

Graduate School- New Brunswick Catalog 1997-1999

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About the Cover:

The illustration on the cover of this catalog arose from research carried out at the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS). This center, a National Science Foundation Science and Technology Center, is a consortium of Rutgers and Princeton universities, AT&T Labs, Bell Labs, and Bellcore, and is headquartered at Rutgers. The center emphasizes programs that involve collaborations between mathematicians and computer scientists and researchers in other fields of science, such as physics, chemistry, biology, or the social sciences, or with researchers from industry. Rutgers graduate students are actively involved in research with the 150 scientists associated with DIMACS and deal with such problems as reconstruction of evolutionary trees, modeling of HIV sequences, computer-aided verification, security and electronic commerce over the Internet, and massive data sets arising from environmental or astronomical modeling.

The model on the cover illustrates a random 3-coloring of a binary tree that is subject to the condition that no red point may be adjacent to a green one. Motivation for the study of such random colorings of the mathematical objects called binary trees comes from an area of mathematical physics called statistical mechanics, in which scientists try to model the behavior of physical phenomena (like magnetism) using the random behavior of small particles. Of particular interest are models of "phase transitions," such as the change of water to ice.

This particular model arose through partnerships among mathematicians, computer scientists, and physicists. Graham Brightwell of the London School of Economics and Peter Winkler of Bell Labs have used these random colorings as abstract mathematical models of the phenomena studied in statistical mechanics and have shown that such colorings can exhibit phase transitions akin to the phase transitions exhibited by physical systems. The illustration shows a "phase" in which green is favored over red even though the local conditions are the same for those two colors.

Much of the work of Brightwell and Winkler was carried out under the auspices of DIMACS. Brightwell and Winkler collaborated through the DIMACS "Special Focus on Discrete Probability," jointly sponsored by the Institute for Advanced Study in Princeton.

The university reserves the right for any reason to cancel or modify any course or program listed herein. In addition, individual course offerings and programs may vary from year to year as circumstances dictate.

THE STATE UNIVERSITY OF NEW JERSEY

RUTGERS

Campus at New Brunswick

Academic Calendars

Dates are subject to change.

1997–1998

September

2 Tuesday Fall term begins.

November

25 Tuesday Thursday classes meet.
26 Wednesday Friday classes meet.
27 Thursday Thanksgiving recess begins.
30 Sunday Thanksgiving recess ends.

December

10 Wednesday Regular classes end.
11 Thursday Reading period begins.
15 Monday Fall exams begin.
22 Monday Fall exams end.
23 Tuesday Winter recess begins.

January

18 Sunday Winter recess ends.
19 Monday Martin Luther King, Jr.'s
birthday.
20 Tuesday Spring term begins.

March

15 Sunday Spring recess begins.
22 Sunday Spring recess ends.

May

4 Monday Regular classes end.
5 Tuesday Reading period.
6 Wednesday Spring exams begin.
13 Wednesday Spring exams end.
21 Thursday Commencement.

1998–1999

September

1 Tuesday Fall term begins.

November

24 Tuesday Thursday classes meet.
25 Wednesday Friday classes meet.
26 Thursday Thanksgiving recess begins.
29 Sunday Thanksgiving recess ends.

December

10 Thursday Regular classes end.
11 Friday Reading period begins.
15 Tuesday Fall exams begin.
22 Tuesday Fall exams end.
23 Wednesday Winter recess begins.

January

17 Sunday Winter recess ends.
18 Monday Martin Luther King, Jr.'s
birthday.
19 Tuesday Spring term begins.

March

14 Sunday Spring recess begins.
21 Sunday Spring recess ends.

May

3 Monday Regular classes end.
4 Tuesday Reading period.
5 Wednesday Spring exams begin.
12 Wednesday Spring exams end.
20 Thursday Commencement.

About the University

Rutgers, The State University of New Jersey, with over 48,000 students on campuses in Camden, Newark, and New Brunswick, is one of the major state university systems in the nation. The university comprises twenty-nine degree-granting divisions: twelve undergraduate colleges, twelve graduate schools, and five schools offering both undergraduate and graduate degrees. Five are located in Camden, eight in Newark, and sixteen in New Brunswick.

