considered biologically and physically. *Prerequisite:* Permission of department chair. Eight hours.

302 Neuroscience. A correlated presentation of the neuroanatomy and neurophysiology of mammalian CNS. Same course as Anatomy 302. *Prerequisite:* Permission. Four hours. Anatomy and Physiology staff.

303 Special Topics in Physiology. Topics of current interest to the individual faculty will be covered in depth during individual, 6-week long minicourses of one credit hour each, offered in succession throughout the calendar year. Each topic will be repeated approximately every two years. Format will include lectures, reports, and directed readings. *Prerequisites:* 301; permission of individual faculty.

308 Biometrics and Applied Statistics. Introduction to the rational use and evaluation of statistical methods in planning experiments and interpreting biological data. Biometrics laboratory included. Course limited to 12 students. *Pre-*

requisites: Math. 110 or equivalent, and permission. Five hours. Fall.

310 Molecular Basis of Biological Motility. Molecular basis of muscle contraction, and cellular motility. Topics include: muscle energetics and mechanics, biochemistry of motility, and regulation of contractile proteins. Lectures and conferences. *Prerequisites:* 301; Biochemistry 301, 302; permission. Three hours. Warshaw. Alternate years.

313 Seminar on Endocrine Physiology. Devoted to a study of current problems in endocrine research with major emphasis on the molecular mechanism of action of hormones. *Prerequisites:* 301; Biochemistry 301, 302; permission. Three hours. Low. Alternate years.

323 Principles and Elements of Biomedical Instrumentation. Laboratory skills for modern molecular physiology. Topics: basic electrophysics; transducers; molecular concepts and manipulation; the computer as a laboratory instrument. Lectures and laboratory. *Prerequisite:* Permission. Five hours. Patlak. Alternate years.

381 Seminar. Presentation and discussion by advanced students, staff, and invited speakers, of current topics in physiology. No credit will be given, but students are expected to participate.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Music (See page 107.)

Natural Resources

The School of Natural Resources offers a Doctor of Philosophy in Natural Resources and four master's degree programs: the Master of Science in Forestry, the Master of Science in Natural Resource Planning, the Master of Science in Water Resources, and the Master of Science in Wildlife and Fisheries Biology.

Natural Resources (Ph.D.)

Professors Bergdahl, Cassell, DeHayes, Donnelly, Hannah, Manning, McIntosh, Newton, Reidel, Ventriss; Associate Professors Capen, Forcier, Gilbert, Hirth, Hudspeth, Lindsay, Richardson, Wang, Watzin; Assistant Professors Ginger, Hughes, Kaza, Kuentzel, Levine, Morrissey; Research Associate Professor Parrish; Research Assistant Professor Scherbatskoy.

The Ph.D. program provides the opportunity for focused, in-depth research in any of the specialties of the school, while fostering an interdisciplinary appreciation and perspective through course work and interactions with ecological, physical, and social scientists in an integrated academic setting. Students can develop programs in areas such as pollution ecology, recreation and tourism, conservation biology, and environmental policy, as well as any of the traditional natural resource disciplines featured in our Masters programs (see below).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

While an undergraduate degree in a discipline appropriate to the field of study will be considered, applicants with a Master of Science degree are preferred. Satisfactory scores on the Graduate Record Examination general (aptitude) section. Acceptability to a potential faculty advisor holding an appointment in the School of Natural Resources.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

It is ordinarily expected that a student will complete the following requirements for advancement to candidacy prior to the end of the second year in the program: (1) one year of full-time graduate study in residence at The University of Vermont; (2) teaching experience in one course; (3) at least 12 credit hours of research; (4) at least 15 credit hours of course work at the graduate level acceptable to the student's Studies Committee; (5) satisfactory performance on a comprehensive examination; and (6) a dissertation proposal accepted by the student's Studies Committee.

MINIMUM DEGREE REQUIREMENTS

The student must (1) present at least 75 credit hours in approved course work and research, including not less than 20 and not more than 35 credit hours in research; (2) have a reading knowledge of a foreign language or an experience living in or working with another foreign or domestic culture (approved by the SNR Graduate Studies Committee); and (3) satisfactorily complete and defend the dissertation.

Forestry (M.S.)

Professors Bergdahl, DeHayes, Donnelly, Hannah, Newton, Reidel; Associate Professors Forcier, Wang; Research Assistant Professor Scherbatskoy; Lecturer Turner; Extension Associate Professors Bousquet, McEvoy.

The goal of this Master of Science Program is to provide graduate students with advanced training in forestry science and the opportunity to further their knowledge and proficiency in some specialized aspect of forestry. The faculty has research interests which span the broad areas of biometry, ecology, genetics, tree improvement, management, pathology, physiological ecology, policy and administration, remote sensing, and silviculture.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE (FORESTRY)

Undergraduate degree in forestry or in a discipline related to the intended specific field of study. Satisfactory scores on the general (aptitude) portion of the Graduate Record Examination.

MINIMUM DEGREE REQUIREMENTS

The Forestry degree has two options.

Plan A

(Thesis Option) Requires 15 to 24 credit hours of advanced forestry and related courses, a comprehensive examination, six to 15 hours of thesis research, and an oral defense of the thesis. A student's thesis research is often an integral part of ongoing research projects.

Plan B

(Project Option) Requires 30 to 33 credit hours of advanced forestry and related courses, a comprehensive examination, three to six hours for a project pertinent to the student's area of specialization, and an oral defense of the project. The project is typically a forest resources management plan, a major paper, or a series of papers.

Natural Resource Planning (M.S.)

Professors Cassell, DeHayes, Manning, McIntosh, Newton, Ventriss; Associate Professors Capen, Forcier, Gilbert, Hirth, Hudspeth, Lindsay, Richardson, Schmidt, Wang, Watzin; Assistant Professor Ginger, Kaza, Kuentzel, Morrissey; Research Assistant Professor Scherbatskoy.

This interdisciplinary program prepares students for professional careers with public agencies and private organizations engaged in various aspects of environmental and natural resource planning and management. It provides theoretical and practical course work and experiences for those seeking to be environmentally-sensitive, resource-based planners and managers (town planners, regional planners, environmental regulation officials) as well as those seeking a broad natural resource education in such areas as: ecology and applied ecology; environmental law, policy, and administration; environmental economics; environmental education and interpretation; recreation management and tourism; management information systems (especially GIS), environmental studies, resource conservation, and sustainable development. Integrated resource management involving interdisciplinary problem-solving teams is stressed in most courses.

Efforts of faculty in the School of Natural Resources with the above specialties are augmented by those of colleagues in related fields at UVM, including the Field Naturalist, Public Administration, and Historic Preservation programs and the Center for Rural Studies. The academic program is further enriched by visiting faculty made up of leading Vermont planners and resource managers.

The program focuses on several concepts: seeking synergy between ecological concerns and economic health, considering the capacity of the land to support appropriate development (designing with nature as opposed to stressing technological solutions for transforming nature to meet human needs), understanding the "sense of place," understanding human institutions and behavior, and technical implementation (with emphasis on Geographic Information Systems).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE (NATURAL RESOURCE PLANNING)

Undergraduate degree in an appropriate field in the sciences, social services, or humanities/fine arts; satisfactory scores on the Graduate Record Examination, general (aptitude) section; and three letters of recommendation attesting to the candidate's academic potential for graduate work and motivation for pursuing this degree. Most successful applicants to this highly competitive program have had past experience in an environmental or natural resource-related job, internship, volunteer work, or international travel.

MINIMUM DEGREE REQUIREMENTS

The Natural Resource Planning program offers two options.

Plan A

(Thesis option) Requires at least 24 credit hours of course work in related fields, a comprehensive examination, six hours of thesis research, and an oral defense of the thesis.

Plan B

(Project option) Requires at least 30 credit hours of course work in related fields (including five hours of core courses and four distributive courses), a comprehensive examination, six credit hours of project research, and an oral defense of the project.

Irrespective of the plan chosen, students in the Natural Resource Planning Program usually are in residence for two years.

Water Resources (M.S.)

Professors Cassell, Donnelly, McIntosh; Associate Professor Wang, Watzin; Assistant Professors Hughes, Levine.

The Master of Science in Water Resources program is designed to provide students with an advanced understanding of water quantity and quality in the natural environment and with the skills and methodologies to analyze and solve technical problems concerning the effects of human activities on water quality and quantity. Current areas of research emphasis include ecotoxicology; integrating dynamic and spatial models; nonpoint source pollution; stream and lake ecology; systems approaches to water resource modeling; water quality modeling; and watershed processes.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE (WATER RESOURCES)

Undergraduate degree in an appropriate discipline and satisfactory scores on the Graduate Record Examination, general (aptitude) section.

MINIMUM DEGREE REQUIREMENTS

The Water Resources degree requires 15 to 24 credit hours of course work in water resources and related fields; a comprehensive examination, six to 15 credits of thesis research, and an oral thesis defense.

Wildlife and Fisheries Biology (M.S.)

Associate Professors Capen, Hirth, Watzin; Research Associate Professor Parrish; Assistant Professor Levine.

The Master of Science program is designed to provide a vehicle for a wildlife or fisheries biologist to develop research abilities and pursue a specialized course of study. Current areas of research emphasis include applied avian ecology, behavioral ecology, big game management, non-game wildlife populations, and freshwater fisheries ecology.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE (WILDLIFE AND FISHERIES BIOLOGY)

Undergraduate degree in wildlife and fisheries biology or management or in the biological sciences. Satisfactory scores on the Graduate Record Examination, general (aptitude) section.

MINIMUM DEGREE REQUIREMENTS

The Wildlife and Fisheries Biology degree requires 15 to 24 credit hours of course work in wildlife and related fields, a comprehensive examination, six to 15 hours of thesis research, and an oral defense of the thesis. The Studies Committee may require additional undergraduate preparation without credit toward the degree in instances of perceived deficiency.

COURSES OFFERED

FORESTRY (FOR)

205 Mineral Nutrition of Plants. (See Plant and Soil Science 205.)

221 Forest Soils and Site Relations. Forest soils from an ecological perspective. Profile development, physical properties, roots, water relations, nutrient cycling, topographic factors, site quality, and the potential to produce biomass. *Prerequisites:* 120, Plant and Soil Science 161 and permission. Three hours. Hannah. Alternate years, contact School.

222 Advanced Silviculture. Scientific bases for selected silvicultural practices. *Prerequisite:* Permission of instructor. Three hours. Hannah. Alternate years, contact School.

225 Tree Structure and Function. Basic anatomy and physiology of trees and other woody plants, emphasizing their unique structural and physiological adaptations to the environment. *Prerequisite:* Permission of instructor. Three hours. Scherbatskoy.

228 Ecosystem Ecology. Examination of structure and function of ecosystems (emphasizing terrestrial), using a systems approach. Laboratory sessions involve modeling and data analysis. *Prerequisites:* Biology 1, 2, Chemistry 3, Forestry 120, Natural Resources 140, Math 19, Physics 11; or equivalent. Two hours. Wang. Alternate years, contact School.

229 Water Relations of Plants. Concept of water potential as it pertains to plant-soil water relations. Absorption, transport, and transpiration. Hydraulic architecture. Development and impacts of plant water deficits. *Prerequisites:* FOR 225 or Botany 104 or equivalent. *Cross-listing:* PSS 207. Three hours. Donnelly. Alternate years, contact School.

231 Integrated Forest Protection. Integration of concepts of forest protection using a holistic ecological approach to forest pest management. Detection, population dynamics, evaluation, prediction, and pest management considerations. *Prerequisites:* 133, 134 or permission. Three hours. Bergdahl. Alternate years, contact School.

242 Advance Forest Biometry. Advanced principles of estimation, prediction, inventory, and evaluation of forest resources. Use of system analysis techniques in natural resource management. *Prerequisite:* NR 140 or permission. Three hours. Newton. Alternate years, contact School.

254 Advanced Natural Resource Policy. Advanced seminar in natural resource policy, with emphasis on current issues in forest policy. *Prerequisites:* Graduate or advanced undergraduate standing; 251 or permission. Three hours. Reidel. Alternate years, contact School.

272 Forest Resources Management. Application of mathematical programming, growth and yield forecasting, and economic analysis to the planning and organization of forests for multiple-use sustained yield production. *Prerequisites:* 123, 153 or permission. Four hours. Newton.

285 Advanced Special Topics. Advanced special topics courses or seminars in forestry beyond the scope of existing formal courses. *Prerequisites:* Graduate or advanced undergraduate standing and permission. Credit as arranged.

324 Advanced Forest Genetics. Discussion of the adaptive and physiological nature of genetic variation in forest trees. Analysis of procedures, results, and interpretations of selected forest genetics research. *Prerequisites:* Statistics 211; FOR 124 or equivalent and permission. Three hours. DeHayes. Alternate years, contact School.

382 Seminar in Research Planning. (See Natural Resources 382.) One hour.

385 Selected Problems in Forestry. Advanced readings, or a special investigation dealing with a topic beyond the scope of existing formal courses. *Prerequisites:* Permission. Credit as arranged.

391 Master's Thesis Research. Credit as arranged.

392 Master's Project Research. Credit as arranged.

NATURAL RESOURCES (NR)

206 Environmental Problem Solving and Impact Assessment. Group dynamics, impact assessment and decision making. Emphasis on the process of solving complex environmental problems, interdisciplinary team work, and the National Environmental Policy Act. *Prerequisite:* 1, 2, 103, 104, 205, and Statistics. Four hours. Donnelly.

220 Landscape Ecology. Study of pattern, process and dynamics in the landscape. Considers the role of landscape

pattern in determining habitat quality and ecosystem function. *Prerequisites:* One biology, one ecology course, or equivalent. Two hours. Wang.

235 Legal Aspects of Planning and Zoning. Comparison of Vermont planning and zoning law with that of other states. Case studies in planning, zoning, and land use controls. *Prerequisite:* Permission. Three hours.

240 Wilderness and Wilderness Management. See Recreation Management 240. Three hours. Manning.

244 Quantitative Assessments of Natural Resources. Principles associated with inventorying selected natural resources. Survey of measurement and estimation techniques for land, timber, wildlife, fisheries, surface water, and recreation. *Prerequisites:* One course in statistical methods, one 200-level natural resource course, permission of instructor. Three hours. Newton.

250 Limnology. Ecology of lakes and reservoirs, including their origin, physics, chemistry and biology, and the effects of anthropogenic perturbations. *Prerequisites:* An ecology course, a college-level chemistry course. Three hours. Levine.

251 Limnology Laboratory. Field and laboratory experience in limnology, including sampling techniques, physical measurements and analysis of chemical and biological samples. *Prerequisites:* Previous or concurrent enrollment in 250. One hour. Levine.

252 Visual Resource Planning and Management. Investigates the theories and principles of aesthetics related to landscape perception, and their applications to visual impact assessment and scenic resource planning. Three hours.

254 Advanced Natural Resource Policy. (See Forestry 254.) Three hours. Reidel.

255 Field Methods in Water Resources. Techniques used in field assessment of water quality in rivers and lakes. Case studies on the LaPlatte River and Lake Champlain. Sampling strategies, field measurements and data evaluation. Extensive field work. *Prerequisite:* NR 102 or equivalent basic course in water. Three hours. McIntosh.

260 Wetlands Ecology and Management. Structure, dynamics and values of natural and artificial wetlands; wetlands management and issues. *Prerequisites:* Biology 1 and 2, an upper level ecology course. Three hours. Levine.

261 Wetlands Ecology Laboratory. Field and laboratory experience related to wetlands ecology and management. One weekend trip. *Prerequisites:* Previous or concurrent enrollment in 260. One hour. Hirth.

262 International Problems in Natural Resource Management. Discussion of problems associated with the management of natural resources which have international implications. Topics may include deforestation, desertification, fisheries, wildlife, refuges, fuelwood, pollution. *Prerequisite:* Permission. Three hours. Hudspeth.

270 Toxic and Hazardous Substances in Surface Waters. The fate of toxic and hazardous pollutants, including trace elements and organics, in surface waters; effects on human health and aquatic biota. *Prerequisites:* NR 102 or equivalent; Biology 1; Chemistry 23, 42; senior standing. Three hours. McIntosh. *Cross-listing:* Geology 270.

275 Natural Resource Planning: Theory and Methods. Investigates theoretical development of natural resource planning. Studies planning methods appropriate to protection and use of scenic, recreational, forest, agriculture, and historic resources and ecologically sensitive areas. *Prerequisite:* Permission. Three hours.

276 Water Quality Analysis and Interpretation. Selected aspects of water chemistry and bioassay as related to surface and ground waters. Laboratory analysis of water quality

parameters and data interpretation. *Prerequisites:* One course in calculus, chemistry, and statistics, or equivalent. Three hours. Cassell. Cross-listing: Geology 276.

278 Principles of Aquatic Systems. Study of physical, chemical and biological principles as related to rivers, streams and lakes. Description of dynamic behavior of these systems using simulation techniques. *Prerequisites:* NR 170 or equivalent (or as a co-requisite), Math 19, Physics 11, Chem 23, 26 or equivalent; senior standing. Three hours. Cassell. Cross-listing: GEOL 278.

279 Watershed Management Hydrology. Fundamental elements of hydrology and contaminant transport in watersheds. Application of dynamic stimulation techniques. Discussion of new technologies for watershed management. *Prerequisites:* NR 170 or equivalent (or as a corequisite), Math 20, Physics 11, Chem 23, 26 or equivalent, senior standing. Three hours.

280 Stream Ecology. Physical, chemical and biological aspects of stream ecosystems. Impacts of human activities such as agriculture, forestry and water withdrawal. Bioassessment techniques using macroinvertebrates and fish. *Prerequisites:* 1 year biology, 1 year chemistry, NR 104 or 250. Three hours.

285 Advanced Special Topics in Natural Resource Planning. Advanced special topics in natural resource planning beyond the scope of existing formal courses. *Prerequisites:* Permission. Credit as arranged.

360 Environmental Sociology. An in-depth exploration of how sociologists understand the relationship between a) the physical environment's effects on society, and b) society's effects on the natural environment. *Prerequisite:* Graduate Standing or permission. Fall, alternate years. Three hours. Kuentzel.

370 Special Topics in Aquatic Toxicology. Discussions of the current literature in aquatic toxicology. *Prerequisites:* Concurrent enrollment in 270, graduate student standing. One hour. McIntosh.

375 Natural Resource Planning: Laboratory. Experiential laboratory applying natural resource planning theory and methods to local or regional issues. Students conduct a planning exercise for a town or region. *Prerequisites:* To be taken concurrently with 275. One hour.

380 Seminars in Natural Resources. Presentation and discussion of advanced problems, research, and current topics in natural resources by faculty, graduate students, and outside guest speakers. *Prerequisites:* Permission. 0.5 hours/semester, maximum two hours. School of Natural Resources faculty (Chairman of Curriculum Committee).

382 Seminar in Research Planning. Discussions of the planning and activities associated with graduate student projects and research. *Prerequisite:* Permission. One hour. Forcier, Newton.

384 Independent Studies in Natural Resources. 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.

385 Special Topics in Natural Resources. Graduate topics and material that may eventually develop into a regular course offering; in addition, it may include topics and material presented only once. *Prerequisite:* Permission. Credit as arranged.

391 Master's Thesis Research. Credit as arranged.

392 Master's Project Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

RECREATION MANAGEMENT (RM)

235 Outdoor Recreation Planning. The planning of large

wildland areas for outdoor recreation. Emphasis on the planning process relative to the leisure time use of natural resources. *Prerequisites:* Advanced undergraduate or graduate standing in Recreation Management or permission. Four hours. Lindsay.

240 Wilderness and Wilderness Management. History, philosophy, and management of wilderness, national parks, and related areas. *Prerequisite:* 235 or permission. Three hours. Manning.

255 Environmental Interpretation. Philosophy, principles, and techniques of communicating environmental values, natural history processes, and cultural features to visitors to recreational settings through the use of interpretive media. *Prerequisite:* 235 or permission. Four hours. Hudspeth.

WATER RESOURCES (WR)

391 Master's Thesis Research. Credit as arranged.

WILDLIFE AND FISHERIES BIOLOGY (WFB)

232 Ichthyology. Biology of fishes. Study of the structure and function of systems; behavior and ecology of modern fishes. *Prerequisites:* Zoology 104 or 219 or equivalent, WFB 161. Three hours. Alternate years, contact School.

273 Terrestrial Wildlife. Integration of ecological principles, wildlife biology, land use, and human dimensions in wildlife. Emphasis on development and maintenance of terrestrial wildlife habitat, and population regulation of terrestrial species. *Prerequisites:* 150, 174 or equivalent. Three hours. Hirth.

274 Terrestrial Wildlife Laboratory. Laboratory and field experience related to terrestrial species and management of their habitat. Field project required. *Prerequisite:* Previous or concurrent enrollment in 273. One hour. Hirth.

275 Wildlife Behavior. Behavior and social organization of game and nongame species as they pertain to population management. *Prerequisites:* One year of biology, an ecology course, 74 or 174 recommended, or equivalent. Three hours. Hirth.

279 Marine Ecology. Structure and function of major marine communities, including open ocean, benthos, coral reefs, and estuaries. Emphasis on unique ecological insights gained in the marine environment. *Prerequisites:* Biology 1 and 2, an ecology course, or instructor permission. Three hours. Watzin.

285, 286 Advanced Special Topics. Credit variable.

352 Modeling and Estimation of Animal Populations. Modeling and analysis of animal population dynamics, as influenced by environmental, ecological, and management factors; estimation of population size, density, survivorship, reproduction, and migration. *Prerequisites:* Math. 19; NR 140 or Statistics 211; an ecology course. Four hours. Cross-listing: Statistics 352.

387, 388 Graduate Special Problems. Advanced readings or special investigation dealing with a topic beyond the scope of existing formal courses or thesis research, culminating in an acceptable paper. *Prerequisite:* Permission. Credit as arranged.

391 Master's Thesis Research. Credit as arranged.

Nursing (GRNU)

Professors Hamel-Bissell, Winstead-Fry (Interim Dean); Associate Professors Cohen, Green-Hernandez, Welch; Assistant Professors Botter (Interim Associate Dean), Carr, Ettlinger, Kusserow, Morris, Sowen. (List of Adjunct Faculty available in the School of Nursing.)

The Master of Science in nursing prepares professional nurses to assume leadership roles within the discipline of nursing in a variety of settings, to expand knowledge of nursing, develop expertise in a specialized area of nursing and acquire the foundation for doctoral study and continued professional development.

The tracks/majors offered are: Adult Health Nursing, Community Health Nursing and Primary Health Care Nursing. Upon completion of the Adult or Community Health Nursing tracks/majors graduates are eligible to take the ANA certification examination for Adult or Community Health Clinical Nurse Specialist. Upon completion of the Primary Health Care Nursing track/major graduates are eligible to take the ANA certification examination for Adult or Family Nurse Practitioner.

Current research interests of the faculty include: rural health issues, women's health issues, determinants of healthy aging, health promotion, caring, feminist theory, ethical decision making, advanced practice framework, determinants of leadership, alcohol and drug use within a community health context, patient classification, program evaluation, suicide, women's mental health, psychosocial concerns of consumers and health care providers, multidimensional healing, therapeutic touch, diabetes, cancer, and client self-teaching tools.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

A bachelor's degree with a major in nursing, preferably with a grade point average of 3.00 or better including a basic course in statistics. Eligible for licensure as a registered nurse in Vermont. Satisfactory scores on the Graduate Record Exam. Three letters of recommendation from persons who can assess your potential for graduate work. RN's with a bachelor's degree in another field may be admitted upon successful completion of the Bridge Process (a means to assess prior nursing knowledge). Current UVM nursing undergraduates may be eligible to apply for the Accelerated Master's Program.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Under most circumstances, meeting the requirements for admission as stated above will allow advancement to candidacy. Students who appear to be marginal in meeting admission requirements may be required to satisfactorily complete certain courses before acceptance as a degree candidate.

MINIMUM DEGREE REQUIREMENTS

Credit hour requirements vary depending on track and include thesis (6 credits) or project (3 credits) and successful completion of written comprehensive exam.

COURSES OFFERED

* (Class hours – clinical hours.)

296, 396 Special Topics in Graduate Nursing. Topics of interest to graduate nursing which are based on theory, research or advanced practice. Course content will deal with topics beyond the scope of existing formal courses or thesis research. *Prerequisite:* Permission. One to six hours.

300 Nursing Research – Application of Quantitative Methods. Study of philosophical assumptions, purposes and methods of quantitative research. Study of statistics and use of quantitative research in nursing. Knowledge and skills related to the research process are applied to delineate a nursing problem and to develop a plan for its study. *Prerequisites:* Basic statistics course and permission. Three hours.

305 Pathophysiology. Focus on physiologic and pathophysiology aspects of disease. Emphasis on biochemical mechanisms associated with selected disease states which occur across the lifespan. *Prerequisite:* Permission. Three hours.

306 Pharmacotherapeutics in Primary Care. Examination of the pharmacokinetics and pharmacodynamics of select drugs focusing on indications, interactions, adverse reactions, special population considerations, educational needs, cost-effectiveness, and the ethical/legal standards of prescriptive authority. *Prerequisites:* 305 recommended. Permission required. Three hours.

310 Nursing Theory. Exploration of the concepts, conceptual frameworks, and theories in nursing. Analysis of the current nursing theories with emphasis on the relationship between theory and practice. *Prerequisite:* Permission. Three hours.

315 Nursing Issues and Health Care Trends. Issues germane to contemporary nursing are explored. Forces influencing health care organizations are discussed with respect to concepts of management, leadership, change, and nursing roles. *Prerequisite:* Permission. Three hours.

320 Nursing Research: Application of Qualitative Methods. Study of purposes, methods, and strategies underlying historical and philosophical principles, and the implementation of qualitative research in nursing. *Prerequisite:* Permission. Three hours.

324 Nurse as Administrator – Theory. This course is a critical study of the knowledge and skills necessary to exercise effective leadership in contemporary and dynamic health care systems. *Prerequisites:* 310, 315, and 300 or 320. Three hours.

326 Nurse as Administrator: Practicum. (0-9)* Provide student with opportunity to integrate administrative theory, operations and research in a variety of settings. Practicum is structured according to the needs of the individual to provide knowledge, skills essential for the nurse administrator. *Pre/corequisite:* 324. Three hours.

328 Curriculum and Instruction in Nursing. Study of the development, implementation and evaluation of curricula in collegiate and nursing service education. *Prerequisite:* 310, 315, and 300 or 320. Three hours.

330 Theory and Practicum in Adult Health Nursing I. (3-9)* Examination of concepts and theories essential to the assessment, diagnosis, and clinical decision making in adult health nursing. Class and clinical placement. *Prerequisites or Corequisite:* 300, 305 and 310. Six hours. Alternate years, 1999–2001. *(class hours-clinical hours.)

331 Theory and Practicum in Adult Health Nursing II. (3-9)* Analysis and evaluation of nursing concepts based upon theories, research and the practice of adult health nursing. Class and clinical placement. *Prerequisite:* 330. *Corequisite:* 315 and 320. Six hours. Alternate years, spring 2000 and 2002.

332 Theory and Practicum in Adult Health Nursing III. (2-12)* Application and synthesis of concepts relevant to advanced practice in adult health nursing, with emphasis on role development. Class and clinical placement. *Prerequisites:* 331 and one elective. Six hours. Alternate years, fall 2000 and 2002.

333 Advanced Physical and Psychosocial Assessment. (2-2)* Systematic collection, organization, interpretation, and communication of data related to individual health status. A holistic perspective provides the data necessary for formulation of nursing and medical diagnoses. Lab fee required. *Prerequisites:* 305 or permission. Three hours with a laboratory component.

334 Theory and Practicum in Primary Health Care I, (3-9)* Provides the theoretical basis for primary care for

well women and children. Emphasis placed on comprehensive health promotion, illness prevention and health maintenance. *Prerequisites:* 305, 310, 333. *Pre/corequisites:* 306, 300, 315, or 320. Six hours.

335 Theory and Practicum in Primary Health Care II. (3-9)* Focuses on the assessment, diagnosis, management and evaluation of complex responses of individuals and families to commonly encountered acute and chronic health conditions. *Prerequisite:* 334. *Pre/corequisites:* 300, 315, or 320. Six hours.

340 Theory and Practicum in Community-Health Nursing I. (3-9)* Provides overview of factors related to community/public health nursing with special emphasis on the determinants of health of populations. Focus on state, national health priorities, community assessment strategies. *Prerequisites:* 300, 305, 310, and Statistics 200. Six hours.

341 Theory and Practicum in Community Health Nursing II. (3-9)* Examines advanced practice roles in community/public health nursing related to the analysis of health promotion strategies. Focus on program planning and the analysis of the policies for which these programs were designed. *Prerequisite:* 315, 320, and 340. Six hours.

342 Theory and Practicum in Community Health Nursing III. (3-9)* Focus on synthesis and application of concepts, relevant to advanced practice roles in community/public health nursing, and on role development and plans for useful program evaluation. *Prerequisite:* 341. Six hours.

348 Practicum in Nursing Education. (0-9)* A practicum provides opportunity to investigate the roles and functions of the teacher in higher education and/or nursing service settings. Builds on the theory studied in GRNU 328 and focuses on the interactive nature of the teaching-learning process. *Prerequisites:* 330 or 340; *pre/corequisite* 328. Three hours.

363 Theory and Practicum in Primary Health Care III (Adults). (2.5-19.5)* Focuses on the continued refinement of critical thinking related to diagnostic and ethical judgments and therapeutic interventions in providing primary care to adolescents and adults. *Prerequisites:* 335. Nine hours.

364 Theory and Practicum in Primary Health Care III (Family). (2.5-19.5)* Focuses on the continued refinement of critical thinking related to diagnostic and ethical judgments and therapeutic interventions in providing primary care to individuals and families. *Prerequisite:* 335. Nine hours.

390 Master's Project. Self-designed clinical paper or innovative production pertinent to advanced nursing practice. *Prerequisites:* 331, 335 or 341 and permission of academic advisor. Credit as arranged.

391 Master's Thesis Research. *Prerequisites:* 331, 335 or 341 and approval of Studies Committee. Six hours.

395 Independent Study in Graduate Nursing. Individual work in graduate nursing with a base of theory, research, or advanced practice. Student in consultation with faculty sponsor devises objectives, plan of work, and evaluation for designated credit hours. *Prerequisites:* Permission of academic advisor and sponsoring faculty. One to six hours as arranged. Graduate Nursing Faculty as selected by student.

Nutrition and Food Sciences (NSF)

Professors Chamberlain, C. Donnelly, Kindstedt, Poehlman, Tyzbir (Chairperson); Associate Professors Chen, Johnson, Pintavro, Ross, Sheard; Extension Associate Professor Harvey - Berino; Assistant Professor Clark; Lecturers Gagne, Geiger, Pritchard; Adjunct Assistant Professor S. Donnelly; Adjunct Instructors Kaskoun, Lyons

The department mission is to study the relationship between nutrition, food science, health and fitness (preventive nutrition) and between diet and disease (therapeutic

nutrition). Faculty research encompasses both basic and applied or community aspects of human nutrition and food science and technology. Research is being conducted on: the impact of attitudes and behaviors toward eating and exercise on body size, shape and composition, the elucidation of arrhythmogenicity of long-chain acyl-carnitines in humans, factors effecting energy intake and expenditure in aging, developing web-based interactive multimedia tools for use in teaching and research, inter-generational nutrition program development, developing behavior modification programs to improve individual eating behaviors and the nutritional status, health, and fitness of communities, testing the effectiveness of Internet support on the long term management of obesity, factors effecting the nutritional status of children, milk chemistry and cheese technology (i.e., structure, function, and properties of mozzarella and goat's milk cheese), chemistry and processing of infant formula, food microbiology, food material science, mathematical modeling of biological processes important to foods and cheese rheology.

For more information, contact Professor Robert S. Tyzbir, Chair of the Department of Nutrition and Food Sciences, 315 Terrill Hall, 656-3374 or e-mail rtyzbir@zoo.uvm.edu.