Rutgers has a unique history as a colonial college, a land-grant institution, and a state university. Chartered in 1766 as Queen's College, the eighth institution of higher learning to be founded in the colonies, the school opened its doors in New Brunswick in 1771 with one instructor, one sophomore, and a handful of first-year students. During this early period the college developed as a classical liberal arts institution. In 1825, the name of the college was changed to Rutgers to honor a former trustee and revolutionary war veteran, Colonel Henry Rutgers.

Rutgers College became the land-grant college of New Jersey in 1864, resulting in the establishment of the Rutgers Scientific School with departments of agriculture, engineering, and chemistry. Further expansion in the sciences came with the founding of the New Jersey Agricultural Experiment Station in 1880, the College of Engineering in 1914, and the College of Agriculture (now Cook College) in 1921. The precursors to several other Rutgers divisions were also founded during this period: the College of Pharmacy in 1892, the New Jersey College for Women (now Douglass College) in 1918, and the School of Education (now a graduate school) in 1924.

Rutgers College assumed university status in 1924, and legislative acts in 1945 and 1956 designated all its divisions as The State University of New Jersey. During these years the university expanded significantly with the founding of an evening division, University College, in 1934, and the addition of the University of Newark in 1946 and the College of South Jersey at Camden in 1950.

Since the 1950s, Rutgers has continued to expand in the area of graduate education. The Graduate School–New Brunswick, Graduate School–Newark, and Graduate School–Camden serve their respective campuses. In addition, several professional schools have been established in such fields as management and labor relations, social work, criminal justice, planning and public policy, applied and professional psychology, the fine arts, and communication, information, and library studies. A number of these schools offer undergraduate programs as well. Livingston College was founded in 1969 to provide a diverse community of students with the opportunity to pursue undergraduate degrees in the liberal arts and professions.

Today, Rutgers continues to grow, both in its facilities and in the variety and depth of its educational and research programs. The university's goals for the future include the continued provision of the highest quality undergraduate and graduate education along with increased support for outstanding research to meet the needs of society and fulfill Rutgers' role as The State University of New Jersey.

Graduate Study at the University

GRADUATE SCHOOL–NEW BRUNSWICK

Graduate instruction at the university began with course offerings by the faculty of Rutgers College in 1876, and the first Doctor of Philosophy degree was conferred in 1884. Detailed regulations governing graduate degrees were established in 1912, a graduate faculty was separately organized in 1932, and the Graduate School in New Brunswick was formally established in 1952. Graduate programs also developed on the Newark campus, and these were the basis for the establishment of the Graduate School–Newark in 1974. A similar expansion led to the establishment of the Graduate School–Camden in 1981.

There are now seventeen units granting graduate degrees in the university; in addition to the three graduate schools already referred to, there are schools offering graduate professional degrees in the arts; criminal justice; education; law; communication, information, and library studies; management; management and labor relations; planning and public policy; applied and professional psychology; and social work. The Graduate School–New Brunswick has faculties in the academic arts and sciences, as well as several professional fields, and is responsible, together with the Graduate School–Newark, for all philosophical degrees in the university at the doctoral level. The school's enrollment of about 4,500 students is distributed among fifty-eight graduate programs. The faculty is drawn from virtually all the academic divisions of the university.

The traditional goal of undergraduate instruction is a liberal education in the arts and sciences, and the traditional goal of graduate instruction is an education that fosters creative research, criticism, and scholarship in a particular discipline. The two goals are complementary. "The subjects pursued for the sake of a general education," Alfred North Whitehead observed, "are special subjects specially studied." Most members of the graduate faculty at the university teach both graduate and undergraduate courses and are as concerned with general education as with specialization. They know that a university is supposed to be an organization of men and women dedicated to bringing about improved orderings in human knowledge and experience, and that the measure of its success is the degree to which its faculty and students are able to ameliorate and enrich the life of human societies.