A Master of Arts in Teaching degree program is also offered in Family and Consumer Sciences. This degree enhances an in-service teacher's content expertise or leads to initial licensure. With appropriate elective courses this degree can provide endorsements for teaching Science and Health in addition to licensure for Family and Consumer Sciences. For more information, contact Professor Valerie Chamberlain, Department of Nutrition and Food Sciences, 106 Terrill Hall, 656-0035 or 656-3374.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in nutrition, dietetics, food science, or a science-related field. Satisfactory scores on the Graduate Record Examination, general (aptitude) portion.

MINIMUM DEGREE REQUIREMENTS

Thirty hours including six to fifteen hours of thesis research. Twenty-one hours should be earned in the field of specialization; nine hours may be selected from related areas; courses in statistics, Research Methods in Nutrition and Food Sciences, and Nutrition and Food Sciences Seminar are required.

COURSES OFFERED

Prerequisites for all courses: as listed, or equivalent, or by permission of instructor.

201 Fermented Dairy Foods (3-3) Fundamental processes involved in the manufacture of domestic and imported cheese varieties and other cultured dairy foods. Acquired knowledge of manufacturing procedures applied at pilot plant level. *Prerequisites:* a course in organic chemistry, AGBI 201, or permission. Four hours. Kindstedt. Alternate years, Spring 2000.

203 Food Microbiology (3-3) Desirable and undesirable activities of bacteria in foods. Mechanisms of food-borne infection and intoxication. Laboratory methods to enumerate and identify microorganisms associated with food. *Prerequisites:* a course in biochemistry. Four hours. S. Donnelly.

206 Principles of Food Engineering (3-3) Engineering fundamentals involved in food industry. Conservation of mass and energy; thermodynamics; fluid mechanics; conduction, convection, and psychometrics; and drying. *Prerequisites:* Math 19 or instructor's permission. Four hours. Chen. Alternate years, Spring 1999.

222 Curriculum Development in the Human Sciences (3-0) Basic principles of curriculum development applied to human sciences education. Unique characteristics and contributions of human science education as related to educational, economic, and sociological trends. Three hours. Chamberlain. Spring (odd number years).

223 Methods of Education in the Human Services (3-0) Planning and presenting of appropriate methods, media, and materials for audiences in community, school, and institutional settings emphasizing interpersonal communication and group process skills. Three hours. Chamberlain. Fall.

224 Evaluation Techniques in the Human Sciences (3-0) Test, questionnaire, and interview schedule construction and other non-testing means of evaluation. Usability, objectivity, validity, reliability, and discrimination of evaluation instruments. Selected sociometric techniques and evaluation in affective domain. Three hours. Chamberlain. Spring (even numbered years).

238 Food Service Systems Management. Organization and administration of food service systems including principles of production, accounting management decisions, communications, and legal responsibilities, specific to quantity food production. Emphasis on problem solving. *Prerequisites:* 138, Business Administration 120. Three hours. Geiger. Spring.

243 Advance Nutrition (3-0) Study of nutrients and their specific functions in metabolic process integrating cellular physiology, biochemistry, and nutrition. *Prerequisites:* 43, AGBI 201 or equivalent, ANPS 19 or equivalent. Three hours. Sheard. Spring.

253 Food Safety and Regulation (3-0) Comprehensive study of the relationships between food processing and preservation, food toxicology, and the scope, applicability, and limitations of U.S. food laws. *Prerequisites:* AGBI 201 or equivalent. Three hours. Pintauro. Spring.

260 Diet and Disease (3-0) Examination of the physiologic, biochemical, and psychosocial basis of several disease states with application of the normal and therapeutic food and nutrition principles associated with treatment. *Prerequisites:* 53, 123, 143, 243. Three hours. Ross. Fall.

261 Clinical Nutrition (3-0) Applications of clinical nutrition including practice experiences in interviewing, nutritional assessment and counseling, case studies, and in depth discussions of current controversies in the dietary management of specific diseases. *Prerequisites:* 260 or concurrently enrolled. Three hours. Sheard. Fall.

262 Community Nutrition (3-0) Analysis of current programmatic and policy approaches addressing the major nutrition-related health problems in the U.S. Emphasis on program planning, marketing, and evaluation of community nutrition services. *Prerequisites:* 260 and senior standing. Three hours. Johnson. Spring.

263 Nutritional Biochemistry (3-0) Comprehensive study of metabolism of carbohydrates, lipids, and protein emphasizing diet induced, hormone mediated changes in metabolism, nutritional and metabolic interrelationships, and dietary abnormalities (e.g. diabetes, alcoholism, starvation and obesity). *Prerequisites:* 243 or instructor's permission. Three hours. Tyzbir. Spring.

295 Special Topics Lectures, laboratories, readings, or projects relating to contemporary areas of study. Enrollment may be more than once, maximum of 12 hours in 195 and 295 combined. *Prerequisite:* Departmental permission. Variable credit.

296 Field Experience Professionally-oriented field experience under joint supervision of faculty and business or community representative. Maximum of 15 hours in 196 and 296 combined. *Prerequisite:* Departmental permission. Variable credit.

350 Nutrition and Food Sciences Seminar (1-0) Review of recent developments in nutrition and food science research. *Prerequisites:* 243 and instructor's permission. One hour. Pintauro. Fall/Spring.

360 Research Methods in Nutrition and Food Sciences (1-6) Advanced research methods, including grant preparation, Institutional Review Board requirements, data analysis and presentation, and selected techniques in advanced nutritional biochemistry. *Prerequisites:* AGBI 201, 202 or equivalent. Four hours. Pintauro. Spring.

391 Master's Thesis Research. Credit as arranged.

Obstetrics and Gynecology

(See page 108.)

Orthopaedic Surgery (See page 108.)

Pathology (PATH)

Professors Bovill (Chairperson), Craighead, Hardin, Howard, Mossman, Pendlebury, Stark, Trainer, Winn; Associate Professors Heintz, Huber, Lunde, MacPherson, Morrow, Mount, Tindle, Tracy, Waters, Yandell; Assistant Professors Adams, Allen, Drejet, Gibson, Harmon, Janssen-Heininger, Koh, Taatjes, Tang, Tutschka, Weaver, Zarka.

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.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Satisfactory undergraduate or graduate course work in chemistry and the biological sciences. Microbiology and immunology are also recommended but not required. Satisfactory scores on the Graduate Record Examination, general (aptitude) section. Persons interested in a Ph.D. program may wish to consider the interdisciplinary program in Cell and Molecular Biology in which Pathology participates.

MINIMUM DEGREE REQUIREMENTS

Anatomy 311 (three hours), Pathology 305 (three hours), Biochemistry 301-302 (six hours); additional approved courses; thesis research (six to 15 hours).

COURSES OFFERED

295 Special Topics. *Prerequisite:* Permission. Credit as arranged.

301 General Pathology. A study of the processes of injury, repair, neoplasia, degeneration, etc., as they affect cells, tissues, and the human patient. For medical students. *Prerequisite:* Permission. Three hours.

302 Systemic Pathology. Introduction to diseases, pathologic processes with particular reference to their effects on various organ systems. Instruction in clinical laboratory medicine is correlated with work in systemic pathology. *Prerequisites:* 301, permission. Eight hours.

305 Molecular Mechanisms of Environmental Disease. Basic state-of-the-art survey of pathobiological mechanisms for graduate and postdoctoral students who are not candidates for M.D. degree, advanced medical students, and pa-

thology residents. *Prerequisites:* Required: basic background in chemistry including biochemistry. Desirable: microbiology including fundamental immunology, physiology, histology, permission. Three hours. Alternate year course with Immunopathology 395.

306 Lab – Pathology of Environmental Disease.

375 Special Topics in Molecular Pathobiology. Three independent, rotating one-semester modules concerning coronary heart disease, DNA replication, and control of cell cycle. Based on critical review of primary literature. *Prerequisites:* Biochemistry 301, 302. Three hours. DNA replication module – Heintz, Heart module – Tracy, Cell Signaling – Janssen-Heininger and Timblin, Computer-Assisted Microscopy and Image Analysis, Taatjes.

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.

395 Special Topics in Pathology: Immunopathology. An in-depth analysis is planned into the role of the immune system in disease processes. Discussions center on current and controversial areas of immunopathology. *Prerequisites:* Immunology desirable. Two hours. Alternate year course with 305.

Pharmacology (PHRM)

Professors Branda, Brayden, Grunberg, McCormack, Nelson (Chairperson), Osol, Pallak, Scollins; Associate Professors Cooper, P. Jones, Lidofsky, Maw, Mischler, Penar; Assistant Professors Bednar, Damon, Dostmann, Lounsbury, Segal; Research Assistant Professors Bigelow, Boneu; Research Associate Heppner; Adjunct Professor Tritton; Adjunct Assistant Professors Bress, Freilich; Visiting Professors Dustan, Lederer, Standen; Visiting Associate Professor Hesechler; Visiting Assistant Professor Laher.

This degree program involves development of a broadly based background in biomedical science followed by intensive laboratory research in the chosen area of specialization. Primary research interests of the faculty include: Cardiovascular Pharmacology (ionic basis of vascular smooth muscle function, neurovascular communication, gene transcription and smooth muscle cell proliferation), Signal Transduction (protein nuclear transport, signaling by protein kinases), and Pharmacokinetics of anti-AIDS and anti-cancer drugs (chemical determinants of therapeutic activity, natural products as anti-cancer agents). World Wide Web page: <http://pharmweb.med.uvm.edu>.

A pre- and postdoctoral training program in clinical pharmacology of anticancer drugs is offered in cooperation with the Vermont Cancer Center.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREES OF MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY

Year courses in biology, organic chemistry, physics, analytic geometry and calculus; physical chemistry and/or a reading knowledge of one foreign language may be additional prerequisites, depending on the requirements of the research supervisor; and acceptable scores on the general (verbal, quantitative) section of the Graduate Record Examination.

MINIMUM REQUIREMENTS FOR THE MASTER OF SCIENCE DEGREE

Pharmacology 301, 302, 303, 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, 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. Three hours.

290 Topics in Molecular and Cellular Pharmacology. Focus on basic principles, drug interactions with receptors, membranes, synapses, neurotransmitters, macromolecules, cytoskeleton, ion channels and pumps, and mechanisms of drug resistance. *Prerequisites:* Organic chemistry, biochemistry, biology. Three hours.

301 Medical Pharmacology. The chemical and biological properties of drugs. *Prerequisite:* Permission. Six hours.

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. Two hours, by arrangement.

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. *Prerequisite:* Chemistry 131-132, or permission. 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. Credit variable, one to three hours.

373 Readings in Pharmacology. Intensive directed reading in one area of pharmacology. Pharmacology students must choose a topic outside thesis research area. Term paper and seminar on selected topic required. *Prerequisite:* Permission. Two hours, by arrangement.

381 Seminar. Current developments in pharmacology are presented for discussion by students. *Prerequisite:* Permission. One hour.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Philosophy (See page 108.)

Physical Therapy (PT)

Associate Professors Held (Chair), Reed; Assistant Professors Henry, Wu; Professors Emeriti Feitelberg, Moffroid.

The Master of Science Degree Program is designed for graduate Physical Therapists who desire to expand and enhance their scientific knowledge and professional skills in a scholarly environment in preparation for practicing as an advanced clinician. The advanced clinician is a practitioner with in-depth knowledge who can act as a mentor, coach, advocate, and resource for providers and consumers by demonstrating competent advanced clinical judgment and skill, as well as competent teaching skill, and by promoting research as a critical reader and contributor. The core of the program focuses on the scientific basis of normal and abnormal movement. It is accompanied by courses within a professional practice sequence, as well as a research sequence which will culminate in the completion of a thesis. The program is

designed to accommodate practicing clinicians who wish to pursue part-time or full-time graduate studies.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Graduate of an accredited entry level physical therapy educational program with a minimum GPA of 2.67 (B-) desired. Submission of scores of the Graduate Record Examination. A minimum score of 1500 on the aptitude portion is expected. Three letters of reference, at least one each from professional and educational sources. Official transcript, completion of application form, completion of health form. At least two years of clinical practice as a physical therapist. Current knowledge of statistics, neuroscience, and biomechanics which may be demonstrated by prerequisite courses within the last five years or satisfactory performance on equivalency tests in each of these areas. (Appropriate courses on campus, or self-study guides will be recommended for anyone who does not initially meet these standards.) A personal interview during which clearly defined educational goals and objectives for graduate study are discussed as they are reflected in the application and supportive documentation. These goals will be discussed in relationship to departmental resources and goals to determine whether personal and departmental objectives are congruent and compatible.

MINIMUM DEGREE REQUIREMENTS

Completion of 36 credits of graduate courses in physical therapy, including six credits of thesis research and six credits of approved electives. Completion of a practicum in one of the following areas: teaching, clinical specialty, management, and consultation. Completion of a comprehensive written exam is required prior to the initiation of the masters thesis research. In addition to the exam, the student must defend the research proposal in an oral presentation.

COURSES OFFERED

300 Research Tutorial. Through seminars, actual research participation, informal discussions, and individual advisement, the student will develop a proposal for thesis research. Explore instrumentation, experimental design, and logistics of research. One to three hours. Held.

302 Professional Practice I. Factors influencing professional practice. Societal issues regarding the health care industry and their impact on professional practice. Strategies to manage these environmental forces. Two hours.

303 Professional Practice II. Analysis of the various professional roles of the Physical Therapist. Focus on the development of skills within each role to promote professional satisfaction and contribution. *Prerequisite:* 302. Two hours.

304 Professional Practice Practicum. Practicum experience in a clinical specialty, teaching, management or consultation. Companion seminar to analyze and assess practicum experience. *Prerequisites:* 302, 303. Two hours. Held.

311 Motor Function and Dysfunction: Muscle. Structure, function, biomechanics, plasticity, measurement of muscle characteristics, muscle performance in relation to development, aging, nutrition, activity, pathology, elasticity, viscosity and responses to therapeutic interventions. Three hours. Wu.

312 Motor Function: Connective Tissue. Structure, function, plasticity and biomechanics of connective tissues will be studied relative to development, aging, nutrition, activity, pathology, compressive and tensile forces, and therapeutic intervention. Three hours. Henry.

313 Motor Function and Dysfunction: Energetics & Clinical Application of Exercise Physiology. Utilization of metabolic energy on molecular, cellular and whole organism levels. Quantification of work capacity and energy expendi-

ture with orientation to clinical situations. *Prerequisite:* 311. Two hours. Reed.

314 Motor Function and Dysfunction: Movement Science. Motor Learning, motor control, and recovery of function; their alterations with pathology, age, sex, and experience; and implications for therapeutic intervention. *Prerequisites:* 311 or permission. Four hours. Held

381 Special Topics Seminar. Topics of interest to graduate physical therapists based on theory, research or advanced practice. Content will go beyond the scope of existing courses or thesis research. May be repeated for credit. *Prerequisites:* Advisor and instructor permission. Two to three hours.

391 Master's Thesis Research. Credit as arranged.

397 Special Readings and Research. Directed individual study of areas not appropriately covered by existing courses. *Prerequisites:* Advisor and sponsoring faculty permission. One to three hours.

Physics (PHYS)

Professors Arns, Brown (Emeritus), Detenbeck (Emeritus), Nyborg (Emeritus), Rankin, Scarfone (Emeritus), Smith, Wu (Chairperson); Associate Professors Anderson, Clougherty, Sachs (Emeritus), Spatalian; Assistant Professor Yang.

The Department of Physics offers research opportunities in astrophysics, biophysics, condensed matter physics, and the physics of materials.

Astrophysical research centers on experimental radio astronomy, with particular emphasis on pulsars and the interstellar medium. Observations are carried out using major instruments of the U.S. National Observatories and generally involve computer analysis and interpretation.

Research in biophysical ultrasound is directed toward an understanding of the physical principles involved when ultrasound interacts with living systems. This often involves collaboration with the College of Medicine. Acoustical and optical tweezers permit manipulating single cells without touching them. New forms of ultrasonic transducers and biosensors are being developed in collaboration with Electrical Engineering, as part of the Materials Science Program.

Theoretical and computational research programs in condensed matter physics deal with electronic, optical, lattice-dynamical, thermodynamic, surface, and magnetic properties of metals, semiconductors, superconductors, laser crystals, and biological materials. Some of the general approaches include the analytical and numerical methods of self-consistent band theory, crystal-field theory, multiple-scattering theory, Green's function formalism, and density-functional theory.

Theoretical studies of the optical properties of materials include the electronic structure of defect complexes in ionic crystals, the application of subtracted dispersion relations to optical data analysis, and the separation of inter- and intra-band effects in the infrared spectra of metals. Related studies are concerned with theories of X-ray scattering, of X-ray optical properties, and of X-ray optical elements.

Some faculty members perform experiments on the non-linear interactions of ultrasound with condensed matter. Other faculty members are active in the history and philosophy of physical science, with particular regard to the way in which it evolves, and applications to physics education. Particular interests include the relations between science, society, and technology issues in the physical sciences.

Opportunities for collaborative research with other University departments and groups include those with Chemistry, the Materials Science Program, Molecular Physiology and

Biophysics, the Cell and Molecular Biology Program, Computer Science and Electrical Engineering, Civil and Environmental Engineering, and Mechanical Engineering, Medical Radiology, and Geology.

The Department participates in two doctoral programs: Materials Science and Cell and Molecular Biology.

Laboratory facilities for work in biophysics and condensed matter physics are supplemented by computational facilities which include a campus-wide network on which DEC, IBM, and Silicon Graphics computers are available. The Department is networked internally via thin Ethernet and connected to the campus fiber-optic backbone. Within the Department itself are PCs in variety and four Silicon Graphics Indigo computers.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

Undergraduate majors in science, engineering, or mathematics are considered for admission to the program. Satisfactory scores on the Graduate Record Examination (general and subject section) are required.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

Physics 211, 213, and 273; two additional semester courses in physics above the sophomore level; two semester courses in mathematics above the sophomore level.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

A total of 30 credit hours including a minimum of six hours of thesis research and at least nine hours of Physics courses numbered over 300.

The Department also offers programs leading to the degrees of Master of Science in Engineering Physics, Master of Arts in Teaching, and Master of Science for Teachers of Physical Science. As a participant in the Materials Science program, the Department sponsors candidates for the degrees of Master of Science and Doctor of Philosophy in Materials Science. Details are available elsewhere in the catalogue and also from the Physics Department.

COURSES OFFERED

201, 202 Experimental Physics. Experiments in classical and modern physics. Each student selects laboratory experiments appropriate to his/her background and interests. *Prerequisites:* 42, 22 or 128, Math. 121 or equivalent. Three hours per semester, four semesters maximum.

211 Mechanics. Newtonian dynamics of particles and systems of particles, with applications to problems of special importance, such as driven and coupled harmonic oscillators and central field trajectories. *Prerequisites:* 42, 22; Math. 121 or equivalent. Three hours.

213 Electricity and Magnetism. Fundamental principles of electricity and magnetism; electrostatic fields, and magnetic fields of steady currents. Electric and magnetic properties of matter and electromagnetic energy relationships. *Prerequisites:* 42; Math. 121. Three hours. Credit not granted for more than one of PHYS 213 or EE 141.

214 Electromagnetism. An introduction to time-dependent electromagnetic fields. Maxwell's equations in space and matter. Electromagnetic waves and radiation. *Prerequisite:* 213. Three hours. Credit not granted for more than one of PHYS 214 or EE 142. Alternate years.

222 Biological Physics. Physical laws, processes, and interactions pertaining to biological systems. *Prerequisites:* 12 or 42, Math 121, permission. Three hours. Spartalian, Wu, Yang.

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 semiconductors. Elementary band theory. *Prerequisite:* 128 or equivalent. Three hours. Alternate years.

257 Modern Astrophysics. Stellar structure and evolution, compact objects, the interstellar medium, galactic structure, gravitational theory, cosmology, the formation of our solar system, and terrestrial life. *Prerequisites:* One year calculus-based physics course. Math. 121 strongly recommended, or equivalent. Three hours. Alternate years.

258 Relativity. Development of Einstein's theory of special relativity. Lorentz transformation, time dilation, length contraction, mass variation, relative velocities. Introduction to four-dimensional space. Concepts of general relativity. Applications selected from astrophysics, elementary particles, etc. *Prerequisite:* 128 or equivalent. Three hours.

264 Nuclear and Elementary Particle Physics. Introduction to theoretical and experimental aspects of nuclear and elementary particle physics. *Prerequisites:* 128, and junior standing, permission. Three hours.

265 Thermal Physics. Thermodynamics, kinetic theory, statistical mechanics. *Prerequisites:* 128 or 42, 22, Math. 121 or equivalent. Three hours. Alternate years.

273 Quantum Mechanics I. Introduction to nonrelativistic quantum mechanics. Schroedinger equation and applications to simple systems. *Prerequisites:* 128, 211. Three hours.

295, 296 Special Topics. Lectures, readings, or laboratory studies. Format and subject matter at the instructor's discretion. *Prerequisite:* Permission. Credit as arranged.

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. Three hours. Alternate years.

305 Teaching of College Physics. Instructional strategies and techniques with application to the teaching of laboratories and recitations. *Prerequisites:* Undergraduate degree in physics and permission. One hour, repeatable to maximum of two hours.

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. *Prerequisite:* 211. Three hours. Alternate years.

313 Electromagnetic Theory. Development of Maxwell's theory of electromagnetism emphasizing its physical basis and the modes of mathematical description. *Prerequisite:* 214. Three hours. Alternate years.

321 Seminar in Theoretical Physics. For research students interested in pursuing topics of general and departmental research interest in theoretical physics. *Prerequisite:* Permission. Offered as occasion warrants. Credit as arranged.

323 Seminar in Contemporary Physics. Topics of current interest in physics to be offered as student and faculty interest warrants. May be repeated for credit with departmental approval. *Prerequisite:* Permission. Credit as arranged.

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. Credit as arranged. Offered as occasion warrants.

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. *Pre-*

requisites: 214, 265, 273 or their equivalents; permission. Three hours. Alternate years.

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 for the department and the field generally. May be repeated for credit with departmental approval. *Prerequisite:* Permission. Credit as arranged. Offered as occasion warrants.

362 Quantum Mechanics II. Mathematical and physical foundations of nonrelativistic quantum mechanics from the unifying point of view of Dirac. Symmetry operations and the algebraic structure of quantum mechanics are emphasized. *Prerequisite:* 273. Three hours. Alternate years.

381, 382 Problems in Engineering Physics. Directed readings and independent study in one or more topics in engineering physics, leading to a written report and an oral presentation. Four to six hours. Graduate credit only.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Plant and Soil Science (PSS)

Professors Aleong, Magdoff, Murphy, Parker; Assistant Professor Starrett; Extension Professors Berkett (Chairperson), Gottlieb, Perry; Extension Associate Professors Bosworth, Jokela; Extension Assistant Garcia; Research Assistant Professors Brownbridge, Harper, Ross, Skinner.

Current research projects are concerned with the solution of horticultural and agronomic problems with special emphasis on environmental physiology, soil chemistry, pasture management, plant nutrition, and pest management. Areas of research include winter hardiness of fruits, and woody and herbaceous ornamentals; cultural and environmental interrelationships as they affect plant growth, crop adaptation, and variety; pasture production and marginal land utilization; crop establishment and soil productivity; mycorrhizal fungi; soil chemistry of the rhizosphere; redox reactions in soils; the behavior of heavy metals; compost and organic matter research; behavior of nitrogen in the soil; nutrient availability to plants; agricultural waste management; biological control of insects, disease, and weeds; integrated pest management for control of insects, diseases, and weeds. A student's thesis research will be an integral part of the on-going research efforts of the department.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SCIENCE

An undergraduate major in an appropriate agricultural, environmental, biological, or physical science. Satisfactory scores on the Graduate Record Examination, general (aptitude) section.

REQUIREMENTS FOR ADVANCEMENT 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 or oral comprehensive examination. The decision on the type of comprehensive exam will be made by the major professor after consultation with the student.

MINIMUM DEGREE REQUIREMENTS

Eighteen to 22 hours in Plant and Soil Science and closely related fields; satisfactory participation in seminars during residency; thesis research (eight to 12 hours).

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

An undergraduate major in an appropriate agricultural, environmental, biological, or physical science. Satisfactory scores on the Graduate Record Examination, general (aptitude) section.

REQUIREMENTS FOR ADVANCEMENT 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 completion of a written and oral qualifying doctoral examination as prescribed by the Department.

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, chemistry, 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

205 Mineral Nutrition of Plants. See Botany 205. Alternate years, 1998-99.

207 Water Relations of Plants. See Forestry 229.

210 Soil Erosion and Conservation. General hydrological processes involved in surface runoff and resultant soil erosion land management techniques for controlling soil and sediment pollution. *Prerequisites:* 161, Math. 2 or 9, Chemistry 3 or equivalent. Three hours. Alternate years, 1999-2000.

215 Weed/Crop Ecology. Weed identification, reproduction, ecological relationships with crops, and integrated management. Alternate years, 1998-99. Murphy.

217 Pasture Production and Management. Physiological and ecological relationships of pasture plants, effects of grazing livestock on them, grazing management effects on livestock and pastures; emphasis on French Voisin system. *Prerequisites:* 11, 161 or equivalent. Three hours. Murphy.

221 Tree Fruit Culture. Theory and practice of modern commercial fruit science. Nutrition and cultural responses to various management practices. *Prerequisites:* 11, 161 or equivalent. Three hours. Garcia. Alternate years, 1998-99.

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, 1998-99.

261 Soil Classification and Land Use. Field techniques that describe soil properties and classification; the principles and processes of soil genesis; land use classification systems; and the challenges of competing land uses. *Prerequisite:* 161 or permission. Three hours. Harper. Alternate years, 1998-99.

264 Chemistry of Soil and Water. An environmentally oriented study of the colloidal chemistry of soil and its interfaces with roots, water, and air. *Prerequisites:* 161 or permission, two semesters chemistry. Four hours. Ross. Alternate years, 1998–99.

266 Soil Physics. Mathematical and physical principles of the soil-water-plant interaction and its relationship to environmental and agricultural issues. *Prerequisites:* 161 or permission, one semester of physics. Three hours. Ross. Alternate years, 1999–2000.

281 Seminar. Presentation and discussion of papers on selected topics of current interest by students and staff. *Prerequisite:* Permission. One hour.

297 Special Topics. Lectures, laboratories, readings, field projects, surveys, or research designed to provide specialized experience in horticulture, agronomy, soils, entomology, and integrated pest management. *Prerequisites:* Permission. One to three hours.

301 Plant Science Colloquium. Graduate student and staff discussion of current research topics in plant science. One hour.

302 Soil Science Colloquium. Graduate student and staff discussion of current research topics in soil science. One hour.

381 Graduate Special Topics. Advanced readings and discussion of horticulture, crops, or soils research literature. Three hours.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Psychology (PSYC)

Professors Emeriti Albee, Ansbacher; Associate Professor Emeritus Dietzel; Professors Achenbach, Bickel, Bond, Bouton, Bronstein, J. Burchard, Compas, Crockenberg, Gordon, Guitar, Higgins, Howell, Hughes, Joffe (Chairperson), Kapp, Lawson, Leitenberg, Miller, Musty, Rosen, Rothblum, L. Solomon; Associate Professors S. Burchard, Hasazi, Kessler, Leff, Yadav; Assistant Professors Falls, Gorman; Visiting Assistant Professor S. Solomon.

Additional clinical, research, and adjunct faculty supervise students in clinical and research placements.

The Ph.D. Program in General/Experimental psychology admits students in three broad specialty areas ("clusters"): Biobehavioral Psychology; Basic and Applied Social Psychology; and Basic and Applied Developmental Psychology.

The Ph.D. program in Clinical Psychology places equal emphasis on research and clinical training. The clinical program is fully accredited by the American Psychological Association.

Further information about both programs can be obtained by requesting a copy of the department's graduate studies brochure from the Chairperson of the Department of Psychology. The brochure can also be accessed electronically: <http://www.uvm.edu/~dhowell/PsychAtUVM/Department.html>. This contains details of requirements, funding opportunities, clinical and research facilities, specialty areas, ongoing research, and faculty, as well as general information about the University and the area.

Applicants must apply for the Ph.D. degree only. Students whose goal is a terminal master's degree are not accepted. The application deadline for admission is January 15.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF ARTS

A major or its equivalent in undergraduate psychology including courses in statistics and experimental psychology; satisfactory scores on the Graduate Record Examination, including the subject (advanced) subtest in Psychology.

MINIMUM DEGREE REQUIREMENTS

Twenty-four hours of psychology courses and seminars, including Psychology 301, 302, 340, 341; Proseminar; thesis research for six credits. The requirements of the specific courses (301, 302, 340, 341) may be exempted by examination. There is no foreign language requirement.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

A major or its equivalent in undergraduate psychology including courses in statistics and experimental psychology; satisfactory scores on the Graduate Record Examination, including the subject subtest in Psychology. A telephone interview is required of top applicants to the Clinical Program.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

For the General/Experimental Program, satisfactory completion of minimum degree requirements for Master of Arts degree or equivalent; for the Clinical Program, satisfactory performance of the Ph.D. comprehensive examination.

MINIMUM DEGREE REQUIREMENTS

Both the General/Experimental and the Clinical Program require a minimum of 75 credit hours. However, each program requires proficiency in several specific areas. In order to achieve such proficiency, most students must complete a total of 79 to 83 credit hours. A minimum of 20 credits must be accumulated in dissertation research and the remainder in course credits numbered in the 200 through 400 sequences of the psychology curriculum, or acceptable courses at the 200 or 300 level from other curricula. Detailed information on courses of study is available from the Department. Satisfactory performance on the department final oral examination. There is no foreign language requirement. Both programs have a required preliminary examination.

COURSES OFFERED

Psychology graduate students meet prerequisites for all 200-level courses. Other graduate students must have equivalent prerequisites or permission of instructor.

205 Learning. Analysis of theory and research on the basic learning process and behavior. *Prerequisite:* 109. Three hours. Bouton.

206 Motivation. Theory and research on motives, including hunger, fear, sex drive, and addiction, their influence on behavior, relationship to other psychological processes and biological correlates. Three hours. Musty.

207 Thinking. Survey of cognitive psychology, examining theory and research on perception, memory, language, cognition, and their interactions. *Prerequisite:* 109. Three hours. Gordon.

208 Cognition and Language. (See Communication Sciences 208.)

215 Cognition and Aging. (See Communication Sciences 215.)

220 Animal Behavior. Behavior of animals under controlled experimental conditions and in their natural environments. Consideration of antecedents of behavior and of its adaptive significance, evolution, and development. *Prerequisite:* 109 or Biology 102. Three hours. Bouton.

221 Physiological Psychology I. Structure and function of mammalian nervous system, emphasizing neurological correlates of sensory experience and perception. Individual laboratory experience. *Prerequisite:* 109. Four hours. Kapp.

222 Selected Topics in Behavioral Neuroscience. Selected topics examining the role of the central nervous system in determining behavior, including innate behaviors, arousal, motivation, learning, and memory. *Prerequisites:* 121 or 221. Three hours. Falls, Kapp, Musty.

223 Psychopharmacology. Effects of drugs (both medical and recreational) on behavior. Topics such as drug effects on learning, memory, motivation, perception, emotions, and aggression. *Prerequisites:* 109, 121 or 222. Three hours. Musty.

230 Advanced Social Psychology. Advanced survey of current research on the behavior of individuals in social situations. *Prerequisite:* 109 or 130. Three hours. Miller.

231 Psychology of Women. Psychological theories about women and research on women's roles. Biological, personality, cognitive, and developmental factors considered. *Prerequisite:* One psychology course at the 100 level. Three hours. Bond, Rothblum.

233 Psychology of Experience and Creativity Enhancement. Explores psychological processes for developing creative thinking and for enhancing the quality of conscious experience. Emphasizes personal growth as well as theoretical understanding. *Prerequisite:* Advanced background in at least one relevant field such as psychology, environmental studies, art, or education. Three hours. Leff.

234 Psychology of Social and Environmental Change. Examines psychological foundations of beneficial changes in social and physical environments. Emphasizes action strategies and projects as well as utopian visions. *Prerequisite:* Advanced background in psychology or in environmental studies or a social science. Three hours. Leff.

236 Theories of Human Communication. The study of the role of perception, human information processing, language, nonverbal codes, meaning, cognition, and interpersonal and sociocultural context in human communication process. *Prerequisite:* 109 or 130. Three hours. Yadav.