The size of the graduate community is a result of the large number of programs offered by many departmental and interdepartmental graduate programs; the actual enrollment of each is limited. Most graduate degree programs offer their instruction in small classes and seminars, provide for close association between students and faculty members, encourage independent study, and work with their students to create programs flexible enough to meet mutual interests and needs. Students and faculty members are engaged in common pursuits of understanding and learning, and the Graduate School–New Brunswick encourages their

cooperative exploration of the subjects that interest them without the impediments of routine and the rigidities of mechanical requirements.

The graduate students who earn their degrees at the university are equipped with a rigorous grounding in their own disciplines and with markedly broader intellectual experience and agility than they possessed when they began; they will go on to careers in the professions, industry, business, museums, research institutions, college or university teaching, or other work demanding highly specialized training, with an enhanced capacity for leadership and a cultivated ability to contribute something of value to their own lives and the present and future lives of others.

OTHER GRADUATE STUDY AT THE UNIVERSITY

In addition to the degree programs offered by the Graduate School–New Brunswick, the following divisions of the university offer a variety of postbaccalaureate programs. In New Brunswick, there are the Graduate School of Applied and Professional Psychology, the School of Business–New Brunswick, the College of Pharmacy, the Graduate School of Education, the School of Communication, Information and Library Studies, the School of Social Work, the Edward J. Bloustein School of Planning and Public Policy, the School of Management and Labor Relations, and the Mason Gross School of the Arts. In Newark, there are the Graduate School–Newark, the Graduate School of Management, the School of Criminal Justice, and the School of Law–Newark. In Camden, there are the Graduate School–Camden, the School of Law–Camden, and the School of Business–Camden. All of the above divisions publish catalogs that are available upon request.

LOCATION

New Brunswick, with a population of about 42,000, is located in central New Jersey at Exit 9 of the New Jersey Turnpike and along the New York–Philadelphia railroad line. It is approximately thirty-three miles from New York City, and frequent express bus service is available from a station near the College Avenue campus to terminals in central Manhattan. Princeton is sixteen miles to the south, Philadelphia about sixty miles, and Washington under two hundred miles. The libraries, theaters, concert halls, museums, galleries, research institutes, clubs, and other educational, cultural, and recreational resources of the New York–Philadelphia region are easily accessible to the interested student. Rutgers attracts many distinguished visitors, lecturers, and performing artists not always available to less favorably situated institutions. Newark, the state's largest city, and Camden, which faces Philadelphia across the Delaware River, are characteristic northeastern American metropolitan centers. A distance of twenty miles separates the Newark campus of the university from the New Brunswick–Piscataway campuses, and a few faculty members and graduate students involve themselves in activities at both locations; the distance between New Brunswick and Camden is about fifty-five miles, and interchanges are consequently less frequent, although the faculty participating in New Brunswick–Piscataway graduate programs includes members from Camden and from Newark.

Degree Programs Available

Advanced degrees in the subjects listed below are conferred by the university upon recommendation of the faculty of the Graduate School–New Brunswick. Further information about the specific areas of specialization in which degree programs are conducted may be found under the general subject headings in the Programs, Faculty, and Courses chapter.