237 Cross-Cultural Communication. Study of cultural factors, cognitive processes, communication patterns and problems in cross-cultural communication; role of communication in development and social change in third-world countries. *Prerequisite:* 109 or 130 or 230. Three hours. Yadav.

240 Organizational Psychology. Study of the psychological impact of macro and micro features of organizations upon leadership, decision-making, workforce, diversity, group processes, conflict, and organizational performances. *Prerequisite:* 1, 109, or permission. Three hours. Lawson.

241 Organizational Psychology: Global, Cultural, and Local Forces. Study of global, cultural, and local dynamics upon organizational culture, leadership, workforce diversity, ethics and justice at work, and conflict resolution. Conduct applied organizational cultural analysis. *Prerequisite:* 109 or permission. Three hours. Lawson.

250 Introduction to Clinical Psychology. Study of basic principles of interviewing, testing, assessment from life situations, and report writing. Examination of the most common approaches to psychotherapy. *Prerequisites:* 109, 152. Three hours. Bronstein, Compas, Kessler.

251 Behavior Disorders of Childhood. An overview of theory, research, and practice in developmental psychopathology from infancy through adolescence. The major disorders of social and emotional development are reviewed. *Prerequisites:* 161 or 109 (109 may be taken concurrently). Three hours. Hasazi.

253 Advanced Behavior Modification. Application of techniques for the modification of human behavior in a variety of educational and social situations involving the collection and analysis of behavioral data. *Prerequisites:* 109, 152. Three hours. J. Burchard.

257 Personality. The understanding of personality development and human behavior from a psychoanalytic, humanistic, trait measurement, and sociocultural perspective. *Prerequisite:* 109. Three hours. Bronstein.

258 Workshop in Primary Prevention. Meet with specialists in primary prevention of psychological problems and promotion of mental health to examine research, theory, and preventive interventions promoting psychological wellbeing. *Prerequisites:* Three Psychology courses at 100-level or higher, or related advanced professional training by permission of instructor. Three hours. Bond, Gorman.

259 Chemical Dependency: Etiology and Treatment. Cross listing: EDCO 376

261 Cognitive Development. Examination of research and theory concerning developmental changes in the human processing of information from infancy to adulthood centered on the work of Piaget. *Prerequisites:* 161 or 109 (may be taken concurrently). Three hours. S. Burchard.

262 Social Development. Examination of theory and research concerning interpersonal development in humans from infancy through adulthood. Relationships between language, cognition, and social development are emphasized. *Prerequisites:* 161 or 109 (may be taken concurrently). Three hours. Crockenberg.

263 Disabilities of Learning and Development. Seminar in etiology, treatments, prevention of developmental and learning disabilities within framework of current service and educational practices. Ethical, legal, and psychological issues are examined. *Prerequisites:* one 100 level Psychology course or advanced standing in Education or Physical Therapy. Three hours. S. Burchard.

265 Infant Development. Biological, cognitive, and social aspects of infant development in context; opportunities to evaluate and design research and apply knowledge to parenting, prevention, and social policy. *Prerequisites:* 161 and 109 (may be taken concurrently) or comparable courses. Three hours. Crockenberg, Gorman.

266 Communication and Children. Study of the role of communication, especially television, in cognitive and social development from preschool to adolescence. Relationship between television violence and abnormal behavior examined. *Prerequisite:* 109 or 161 or 163. Three hours. Yadav.

268 Psychology of Adult Development and Aging. Psychological development in the final third of the life span emphasizing theory and research concerning social, cognitive, perceptual, and mental health transition and supportive interventions. *Prerequisites:* 001 and Soc/Nurs/ECHD 20 or ECHD 195/295 or permission. Three hours. Staff.

295, 296 Advanced Special Topics. Three hours.

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, systems of psychology, and statistics. In special cases, these prerequisites may be waived by permission of the instructor.

301, 302 Faculty Seminar. Introduction to specialized areas of psychology. Zero hours.

331 Interpersonal Processes: Modes of Interacting. Examination of interpersonal conflict, cooperation, power relations, information transfer, and persuasion. *Prerequisite:* Permission. Three hours. Leff.

332 Interpersonal Processes: Cognition in Social Behavior. Examination of social attribution, interpersonal set, perspectives in social encounter, and the formulation of interpersonal strategies. *Prerequisite:* Permission. Three hours. Leff.

334 Organizational Behaviors and Cultures. Examination of the impact of various organizational cultures upon leadership, personnel selection, group processes, motivation, entrepreneurship, decision making, conflict, negotiation strategies, and organizational development. *Prerequisite:* Permission. Three hours. Lawson.

340 Advanced Statistical Methods I. Statistical methods for evaluating psychological data. Emphasizes exploring data with respect to research hypotheses. Critical study of hypothesis tests on means, chi-square, and correlational techniques. Three hours. Howell.

341 Advanced Statistical Methods II. Continuation of 340. In-depth study of the analysis of variance and multiple regression. Further study of analysis and interpretation of data from the behavioral sciences. *Prerequisite:* 340. Three hours. Howell.

347 Measurement and Scaling. Traditional psychophysical methods, Thurstonian judgmental methods, recent topics in unidimensional scaling. Techniques, applications in multidimensional scaling. Relation of these to mental test theory, factor analysis, cluster analysis. *Prerequisites:* 340, 341. Three hours. Gordon.

349 Seminar in Psychology Research Methodology. For advanced psychology graduate students. Topics may include but are not limited to: factor analysis, discriminant function analysis, multivariate analysis of variance, advanced experimental design, computer application in data collection and analysis. *Prerequisite:* 341 or permission. Three hours. Gordon, Howell.

350 Family Therapy. An exploration of current theories and techniques in family therapy, through readings and discussion, as well as observation of taped and live family therapy sessions. Graduate standing in Clinical Psychology, or permission. Three hours. Bronstein.

351 Behavior Therapy: Adults. Review of literature relating to theory, practice, research. Emphasis on the evaluation of a variety of procedures applied to behavior disorders in adults. *Prerequisite:* Permission. Three hours. Leitenberg.

352 Behavior Therapy: Children. Review of literature relating to theory, practice, research. Emphasis on the evaluation of a variety of procedures applied to behavior disorders in children. *Prerequisite:* Permission. Three hours.

353 Introduction to Clinical Human Neuropsychology. Clinical seminar on effects on human behavior of neocortical dysfunction. Review of theoretical, clinical approaches to brain function, emphasis on recent developments in diagnostic techniques, ensuing theoretical developments. *Prerequisite:* 221, 222 or equivalent. Three hours.

354 Psychopathology I. An advanced course dealing with models of classification, diagnosis, epidemiology of behavior disorders in children. *Prerequisite:* Permission. Three hours. Hasazi.

355 Psychopathology II. An advanced course dealing with models of classification, diagnosis, epidemiology of behavior disorders in adults. *Prerequisite:* Permission. Three hours. Rothblum.

356 Mental Retardation. Study of abnormal behavioral development in the intellectual area. Etiology, assessment, and modification of mental retardation. *Prerequisite:* Permission. Three hours. S. Burchard, Hasazi.

358 Feminist Therapy. Combines feminist theory with practice of psychotherapy. Uses feminist process in course organization and content. Focuses on issues in feminist therapy and feminist supervision. *Prerequisite:* Permission. Three hours. Rothblum.

359 Interpersonal Psychotherapy. An examination of psychotherapy as an interpersonal process. Resistance, transference, and counter-transference examined as interpersonal interactions and related to interpersonal personality theory. *Prerequisites:* Advanced graduate standing, permission. Three hours. Kessler.

360 Methods and Models of Clinical Prediction. Study of clinical versus actuarial problems in applied psychology. Historical antecedents, examples of problems of reliability, validity, utility models of intelligence and personality. Modern day solutions. *Prerequisite:* 340 or permission. Three hours. Kessler.

361 Advanced Personality Theory. Personality development from a psychoanalytic, humanistic, trait, and sociocultural perspective. Also, methods of personality measurement, such as scale construction and the analysis of fantasy and projective material. *Prerequisite:* Permission. Three hours. Bronstein.

362 Community Clinical Psychology. Seminar examining community intervention strategies for psychological problems and health risk behaviors. Topics: history of community psychology, discussion of intervention programs, consultation issues, research. *Prerequisite:* Permission. Three hours. J. Burchard.

363 Advanced Primary Prevention. Review of research literature on prevention of psychopathology and promotion of competence; development of model prevention programs; evaluation, ethical issues, and political issues. *Prerequisite:* Permission. Three hours. Gorman.

364 Professional Affairs and Ethics. The origins of professions and of psychology in particular. Accreditation, laws affecting psychology, organization of the profession, licensing certification, and the code of ethics for psychology. *Prerequisite:* Permission. Three hours. Kessler.

365 Group Therapy. An exploration of psychotherapy and training group issues, focusing on leadership styles, group roles and stages, and research. Course will include an observation/experiential component. *Prerequisite:* Permission. Three hours. Bronstein.

366 Seminar in Advanced Developmental Psychology. Critical Analysis of selected topics in developmental psychology. Research, theory, applied, professional issues including, for example, moral development, infancy, early conceptual development, professional writing. *Prerequisite:* Graduate standing in Psychology. Three hours. Crockenberg.

367 Human Sexual Behavior. An exploration of various topics in human sexuality including sexual behavior through the life span, sexual preference, and treatment of sexual dysfunction and deviation. *Prerequisite:* Graduate standing in Psychology or permission. Three hours. Leitenberg.

368 Psychology and Law. A study of mental health law (including the insanity defense and commitment) and of legal processes (jury decision making, jury selection, eye witness testimony). *Prerequisite:* Permission. Three hours. Kessler.

369 Health Psychology. Psychological aspects of the etiology, treatment, prevention of physical illness. Topics include: stress and disease, compliance, health care systems,

coping with illness, positive health behavior. *Prerequisite:* Permission. Three hours. Rosen.

370 Adult Psychological Assessment. Intelligence, neuropsychology, interviewing, psychodiagnosis, objective and projective personality methods, behavioral assessment, report writing. Supervised assessment practicum (100 hours) in university and in-patient mental health settings. *Prerequisite:* Permission. Three hours. Rosen.

371 Child and Adolescent Psychological Assessment. Interviewing, intelligence testing, behavioral assessment, social cognition, family environments, specific disorders of childhood. Supervised assessment practicum (100 hours) in in-patient and out-patient mental health settings and schools. *Prerequisite:* Permission. Three hours. Compas.

372 Psychological Intervention I. Introduction to psychotherapy, theories, and strategies. Skill building in case formulation, therapeutic goals, and effective intervention techniques. Supervised therapy practicum (100 hours) in university setting. *Prerequisite:* Permission. Three hours. Kessler.

373 Psychological Intervention II. Theories and strategies of psychological intervention. Supervised service delivery (150 hours) at University Counseling and Testing Center including individual and group therapy and crisis intervention. *Prerequisite:* Permission. Zero hours. Kessler.

374 Advanced Clinical Practicum. Year-long, 20 hours/week supervised service delivery (1,000 hours) involving psychological intervention and consultation. Training takes place in a variety of mental health agencies. *Prerequisites:* Second-year student or above (or equivalent) in Ph.D. program in Clinical Psychology and permission. (May be taken more than once.) One hour. Compas.

375 Internship in Clinical Psychology. Supervised service delivery (2,000 hours) involving psychological intervention and consultation. Training takes place in an American Psychological Association accredited internship. *Prerequisites:* Three credits in 374, permission. Zero hours. (Note: Zero credits because instruction is done off-campus by non-UVM faculty.)

380 Contemporary Topics including Proseminar. Selected topics in depth, emphasis on critical analysis of original literature. Recent topics: anxiety, behavioral pharmacology, biological bases of memory, depression, organizational behavior, psychotherapy research, primate behavior, skilled performance. Three hours.

381 Clinical Research Seminar. Year-long seminar on methods and design in clinical research. Oral and written presentation of a research proposal and results. Required twice for clinical students. *Prerequisite:* Permission. Three hours. Leitenberg.

382 Advanced Professional Research Seminar. Discussion of current research and student research presentation in areas of concentration ("clusters"). *Prerequisite:* Graduate standing in General/Experimental Program. One hour.

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.

391 Master's Thesis Research. Credit as arranged.

491 Doctoral Dissertation Research. Credit as arranged.

Not offered annually, but regular courses:

210 Principles of Human Perception

The following courses are offered infrequently but may be taught when sufficient student interest is demonstrated.

305 Seminar in Learning Theory. Three hours.

308 Seminar in Operant Conditioning. Three hours.

310 Seminar in Perception. Three hours.

315 Seminar in Alcohol and Behavior. Three hours.

326 Central Processes: Cortical Mechanisms. Three hours.

333 Interpersonal Processes: Motivation in Human Interaction. Three hours.

344 Experimental Design. Three hours.

Public Administration (MPA)

Core faculty: Professors Lawson (Interim Director), Ventriss; *Associated Faculty:* Professors Burke, Cooper, Wertheimer; *Associate Professors* Bryan, Gierzynski, Hindes, Parke, Patterson, Tashman, Woolf; *Deans* Martin, Twardy.

The Master of Public Administration program is a professional masters degree program with perspectives from a variety of academic and professional disciplines. Our purpose is to further the student's ability to manage complex public and non-profit organizations and to work effectively in the public policy process. In addition to the core faculty, the program draws upon associated faculty from 11 different departments and colleges across the university.

The MPA degree program is designed to:

1. Provide promising public and nonprofit sector managers with a quality educational experience covering the theories and practices of program planning and control, and the problems of policy making in an environment characterized by resource constraints and rapid social change.
2. Stimulate and focus scholarly research on the problems and issues of public organizations in Vermont, nationally, and internationally.
3. Facilitate mutually beneficial interaction within the community of scholars and practitioners of public administration.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF PUBLIC ADMINISTRATION

A sound academic record, including a baccalaureate degree from an accredited undergraduate institution, satisfactory scores on the general aptitude section of the Graduate Record Examination, three letters of recommendation attesting to the candidate's academic potential for graduate work and motivation for pursuing the MPA. Past experience in public service will be considered. Persons currently employed in administrative positions are encouraged to apply. In addition, a student must have completed these required prerequisite courses: Economics, American Government and Statistics.

NOTE: The application deadlines for the MPA Program are February 1 and June 15 for summer/fall admission and November 15 for spring admission.

Web site: <http://www.uvm.edu/~mpaweb/>

ACCELERATED MASTERS PROGRAM IN PUBLIC ADMINISTRATION (AMP-PA)

The AMP-PA affords UVM students the opportunity to secure a sound undergraduate and graduate program of study in five rather than a minimum of six years, integrates more closely both programs of study, and enhances competitiveness in a marketplace stressing broad undergraduate and focused professional graduate education. The AMP-PA welcomes students majoring in the administrative, behavioral, health, environmental, organizational, social sciences and related disciplines requiring graduate work in administration, or planning and policy capacities in the

public service. For more information contact the MPA Office (802) 656-2606.

REQUIREMENTS FOR ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF PUBLIC ADMINISTRATION

Successful completion of 36 credit hours, including core courses PA 301-303, 305, 306, an approved sequence of courses with an average of B (3.0) plus satisfactory completion of the Comprehensive Examination. Pre-service students (those without substantial public administration experience) will be required to complete an approved 3 credit internship as part of their approved sequence of courses beyond the core. A six credit thesis option is available to students.

COMPREHENSIVE EXAMINATION

A written comprehensive examination (GRAD 397), an evaluative device and capstone experience, is offered three times a year (March, August, and October) for students in the final semester of the MPA Program.

COURSES OFFERED

In addition to the five core courses and electives listed below, regular courses (200-level and above) are available in the respective academic units listed above and, with prior approval, may be included in a candidate's program.

Public Administration 200-level electives are open to junior/senior undergraduates but in NO way decreases the level of difficulty for either graduate or undergraduate students.

206 Introduction to Contemporary Public Affairs. Contemporary policy issues including government and the economy, the role of leadership, ethical and moral issues in public policy, and other contemporary issues impacting society. *Prerequisite:* Economics 11, 12 or equivalent recommended. Three hours. Ventriss.

295, 296 Intermediate Special Topics. Current issues and new developments in public policy and public administration. Three hours.

299 Fundamentals of Quantitative and Economic Analysis. Development of analytical skills with application to economic analysis relevant to the field of public administration. Three hours. Tashman.

301 Fundamentals of Public Administration. Analysis of major elements of management in the public sector (organization, personnel, budgeting) with special attention to problems arising from political imperatives generated by a democratic society. Three hours. Bryan, Ventriss.

302 Public Sector Organizations. Examination of basic classical and contemporary theory, research on human relations, internal structures, environments, types, general properties of complex organizations and bureaucracies. Three hours. Lawson (Summer cross-listing Psychology 240); Martin and Patterson.

303 Research Methods. Data analyses and communication of statistical information for management decision making. Methods of modeling relationships, comparing strategies, and assessing probabilities. Instruction in computer use. Additional lab required. Three hours.

305 Public Budgeting and Finance. A focus on the budget as the primary policy and planning document in public organizations. Three hours.

306 Introduction to Public Policy. Study of stages in the policy process; development of public policy in the federal system; and policy analysis and evaluation at each stage in the policy process. Three hours. Ventriss.

307 Administrative Ethics. Administrative behavior with a focus on ethical dilemmas that arise in the bureaucracy. An

examination of a number of moral issues and ways to resolve them. Three hours. Ventriss, Wertheimer.

308 Decision-Making Models. Application of decision-making models to administrative problems. Structuring decisions through decision trees, making choices, assessing risk, resolving conflicting objectives, and overcoming organizational impediments. *Prerequisites:* 303, BSAD 313 or equivalent. Three hours. Tashman. Cross-listing: Business Administration 346.

311 Policy Analysis and Planning. A seminar providing hands-on knowledge in policy analysis and program evaluation using case studies of current analysis projects and problems. Specific techniques include planning, survey administration, forecasting, cost benefit analysis, and impact assessment. Three hours.

312 Management in Health Services and Medical Care. Addresses major issues and challenges faced by health services managers relating to established and evolving social, economic, and professional policies in a context of practical problem assessment and appropriate resolution. Three hours. Hinds.

313 Public Policy Implementation. A seminar considering aspects of the public policy implementation process from initiation to completion and evaluation with regards to system design, policy goals, communication, compliance, and political environment. Three hours.

314 Administrative Law. Examines legal foundations of public administration focusing on legal issues of most importance to present or future administrators. Three hours. Cooper.

315 Health Services and Medical Care in the United States. Defines the milieu of issues and challenges faced by managers in the health services setting. Three hours. Hinds.

316 Effective Management Techniques. Concentration on leadership, the role of managers, and essential components of well-managed organizations in the public, nonprofit, and private sector. Three hours. Salmon, Twardy.

317 Systems Analysis and Strategic Management. An analysis of, and experience with, planning theories and techniques that derive from General Systems Theory. Three hours.

318 Administrative Theory and Practice. Extensive examination of literature pertaining to the practice and theory of public administration. Explores public/private partnerships, intergovernmental management, ethics, and administrators as agents for organizational change. Three hours. Ventriss.

319 State Administration. Elements of public management at the state level i.e. the state/federal relationship regarding control; management within the force field of local conflict and cooperation; and management within the context of inter-agency conflict and cooperation. Three hours. Bryan. Cross-listing: Political Science 224.

380 Internship. Supervised administrative experience culminating in a written report. Three hours.

391 Master's Thesis Research. Thesis topic must be approved by faculty advisor. Six credits.

395 Special Topics. For advanced students within areas of expertise of the faculty. Varied course offerings. Contemporary topics. Permission. One to three hours.

397 Readings and Research. Readings, with conferences, term paper, to provide graduate students with specialized knowledge in an area in which an appropriate course is not offered. Three hours.

Religion (See page 108.)

Social Work (SWSS)

Professors Burford (Chairperson/Director), Paolucci-Whitcomb, Witkin; Associate Professors Bishop, Roche (M.S.W. Program Coordinator); Assistant Professors Comerford, Dewees (Bachelor's Program Coordinator); Research Assistant Professor Felicio; Lecturers Heading-Grant, Moroz, Pugh, Taylor, Weaver, Widrick (Field Education Coordinator); Adjunct Assistant Professor Edwards-Orr; Adjunct Instructors Larson, Lax, McKenna, Simonson.

MASTER OF SOCIAL WORK

The Master of Social Work Program prepares students for advanced practice which affirms diversity, reflects people's strengths and promotes social justice and human rights. The program emphasizes community and family-centered practice in a variety of professional roles and settings. An advanced standing option exists for those students who have earned a bachelor's degree from an accredited social work program. The Master of Social Work Program is fully accredited by the Council on Social Work Education.

The first year curriculum has five components: human behavior and the social environment, social welfare policy and services, social work research, social work practice, and field practicum. The second year curriculum is built around either of two concentration areas: Social Work in Health/Mental Health or Social Work with Children and Families. Concentrations consist of two advanced practice courses, a field practicum and two concentration electives. Additionally, students take three courses which bridge both concentration areas: Advanced Social Welfare Policy Analysis and Practice, Critical Applications of Human Behavior and the Social Environment, and Advanced Social Work Research.

The analytical paper/portfolio (SWSS 398) is a culminating experience which is evaluative, integrative, interpretive, and constructive. It requires students to demonstrate competency in written and oral expression, understanding of, and identification with, the program philosophy and social work values and ethics, and ability to think analytically, and self-critically in an area of concentration in social work. There are several formats that the analytical paper/portfolio may take, including: a research-based, analytical paper addressing an issue of significance to social work practice, and a reflective practice-based portfolio conceptualizing, analyzing, and illustrating students' learning and social work practice. It may be completed through an individual, small group, or seminar process. The analytical paper/portfolio provides students in their last year in the program with the opportunity for sustained research, conceptualization, and reflection under the guidance of a social work faculty member. It also provides integration and closure to their educational experiences, and fulfills the Graduate College comprehensive examination requirement.

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES FOR THE DEGREE OF MASTER OF SOCIAL WORK

Prospective students must meet the following minimum requirements.

1. Earned a baccalaureate degree from an institution accredited by the Council on Postsecondary Accreditation.
2. Attained satisfactory scores on the Graduate Record Examination (GRE). A holistic view of candidates' qualifications for graduate social work education is utilized; therefore, no minimum score for admission has been set. Applicants must submit GRE scores prior to admission.

3. Earned a minimum grade-point average (GPA) of 2.5 (where 4.0=A) in undergraduate studies.
4. Earned a minimum grade-point average of 3.0 in any previous graduate work in Social Work.
5. Be in good standing from the last institution they attended.
6. Demonstrated achievement of designated liberal arts content in their undergraduate studies including some courses in each of the following areas: social sciences (defined as including sociology, political science, anthropology, economics, etc.); behavioral and life sciences (defined as including psychology, human biology, human ecology, etc.); and humanities (defined as including history, philosophy, English, literature, religion, etc.). Most specifically, students must have completed at least one course in human biology and one in statistics. If they have not done so at the time of admission, they must complete these two prerequisite courses prior to the advanced concentration year.
7. Submission of a resume with their application materials before consideration of their file.

In addition to the above, the typed statement of purpose and resume are essential parts of the application. The written references are also important sources of information regarding the qualifications and experiences of applicants.

Applicants with a Bachelor of Social Work degree from a program accredited by the Council on Social Work Education (CSWE) may apply for Advanced Standing to the MSW program. Students granted advanced standing may waive certain program (Foundation) requirements. Full-time advanced-standing students start their programs in January of each year, while Regular-track students start their programs in the fall semester.

MINIMUM DEGREE REQUIREMENTS FOR THE DEGREE OF MASTER OF SOCIAL WORK

A minimum of 60 credit hours from the following curriculum components are required. Graduates of accredited baccalaureate social work programs who are granted advanced standing may be able to waive credit requirements for SWSS 212, 216, 217, 220, 221 and 227. In addition, field practica are completed within three semesters. For all others, the following courses are required.

FOUNDATION COURSES (30 Credits)

SWSS 212: Social Work Practice I	3 credits
SWSS 213: Social Work Practice II	3
SWSS 216: Theoretical Foundations of HBSE* I	3
SWSS 217: Theoretical Foundations of HBSE II	3
SWSS 220: Social Welfare Policies and Services I	3
SWSS 221: Social Welfare Policies and Services II	3
SWSS 227: Foundations of Social Work Research	3
SWSS 395: Field Practicum	6
An approved elective	3

*Human Behavior in the Social Environment

ADVANCED COURSES (30 Credits)

SWSS 301: Social Work in Health and	3 credits
SWSS 302: Social Work in Mental Health or	3

SWSS 310: Social Work with Children and Families I and	3
SWSS 311: Social Work with Children and Families II	3
SWSS 316: Critical Applications of HBSE	3
SWSS 320: Advanced Social Welfare Policy Analysis and Practice	3
SWSS 327: Advanced Social Work Research	3
SWSS 395: Field Practicum	6
SWSS 398: Analytical Paper/Portfolio Electives	3 6

Electives require advanced approval of faculty advisors.

COURSES OFFERED

200 Contemporary Issues. Content and structure may accommodate special issues not especially appropriate within the boundaries of an existing course. *Prerequisite:* Permission. One to six credits.

212 Social Work Practice I. A comprehensive introduction to concepts and skills employed by social workers in interactions and interventions with individuals, families, and groups is provided. *Prerequisite:* MSW standing or permission. Three credits.

213 Social Work Practice II. Knowledge and skills of social work practice with organizations and communities is emphasized. *Prerequisite:* Completion of 212, MSW advanced standing or permission. Three credits.

216 Theoretical Foundations of Human Behavior and the Social Environment I (HBSE). This course introduces students to the biological, psychological, cultural/social, and economic forces that influence human behavior and their implication for social work practice. *Prerequisite:* MSW standing or permission. Three credits.

217 Theoretical Foundations of Human Behavior and the Social Environment II (HBSE). Focus is on theories regarding the nature and functioning of human service organizations and communities in relation to meeting human needs. *Prerequisite:* 216 or permission. Three credits.

220 Social Welfare Policies and Services I. An introduction to history and philosophy of social work and social welfare and the structure of service programs is provided. *Prerequisite:* MSW standing or permission. Three credits.

221 Social Welfare Policies and Services II. Focus is on the analysis of the economic, political, and social forces that influence the development and implementation of social welfare policy. *Prerequisite:* 220 or permission. Three credits.

224 Child Abuse and Neglect. An MSW foundation elective that considers child abuse and neglect from historical, cultural, sociopolitical and psychological perspectives and examines professional social work responses to them. *Prerequisites:* Matriculation in the foundation year of graduate study in social work or instructor permission. Three credits.

225 Transforming Ourselves and Our Communities: Social Work Perspectives. An MSW foundation elective that examines systems of oppression and social work strategies to decrease biased practices and create more equitable communities and institutions. *Prerequisites:* Matriculation in the foundation year of graduate study in social work or instructor permission. Three credits.

227 Foundations of Social Work Research. An introduction to qualitative and quantitative methods of applied social research including program evaluation and the evaluation of practice and application to social work is taught. *Prerequisite:* MSW standing or permission. Three credits.

301 Social Work in Health. Using a family-systems, family-centered, and strengths approach, course focuses on practice with children and families in health settings. *Prerequisites:* Completion of foundation coursework, MSW advanced standing, or permission. Three credits.

302 Social Work in Mental Health. Advanced knowledge and skills in working with children with severe emotional disturbances and adults with persistent mental illness. Community-based services are emphasized. *Prerequisites:* Completion of foundation coursework, MSW advanced standing or permission. Three credits.

310 Social Work with Children and Families I. Focus is on families whose major task is child rearing and child caring. Covers advanced knowledge, concepts, and methods of contemporary child/family services within a family-centered approach. *Prerequisites:* Completion of foundation course work, MSW advanced standing or permission. Three credits.

311 Social Work with Children and Families II. Focus is on families with adolescents, families with no children and families with dependent adults. Advanced analysis of families from an adult member perspective and from a critical view of family ideology and myth. *Prerequisites:* Completion of foundation coursework, MSW advanced standing or permission. Three credits.

316 Critical Applications of Human Behavior and the Social Environment (HBSE). This course emphasizes advanced analyses of behavioral and social theories as related to social work practice in health and mental health and/or with children and families. *Prerequisite:* Completion of 216 and 217, MSW advanced standing or permission. Three credits.

320 Advanced Social Welfare Policy Analysis and Practice. In-depth analysis of social welfare policy with application to children and families or health and mental health is required. There is an emphasis on the skills of the policy practitioner. *Prerequisite:* Completion of 220 and 221, MSW advanced standing or permission. Three credits.

327 Advanced Social Work Research. An analysis of social work research from methodological and theoretical perspectives is emphasized. The application of research to the student's concentration area is required. *Prerequisites:* Completion of 227, a basic statistics course, and MSW advanced standing or permission. Three credits.

330 Assessment in Social Work. An advanced MSW concentration elective that analyzes competing and complementary assessment strategies and their implications in social work in health/mental health and with children and families. *Prerequisites:* Completion of MSW foundation course work or instructor permission. Three credits.

331 Feminist Social Work Practice. An advanced MSW concentration elective that analyzes practice conceptions and dilemmas of feminist social work in a global context and emphasizes professional activism and leadership. *Prerequisites:* Completion of MSW foundation course work or instructor permission. Three credits.

332 Social Work with Battered Women and their Children. An advanced MSW concentration elective that investigates theoretical and practical issues of social work practice with battered women and their children and develops related recommendations. *Prerequisites:* Completion of MSW foundation course work or instructor permission. Three credits.

333 Social Work with Groups. An advanced MSW concentration elective that integrates professional history, conceptual overviews and direct experience with methods for group work distinctive to social work practice. *Prerequisites:* Completion of MSW foundation course work or instructor permission. Three credits.

380 Professional Issues in Social Work. Designed to cover selected social work issues in depth. Major emphasis on intensive and critical analysis of the literature and practice in a given area. *Prerequisite:* Permission. Three credits.

395 Field Practicum. Supervised field experience. The foundation year placement provides experience in the application of the theory and skills of social work practice. The advanced year placement provides advanced skills related to the student's concentration area. *Prerequisite:* Permission of Coordinator of Field Education. Twelve credits.

397 Independent Study in Social Work. Individual work on Social Work issue(s) selected by the student in consultation with a faculty member. *Prerequisite:* Permission. One to six credits.

398 Analytical Paper/Portfolio. A written identification and analysis of a social work issue related to the student's concentration is prepared and presented. *Prerequisite:* Successful completion of foundation coursework and permission. Variable one to three credits. Total of three credits required. *Fulfills Graduate College comprehensive examination requirement.*

Sociology (See page 109.)

Spanish (See page 110.)

Statistics (STAT)

Steering Committee Members: Professors Aleong, Ashikaga, Costanza, Gordon, Haugh (Director), Howell, Newton, Son; Associate Professor Mickey; Assistant Professor Buzas; Research Professor Hamdy; Research Assistant Professor Callas; Lecturers Badger, Low, MacPherson, Weaver.

The Statistics Program offers biostatistics, statistics, and probability courses for the entire University community along with traditional degree programs and individually designed degree programs emphasizing statistics applied to other fields. The degree programs are designed primarily for students who plan careers in business, actuarial science, industry, and government or advanced training in disciplines that make extensive use of statistical principles and methods. The Program faculty is deeply involved in consulting and collaborative research in a wide variety of fields, including industry, agriculture and in the basic and clinical medical sciences. These research activities along with the research of participating faculty from psychology, natural resources, etc., offer students unique opportunities to apply their classroom training to "real world" problems. Qualified students with the goal of learning statistics to use in a specialized area of application are especially encouraged to take advantage of these cooperative arrangements.

Program faculty have active statistics research efforts in areas such as quality control and reliability, sequential analysis, three stage sampling, time series analysis, survival data analysis, discriminant analysis, bootstrap methods, categorical data analysis, measurement error models, and experimental design. A track in quality and productivity improvement is available. Students seeking the traditional graduate degree in statistics (along with course work in mathematics and computer science, if desired) have excellent opportunities to participate in the faculty research. (See also Biostatistics program description, p. 41.)

REQUIREMENTS FOR ADMISSION TO GRADUATE STUDIES AND ADVANCEMENT TO CANDIDACY FOR THE DEGREE OF MASTER OF SCIENCE

A baccalaureate degree. Three semesters of calculus, a course in matrix methods, and one semester of statistics. Provisional acceptance can be given prior to the completion of these requirements. Satisfactory scores on the general (aptitude) portion of the Graduate Record Examination are required for most sources of financial aid. Computer experience is highly recommended.

Current undergraduate students at The University of Vermont should contact the program director for details on the Accelerated Master's Program (AMP).

MINIMUM DEGREE REQUIREMENTS

Plan A

(Thesis) A 30 semester hour program requiring 24 semester hours of approved course work. This must include Statistics 221, 223, 224, 231, 251, 261, 321, 323, 324, other Statistics courses numbered 200 or above (except 211, 281, 308, 313), other mathematics or quantitative methods courses or (if appropriate) courses in a specialized field of application, plus six hours of approved thesis research (391).

Plan B

(Nonthesis) A 33 semester hour program requiring 30 semester hours of approved course work. This must include Statistics 221, 223, 224, 231, 251, 261, 321, 323, 324, other Statistics courses numbered 200 or above (except 211, 281, 308, 313), other mathematics or quantitative methods courses or (if appropriate) courses in a specialized field of application, plus three semester hours of approved statistical research (381).

Under both plans, students must have or acquire a knowledge of the material in Statistics 201 and 211 in addition to their required course work. Additional specific courses may be required depending on the student's background and interest. Other courses are selected with the approval of the student's advisor from statistics, mathematics, computer science, and (if appropriate) graduate level courses from the student's intended area of specialty application (e.g. business administration, engineering, ecology, genetics, psychology). The student is expected to participate in the Colloquium series of the Program. Plan A and Plan B require successful completion of a comprehensive examination which includes coverage of theoretical and applied aspects of the program's core statistics courses. Under Plan B a student, in lieu of a thesis, must carry out an approved comprehensive data analysis or methodological research project culminating in both an oral and written report to the faculty.

COURSES OFFERED

200 Medical Biostatistics and Epidemiology. Introductory design and analysis of medical studies. Epidemiological concepts, case-control, and cohort studies. Clinical trials. Students evaluate statistical aspects of published health science studies. *Prerequisites:* 141 or 143 or 211. Cross-listing: Biostat 200.

201 Statistical Analysis Via Computer. Intensive coverage of computer-based data processing and analysis using statistical packages, subroutine libraries, and user-supplied programs. Students analyze real data, and prepare comprehensive report. *Prerequisites:* 111 with permission, or 141, or corequisite 211 or 308. Three hours.

211 Statistical Methods I. Fundamental concepts and techniques for data analysis and experimental design. Descriptive and inferential statistics, including classical and nonparametric methods, regression, correlation, and analy-

sis of variance. *Prerequisite:* Junior standing. Cross-listing: Biostat 211. Three hours. Cross-listing: Biostatistics 211.

221 Statistical Methods II. Multiple regression and correlation. Basic experimental design. Analysis of variance (fixed, random and mixed models). Analysis of covariance. Computer software usage. *Prerequisite:* 141 or 143 or 211. Cross-listing: Biostatistics 221.

223 Applied Multivariate Analysis. Multivariate normal distribution. Inference for mean vectors and covariance matrices. Multivariate analysis of variance (MANOVA), discrimination and classification, principal components, factor analysis. *Prerequisites:* Any 200 level Stat course, 221 or 225 recommended, matrix algebra recommended.

224 Statistics for Quality and Productivity. Statistical process control; Shewhart, cusum and other control charts; process capability studies. Total Quality Management. Acceptance, continuous, sequential sampling. Process design and improvement. Case studies. *Prerequisites:* 141 or 143 or 211.

225 Applied Regression Analysis. Simple linear and multiple regression models; least squares estimates, correlation, prediction, forecasting. Problems of multicollinearity and influential data (outliers). Selected statistical computer programs are utilized. *Prerequisites:* 141 or 143 or 211; or 111 with instructor's permission. Three hours. Cross-listing: Biostatistics 225.

227 Statistical Methods for the Behavioral Sciences. See Psychology 341.

229 Survival Analysis. Probabilistic models and inference for time-to-event data. Censored data, life tables, Kaplan-Meier estimation, logrank tests, proportional hazards regression. Specialized applications (e.g. clinical trials, reliability). *Prerequisites:* Any 200 level statistics course, one year of calculus. Cross-listing: Biostatistics 229.

231 Experimental Design. Randomization, complete and incomplete blocks, cross-overs, Latin squares, covariance analysis, factorial experiments, confounding, fractional factorials, nesting, split plots, repeated measures, mixed models, response surface optimization. *Prerequisite:* 211; 221 recommended. Cross-listing: Biostatistics 231.

233 Survey Sampling. Design and data analysis for sample surveys. Simple random, stratified, systematic, cluster, multistage sampling. Practical issues in planning and conducting surveys. *Prerequisites:* 211; or 141 or 143 with instructor's permission. Three hours. Cross-listing: Biostatistics 233.

235 Categorical Data Analysis. Measures of association and inference for categorical and ordinal data in multiway contingency tables. Log linear and logistic regression models. *Prerequisite:* 211. Three hours. Cross-listing: Biostatistics 235.

237 Nonparametric Statistical Methods. Nonparametric and distribution free methods; categorical, ordinal and quantitative data; confidence intervals; rank and Chi-Square hypothesis tests; computer-intensive procedures (Bootstrap, exact tests). *Prerequisites:* 211, or 141 or 143 with instructor's permission. Three hours. Cross-listing: Biostatistics 237.

241 Statistical Inference. Introduction to statistical theory: related probability fundamentals, derivation of statistical principles and methodology for parameter estimation and hypothesis testing. *Prerequisites:* 151 or 251; a course in statistical methods recommended; Math 121. Three hours. Cross-listing: Biostatistics 241.

251 Probability Theory. Distributions of random variables and functions of random variables. Expectations, stochastic independence, sampling and limiting distributions (central limit theorems). Concepts of random number

generation. *Prerequisite:* Math. 121; Statistics 151 recommended. Three hours.

252a Applied Discrete Stochastic Process Models. Markov chain models for biological, social, and behavioral systems models. Decision processes for management science. Random walks, transition, and steady-state probabilities, passage, and recurrence times. *Prerequisite:* 151 or 251. One hour.

252b Applied Continuous Stochastic Process Models. Queueing models for operations research and computer science systems analysis. Birth-and-death processes with applications. Exponential, Erlang, and Poisson distributions. Monte Carlo simulation. *Prerequisite:* 151 or 251. One hour.

253 Applied Time Series and Forecasting. Autoregressive moving average (Box-Jenkins) models, autocorrelation, partial correlation, differencing for nonstationarity, computer modeling. Forecasting, seasonal or cyclic variation, transfer function and intervention analysis, spectral analysis. *Prerequisites:* 211 or 225, or 141 or 143 with instructor's permission. Three hours. Cross-listing: Biostatistics 253.

256 Neural Computation. Cross-listing: See Computer Science 256.

261, 262 Statistical Theory I,II. Point and interval estimation, hypothesis testing, and decision theory. Applications to areas such as nonparametric tests, sequential analysis and linear models. *Prerequisites:* For 261: 151 with permission or 251. For 262: 241 with permission or 261. Three hours each. Cross-listing: Biostatistics 261, 262.

265 Integrated Product Development. Project-based course focusing on the entire product life cycle. Team dynamics, process and product design, quality, materials, management, and environmentally conscious manufacturing. *Prerequisite:* Senior or graduate standing. Three hours. Cross-listings: BSAD 293, ME 265. Haugh.

270 Stochastic Theory in Electrical Engineering. See Electrical Engineering 270.

271 Least Squares Estimation and Filtering of Time Series. See Electrical Engineering 271.

281 Statistics Practicum. Intensive experience in carrying out a complete statistical analysis for a research project in a substantive area with close consultation with the project investigator. One to four credit hours. *Prerequisites:* Any one of 200, 201, 221 through 237, or 253. Some statistics software experience. No credit for graduate students in Statistics or Biostatistics.

295 Special Topics in Statistics. For advanced students. Lectures, reports, and directed readings on advanced topics. *Prerequisite:* As listed in course schedule. One to four credit hours as arranged.

308 Applied Biostatistics. Intensive introduction to the rationale for and application of biostatistical methods in planning experiments and interpreting data in the biological, health and life sciences. Five hours. Cross-listings: Molecular Physiology and Biophysics 308, Biostatistics 308.

313 Statistical Analysis for Management. See Business Administration 313.

321,323,324,325,329 Seminars in Advanced Statistics. Seminar presentations and discussions of statistical literature pertaining to the theoretical aspects of methods studied in 221, 223, 224, 225, and 229, respectively. *Corequisites:* 221 for 321; 223 for 323; 224 for 324; 225 or 221 for 325, 229 for 329. 241 or 261 recommended. One hour each. Cross-listings: Biostatistics 321, 323, 324, 325, 329.

352 Modeling and Estimation of Animal Populations. See Wildlife and Fisheries Biology 352. Four hours. Cross-listing: Biostatistics 352.

381 Statistical Research. Methodologic or data analytic research culminating in oral and written reports to the faculty. *Prerequisite:* Permission. One to three hours. Cross-listing: Biostatistics 381.

385 Consulting Practicum. Supervised field work in statistical consulting. Experiences may include advising UVM faculty and students or clients in applied settings such as industry and government agencies. *Prerequisites:* Second year graduate standing in Statistics or Biostatistics and permission of Statistics Program Director. One to three hours. Cross-listing: Biostatistics 385.

391 Master's Thesis Research. Credit as arranged. Cross-listing: Biostatistics 391.

395 Advanced Topics in Statistics. Lectures or directed readings on advanced and contemporary topics not presently included in other statistics courses. *Prerequisites:* As

listed in course schedule. One to three hours. Cross-listing: Biostatistics 395.

Water Resources

For description of the M.S. Program in Water Resources see NATURAL RESOURCES, page 87.

Wildlife and Fisheries Biology

For description of the M.S. Program in Wildlife and Fisheries Biology see NATURAL RESOURCES, page 87.

Women's Studies (See page 110.)

Courses of Instruction for Graduate Credit

The following courses are offered for graduate credit by departments and programs that do not offer a graduate degree program. Some of the courses below may be appropriate to satisfy a portion of the course requirements for a specific graduate degree program listed earlier.

ANTHROPOLOGY (ANTH)

200 Field Work in Archaeology. Methods and techniques of archaeological investigation in field situations and laboratory analysis of data. *Prerequisites:* 24, one 100-level course in anthropology or permission. Six hours. Summers only.

210 Archaeological Theory. Development of archaeology from the 18th century to the present, including concepts of form, space and time, intellectual attitudes, current systems theory, and research strategies. *Prerequisites:* 24, one 100-level anthropology course; or Historic Preservation 201; or permission. Three hours. Petersen. Alternate years.

225 Anthropological Theory. Schools of anthropological thought in relation to data on non-Western societies and the historical and social context in which the anthropologist works. *Prerequisites:* 21, one 100-level course or permission. Three hours. Gordon, C. Lewin.

228 Social Organization. Examination of the basic anthropological concepts and theories used in the cross-cultural analysis of kinship and marriage. *Prerequisites:* 21, one 100-level course or permission. Three hours. Gordon, C. Lewin.

278 Microethnography. Tape recorders and video cameras used to explore human patterns of communication; specifically phonemic, paralinguistic, haptic, and kinesic detail, as well as ethnographic semantics. *Prerequisite:* 28, or Linguistics 101 or permission. Three hours. Woolfson.

283 Culture Change. Study of sociocultural transformations in non-Western countries. *Prerequisites:* 21, one 100-level course, or 21, six hours in the social sciences or permission. Three hours. Gordon. Alternate years.

290 Methods of Ethnographic Field Work. Examination of theoretical and ethical premises of field work methodology with practical experience in participant observation, interviewing, the genealogical method, and recording of data. *Prerequisite:* Twelve hours of anthropology or permission. Three hours. Alternate years.

295, 296 Advanced Special Topics. *Prerequisites:* 21, one 100-level course or permission.

297, 298 Advanced Readings and Research. *Prerequisite:* Permission. Variable, one to three hours.

ART (ART)

201 Architecture, Landscape, and History. See Historic Preservation 201. Three hours.

207 Seminar in American Architecture and Design. Selected topics in American art and/or architecture, individual research and reports. *Prerequisites:* By permission to advanced students in art history, architectural studies, or historic preservation. Three hours.

282 Seminar in Western Art. Selected topics in Western Art. See Schedule of Courses for specific offerings each semester. *Prerequisites:* Six hours of intermediate level Art History courses, including three hours in the area of the seminar, or equivalent. Three hours.

295 Advanced Special Topics in Studio Art. Advanced work in existing departmental offerings at the 100 and 200 levels. *Prerequisite:* Permission. Three hours.

EDUCATION-EARLY CHILDHOOD AND HUMAN DEVELOPMENT (ECHD)

260 Family Ecosystem. The family will be viewed in and as an environment for human development. The family ecological approach will be applied to practical family concerns. *Prerequisite:* Permission. Three hours.

263 Advanced Child Development. A survey of the professional literature in child development with special emphasis on the influence of early life experiences throughout the life cycle. *Prerequisite:* 80-81 or equivalent. Three hours.

264 Contemporary Issues in Parenting. Contemporary cultural factors that influence adult lifestyles and their relationship to successful parenting. *Prerequisite:* Nine hours in human development or permission. Three hours.

265 Teaching Human Development. Seminar designed for individuals who teach or plan to teach human development. Emphasis on group-building skills and interpersonal relationships. *Prerequisites:* Six hours in human development and permission. Three hours.

266 Seminar in Human Development. Intensive study of 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:* Nine hours of human development or equivalent. Three hours.

268 Seminar in Close Relationships. Causal conditions influencing formation, maintenance and dissolution of intimate adult relationships. Draws on theory and students' personal experiences to explicate the nature of close relationships in contemporary American society. *Prerequisites:* 60, 65, 81 or permission. Three hours.

281 Infancy. Development and rearing from conception to 18 months old and their relationship to subsequent development. *Prerequisites:* Nine hours in human development, nutrition, and physiology or biology or permission. Three hours.

282 Seminar in Physical Development and Health in Later Life. Physical manifestations of senescence, anatomical and physiological development, longevity, vitality, health care, nutrition, chronic conditions, and disability. *Prerequisite:* 181 or permission. Three hours.

283 Personal and Family Development in Later Life. Cognitive development, intellectual performance, work and achievement, retirement and leisure, personal development, self-esteem, coping mechanisms, dying, couples, intergenerational and kinship issues. *Prerequisite:* 181 or permission. Three hours.

284 Public Policy and Programs for Elders. Demography of aging, social institutions and roles, policy and program implementation, income maintenance, housing, health care, social services, transportation, legal and political issues. *Prerequisite:* 181 or permission. Three hours.

291 Special Problems. Reading, discussion, and special field and/or laboratory investigations. *Prerequisite:* Permission. Students may enroll more than once for a maximum of 12 hours. One to six hours.

295 Special Topics. Lectures, laboratories, readings, or projects relating to contemporary areas of study. Enrollment may be more than once; accumulate up to 12 hours. *Prerequisite:* Permission.

296 Field Experience. Professionally oriented field experience under joint supervision by faculty and business or community representative. Credit arranged up to 15 hours. *Prerequisite:* Permission.

ENVIRONMENTAL STUDIES (ENVS)

291 Special Topics. Credit as arranged.

293 Environmental Law. Principles of environmental law, including legal research, methods, threshold issues, case law, trial procedure, and international comparisons in aspects of air, land, and water law. *Prerequisite:* Permission. Three hours. Richardson.

294 Environmental Education. Philosophy, concepts, and strategies of environmental education, emphasizing integration of environmental concerns into formal and nonformal educational programs for youth and adults. *Prerequisites:* Six hours of intermediate or advanced courses in environmental studies, or related areas. Three hours. Hudspeth.

295 Advanced Seminar. Credit as arranged.

GRADUATE COLLEGE (GRAD)

385 Master's Language Examination. Required for all master's degree students during semester in which examination will be completed. Zero hours.

395 Special Topics.

397 Master's Comprehensive Examination. Required for all master's degree students during semester in which comprehensive will be completed. Zero hours.

399 Thesis Defense. Required for all master's degree candidates during semester in which defense is scheduled. Zero hours.

485 Doctoral Language Examination. Required for all doctoral degree students during semester in which examination will be completed. Zero hours.

497 Doctoral Comprehensive Examination. Required for all doctoral degree students during semester in which comprehensive will be completed. Zero hours.

499 Dissertation Defense. Required for all doctoral degree candidates during semester in which defense is scheduled. Zero hours.

900 Continuous Registration Fee. All graduate students who have enrolled for all credits required in their degree program but who have **not completed all degree requirements** (e.g. APA internship, comprehensive exam, defense of project or thesis) must pay a \$100 fee per fall and spring semester. Zero hours.

HUMANITIES (HUMN)

300 Modern Literary Theory. A survey of modern literary theory, including Slavic and Anglo-American formalism, marxism, feminism, structuralism, hermeneutics, deconstruction, and new historicism. *Prerequisites:* Graduate standing at UVM, or an A.B. in some humanities discipline and permission. Three hours. Alternate years.

301 Humanities Graduate Seminar. Varying interdisciplinary topics for humanities graduate students. *Prerequisites:* Graduate standing at UVM, or an A.B. in some humanities discipline and permission. Three hours.

INTERNATIONAL STUDIES (IS)

297, 298 Advanced Readings and Research. Independent study of a specific area subject or theme with an approved instructor. *Prerequisite:* Permission of area Program Director. Three hours.

MUSIC (MUS)

211,212,213,214,215 Seminars in Music Literature. Seminars will treat in detail topics surveyed in the intermediate level music literature sequence. Subject matter will be determined by the instructor. *Prerequisites:* 11, 12; 111 for 211; 112 for 212; 113 for 213; 114 for 214; 115 for 215. Three hours. Offered on irregular basis as required by major enrollment. Ambrose, Cosenza, Neiweem, Schneider.

216 Bibliography Seminar. Biographies and critical works, bibliographies, Festschriften, scholarly and performing editions of music and discography will be surveyed. *Prerequisites:* Music 11, 12, one additional music literature course at the 100 or 200 level. Three hours. Ambrose, Schneider.

231, 232 Advanced Theory. Advanced counterpoint and harmony; analysis of form in music. *Prerequisites:* 132, 134; 231 for 232 or permission. Three hours. Read, Wigness.

233 Arranging. Characteristics of instruments; arranging for ensembles. *Prerequisite:* 231 or permission. Three hours. Wigness.

234 Orchestration. Studies in orchestral scoring. *Prerequisite:* 233 or permission. Three hours. Wigness.

235 Fugal Composition. Study of representative baroque,

classical, and contemporary fugal procedures through analysis and composition. *Prerequisite:* 231 or permission. Three hours. Read.

237, 238 Composition. Creative work in free composition with instruction according to the needs and capabilities of the individual student. *Prerequisites:* 232, 235 or permission. Three hours. Read.

240 Seminar in Musical Analysis. Advanced study of musical forms. Comparison of standard approaches to harmonic, motivic, and rhythmic analysis. *Prerequisites:* 232, 235 or permission. Three hours. Read, Wigness.

259 Conducting. Baton technique, score reading, laboratory practice; preparation and performance of selected scores, including score reading at the piano and rehearsal procedures. *Prerequisites:* 132, 134 or equivalent. Three hours.

265 Vermont Wind Ensemble. Study and performance of masterworks for wind ensemble and concert band. Attendance at all rehearsals and concerts required. *Prerequisite:* Audition. One hour. May be repeated for credit. Staff.

281 Kodaly Institute. Study/application for Kodaly's music education philosophy for children through grade 8. Presentation of folk traditions, solfège, methodology, curriculum; improvisation; children's choirs, conducting, art-music. *Prerequisites:* B.S. in Music Education or equivalent. Cross-listing: EDMU 243. Three hours for two-week course (for Certificate holders) or six hours for three-week course (for study and application of Kodaly's principles and music education).

297, 298 Advanced Readings and Research. Studies in composition or related special topic under the direction of assigned staff member. *Prerequisite:* Permission. Credit as arranged.

OBSTETRICS AND GYNECOLOGY (OBYG)

295 Special Topics. Lectures, readings and discussion for advanced students within areas of expertise of faculty and staff. *Prerequisite:* Permission of instructor. Three hours.

(Molecular endocrinology of human reproduction: A discussion-oriented course for advanced students in reproductive biology. Primary focus on the physiology and endocrinology of human reproduction and pregnancy, including critical evaluation of current technology and bioethical issues. Three hours. Osol, Stürewalt. Spring, alternate years.)

ORTHOPAEDIC SURGERY (ORTH)

291, 292 Research in Orthopaedics and Rehabilitation. Work on research problem under the direction of a faculty member. Review of literature, preparation of manuscript. *Prerequisite:* Permission. Three hours. Beynnon, Stokes (in collaboration with clinical faculty of the Department).

381,382,383,384 Readings and Research in Musculoskeletal Biomechanics. Intended for Graduate Students doing thesis or dissertation work in Biomechanics. Class will meet to discuss current journal articles and literature reviews prepared by students. *Prerequisite:* Permission. One hour each. Beynnon, Stokes.

PHILOSOPHY (PHIL)

Prerequisites for all courses: as listed, or equivalent, or by permission of instructor.

201 Theory of Knowledge. A critical examination of the nature and sources of knowledge: belief, truth, evidence,

perception, memory, and induction. *Prerequisite:* 102 or 112. Three hours. Kornblith.

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 our place in it. *Prerequisite:* 101, 102, or 110. Three hours. Christensen, Kornblith, Mann.

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. *Prerequisite:* 102 or 110. Three hours. Kornblith, Pereboom.

217 Philosophy of Language. A philosophical study of the nature of language. *Prerequisite:* 113 or Linguistics 100, 102. Three hours. Christensen, Kornblith.

221 Topics in Chinese Philosophy. A detailed examination of a classical Chinese philosophical text or school. *Prerequisite:* 121 or 122. Three hours. Chan.

235 Topics in the Philosophy of Religion. Advanced study of such issues in the philosophy of religion as the relation between philosophy and faith, religion and science, and religion and ethics. *Prerequisites:* 101, 102 or 135. Three hours. (May be repeated for credit when topic is significantly different.) Mann.

240 Contemporary Ethical Theory. An analysis of the ideas of contemporary moral philosophers in normative ethics and metaethics. *Prerequisites:* 140, 142, 143 or 144. Three hours. Kuflik, Loeb.

241 Contemporary Social and Political Philosophy. An analysis of the ideas of contemporary philosophers in social and political philosophy. *Prerequisites:* 140, 142, 143, or 144. Three hours. Kuflik, Loeb.

242 Justice and Equality. (Same as Political Science 241.) An examination of contemporary normative theories of distributive justice and equality. *Prerequisites:* 140, 142, 143, or 144. Three hours. Kuflik, Loeb; Wertheimer (Political Science).

260 Topics in Continental Philosophy. Study of a central issue in current continental philosophy, e.g. social theory, psychoanalysis, or aesthetics. Readings from Nietzsche, Heidegger, Gadamer, Ricoeur, Habermas, Derrida, and Foucault. *Prerequisites:* 107 or 160. Three hours. May be repeated when topic is different. Guignon.

265 American Philosophy. The thought of such leading American philosophers as Peirce, James, Royce, Santayana, Dewey, and Whitehead. *Prerequisites:* 101, 102. Three hours. Miller.

271, 272 Seminar: Major Philosophical Author or School. A study of the major philosophical texts by a single author or school of thought. May be repeated for credit when different authors are studied. *Prerequisite:* An appropriate 100-level course in philosophy. Three hours.

295, 296 Advanced Special Topics. Advanced courses or seminars on topics beyond the scope of existing department offerings.

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.

RELIGION (REL)

291, 292 Topics in the History and Phenomenology of Religion. *Prerequisites:* Nine hours in religion; or permission. Three hours.

SOCIOLOGY (SOC)

Courses numbered 200 to 299 require a minimum of **six hours of sociology**, three of which must be at the 100 or intermediate level, equivalent preparation as indicated or permission of the instructor.

202 Population Dynamics. Analysis of factors affecting human population growth, distribution; migration patterns; relationship between economic activity and population trends. *Prerequisites:* Six hours of sociology, or Sociology 1 and an introductory course in biology, economics, geography, or zoology. Three hours. McCann, Strickler.

205 Rural Communities in Modern Society. Changing structure, dynamics of rural social organization in context of modernization and urbanization. Emphasis on rural communities in U.S. Three hours. Diouf, Schmidt, Smith.

206 Urban Communities in Modern Society. Changing structure, dynamics of urban social organization in context of modernization and urbanization. Emphasis on cities, metropolitan areas in U.S. Three hours. Sampson.

207 Community Organization and Development. Communities as changing sociocultural organizational complexes within modern society. Problems of formulation, implementation of alternative change strategies. Three hours. Diouf, Schmidt.

209 Small Groups. Structure and dynamics of small groups and the interpersonal, informal network of relations that characterize interaction of members. Three hours. Fox, Kahn.

211 Social Movements and Collective Behavior. Examination of origins, development, structure, consequences of crowds, riots, crazes, rumors, panics. Political, religious movements and their relationships to cultural, social change. Three hours. Berkowitz, Danigelis, Diouf, Schmidt.

213 Women in Development in Third World Countries. An examination of the meaning and measurement of development, socio-demographic characteristics, sex stratification and effects of Colonialism and Westernization on women's issues in the Third World. Three hours. Diouf, Kahn, McCann, Smith, Strickler.

214 Delinquency. Analysis of nature, types of juvenile behavior that violates law. Mechanisms for defining such behavior as delinquent, their causes and consequences. Three hours. Fishman, Fox, Stanfield.

216 Criminal Justice. Analysis of social structures, processes involved in identification, labeling of individuals as criminal offenders: criminal law, its enforcement and the courts. Three hours. Fishman, McCann, Stanfield.

217 Corrections. Analysis of social structures, processes involved with individuals designated as offenders of criminal law; probation, prison, parole, programs of prevention, rehabilitation. Three hours. Fishman, Stanfield.

219 Race Relations. Examination of American racial subordination in social, historical perspective. Analysis of interracial contacts, racial subcultures, social structures. Responses to racial prejudice, discrimination. Three hours. Danigelis, Diouf, Moore.

221 Aging and Social Change. Examines effects of social change on older persons and on the aging process. Also analyzes how a growing older population leads to social change. Three hours. Cutler, Fengler.

222 Aging and Ethical Issues. Analysis of selected ethical issues posed by an aging society and faced by older persons, their families, health care and service providers, and researchers. Three hours. Cutler, Fengler.

225 Organizations in Modern Society. Examination of basic classical and contemporary theory, research on human relations, internal structures, environments, types, general

properties of complex organizations, bureaucracies. Three hours. Berkowitz, Fox, Mintz, Sampson.

229 The Family as a Social Institution. The institution of the American family in cross-cultural, historical perspective. Theories, research on family continuity, change, institutional relationships. *Prerequisite:* 129 or six hours of sociology or equivalent. Three hours. Cowan, Fengler, Kahn, Moore, Smith, Strickler.

232 Social Class and Mobility. Comparative, historical analysis of causes, forms, consequences of structured social inequality in societies. Selected problems in contemporary stratification theory, research. Three hours. Berkowitz, Danigelis, Diouf, Krymkowski, McCann, Mintz, Sampson, Schmidt, Smith.

239 Women and Public Policy in Vermont. A detailed analysis of the social processes involved in public policy formation in Vermont and the consequences for women. Three hours. Smith.

240 Political Sociology. Social organization of power, authority in modern societies and dynamics, institutional relationships of political institutions, interest groups, parties, publics. Three hours. Berkowitz, Danigelis, Diouf, Mintz.

243 Mass Media in Modern Society. Intensive examination of selected topics in the structure of media organizations and their relationships to and impacts upon the major institutions and publics of contemporary society. Three hours. Streeter.

250 The Sociology of Culture. Analyzes the relationship of cultural forms and subjective experience to social structure and power; in-depth applications of interpretive approaches in contemporary sociology. Three hours. Kahn, Streeter.

254 Sociology of Health and Medicine. Social organization, institutional relationships of medicine in society. Role of sociocultural factors in etiology, definition, identification, treatment of illness. Three hours. Berkowitz, Fox, Kahn, Mintz, Strickler.

255 Sociology of Mental Health. Analysis of social structures, processes involved in identification, definition, treatment of mental illness and its sociocultural etiology, consequences. Three hours.

258 Sociology of Law. Analysis of socio-cultural structure of legal institution and its relationships to other institutions: social organization of legal profession, lawmaking, courts. Three hours. Stanfield.

272 Sociology of African Societies. Current social, cultural, political and economic changes occurring in African societies, including issues of development, the state and civil society, social class, ethnonationalism and democratization. *Prerequisites:* Six hours of sociology. Three hours. Diouf.

274 Research Seminar. Principles of research design, data gathering, ethics, measurement, data analysis, and data presentation. Student will complete a research project. *Prerequisite:* 100 or equivalent with permission. Danigelis, Fox, Krymkowski, Schmidt.

275 Methods of Data Analysis in Social Research. Quantitative analysis of sociological data. Table, regression, path analysis, scaling and factor analysis, analysis of variance (emphasis on multivariate techniques). *Prerequisites:* 100 or equivalent with permission. Three hours. Berkowitz, Danigelis, Krymkowski, McCann, Strickler.

279 Contemporary Sociological Theory. Critical examination of contemporary functional, conflict, exchange, interactionist, structural theoretical approaches. Other theoretical approaches selected by seminar participants. *Prerequisite:* 178 or permission. Three hours. McCann, Sampson.

281, 282 Seminar. Presentation, discussion of advanced problems in sociological analysis. *Prerequisite:* Twelve hours of sociology, permission. Three hours.

288, 289 Seminar: Research and Methods of Teaching Sociology. Development, evaluation of teaching sociology. *Prerequisite:* Twelve hours of sociology, permission. Open only to graduate students and advanced undergraduate sociology students who serve concurrently as teaching assistants in the department. Three hours.

295, 296 Special Topics.

297, 298 Readings and Research.

SPANISH (SPAN)

SPANISH LITERATURE

235 Golden Age Drama and Prose. The picaresque novel and the drama of the 16th and 17th centuries, emphasizing Lope de Vega, Calderón, Quevedo, Tirso De Molina. Three hours. Staff.

236 Golden Age Poetry. The major poets (Garcilaso, Fray Luis, San Juan, Quevedo and Góngora) and the poetic tradition of the 16th and 17th centuries. Three hours. Staff.

245, 246 Cervantes. *Don Quijote*, the *Novelas Ejemplares*, and the theatre of Cervantes. Three hours each course. Staff.

265 19th Century Spanish Literature. Romanticism and realism: (1) Romantic theatre; (2) the realist and naturalist novelists: Galdós and Leopoldo Alas. Three hours. Roof.

276 20th Century Spanish Poetry and Drama. Vanguard vs. tradition from the "Generation of 1898" to the present. Three hours. Roof.

277 20th Century Spanish Prose Fiction and Essay. Innovation and experimentation from the Generation of 1898 to the present. Three hours. Roof.

281 Spanish-American Prose Fiction of the 20th Century. A study of representative works by major authors tracing the development of narrative forms from their roots in the last century to the present. Three hours. Murad.

285, 286 Spanish-American Literature of Social Protest. Readings of major works tracing the various directions of social protest against the Spanish political system, local governments, imperialism. 286 stresses contemporary literature. Three hours each course. Murad.

291 Civilization of Spain. Topical approach to the study of Spanish civilization through the 17th century, emphasizing ideas, art and literature. Three hours. Maura.

292 Civilization of Spain. Topical approach to the study of Spanish civilization from the 18th century to the present, emphasizing ideas, art and literature. Three hours. Escaja, Roof.

293 Latin American Civilization. A study of the ideas, art, literature, and music of Latin America against the background of the history and culture of the religion. Three hours. Staff.

295, 296 Advanced Special Topics.

297, 298 Advanced Readings.

WOMEN'S STUDIES (WST)

295, 296 Advanced Special Topics. Advanced courses or seminars on women's studies. *Prerequisite:* Permission. Three hours.

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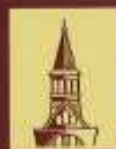
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