Agricultural Economics (M.S.)
Animal Sciences (M.S., Ph.D.)
Anthropology (M.A., Ph.D.)
Art History (M.A., Ph.D.)
Biochemistry (M.S., Ph.D.)
Biomedical Engineering (M.S., Ph.D.)
Bioresource Engineering (M.S.)
Cell and Developmental Biology (M.S., Ph.D.)
Ceramic Science and Engineering (M.S., Ph.D.)
Chemical and Biochemical Engineering (M.S., Ph.D.)
Chemistry (M.S., M.S.T., Ph.D.)
Civil and Environmental Engineering (M.S., Ph.D.)
Classics (M.A., M.A.T., Ph.D.)
Communication, Information, and Library Studies (Ph.D.)
Comparative Literature (M.A., Ph.D.)
Computer Science (M.S., Ph.D.)
Ecology and Evolution (M.S., Ph.D.)
Economics (M.A., Ph.D.)
Electrical and Computer Engineering (M.S., Ph.D.)
English, Literatures in (M.A., Ph.D.)
Entomology (M.S., Ph.D.)
Environmental Sciences (M.S., Ph.D.)
Food Science (M.S., Ph.D.)
French (M.A., M.A.T., Ph.D.)
Geography (M.A., M.S., Ph.D.)
Geological Sciences (M.S., Ph.D.)
German (M.A., Ph.D.)
History (M.A., Ph.D.)
Industrial and Systems Engineering (M.S., Ph.D.)
Industrial Relations and Human Resources (Ph.D.)
Italian (M.A., M.A.T., Ph.D.)
Linguistics (M.A., Ph.D.)
Mathematics (M.S., Ph.D.)
Mechanical and Aerospace Engineering (M.S., Ph.D.)
Mechanics (M.S., Ph.D.)
Microbiology and Molecular Genetics (M.S., Ph.D.)
Music (M.A., M.A.T., Ph.D.)
Nutritional Sciences (M.S., Ph.D.)
Oceanography (M.S., Ph.D.)
Operations Research (M.S., Ph.D.)
Pharmaceutical Science (M.S., Ph.D.)
Pharmacology, Cellular and Molecular (M.S., Ph.D.)
Philosophy (M.A., Ph.D.)
Physics and Astronomy (M.S., M.S.T., Ph.D.)
Physiology and Neurobiology (M.S., Ph.D.)
Plant Biology (M.S., Ph.D.)
Political Science (M.A., Ph.D.)
Psychology (M.S., Ph.D.)
Public Health (Ph.D.) (Offered jointly with and administered by UMDNJ–RWJMS)

Public Policy (M.S.)
 Social Work (Ph.D.)
 Sociology (M.A., Ph.D.)
 Spanish (M.A., M.A.T., Ph.D.)
 Statistics (M.S., Ph.D.)
 Toxicology (M.S., Ph.D.)
 Urban Planning and Policy Development (M.S., Ph.D.)
 Women's Studies (M.A.)

SPECIAL PROGRAMS

Interdisciplinary Ph.D. Programs

In addition to the formally established doctoral programs, special interdisciplinary Ph.D. programs may be arranged for individual students who wish to pursue subjects that cut across the boundaries of program curricula. A student who seeks the Ph.D. in an area requiring the services of two or more program faculties should consult interested faculty members and then submit a formal proposal to the Dean of the Graduate School–New Brunswick, outlining a program of study. Courses, examinations, the dissertation topic, and the names of faculty who have consented to serve as the student's committee must have the approval of the directors of the graduate programs involved. Requests for special programs will normally be considered only after the student has satisfactorily completed at least one year of work in the Graduate School–New Brunswick. Upon receiving the written approval of the faculties concerned, the Dean will appoint the ad hoc committee that will supervise the remainder of the student's program of graduate study and research, and the student will be transferred to the interdisciplinary Ph.D. program (curriculum code 554).

Joint Programs

Rutgers, The State University of New Jersey, and the University of Medicine and Dentistry of New Jersey–Graduate School of Biomedical Sciences also offer joint Ph.D. and M.S. degrees to candidates for the degree in biochemistry, biomedical engineering, cell and developmental biology/anatomy, microbiology and molecular genetics, cellular and molecular pharmacology, physiology and neurobiology, and toxicology.

A joint doctoral program in public health is offered in cooperation with the University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School. This program is administered by UMDNJ–RWJMS. Inquiries should be addressed to the New Jersey Graduate Program in Public Health, Environmental and Occupational Health Sciences Institute, 681 Frelinghuysen Road, P.O. Box 1179, Piscataway, NJ 08855-1179.

Combined M.D./Ph.D. Degree

The University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School and the Graduate School–New Brunswick/University of Medicine and Dentistry of New Jersey–Graduate School of Biomedical Sciences offer a combined M.D./Ph.D. program.

Students will be selected for the program on the basis of previous academic work, M.C.A.T. or G.R.E. test scores, and letters of recommendation.

For further information and an application form, please contact the Graduate School of Biomedical Sciences,

University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School, 675 Hoes Lane, Piscataway, NJ 08854-5635.

Simultaneous Degrees

A student admitted to one degree program may simultaneously pursue a second degree in another program. The director of the graduate program offering the second degree must notify the Office of the Dean of the Graduate School in writing concerning the student's acceptance by that program. Students, however, can only be registered in one program at a time.

Certificate Programs and Core Curricula

The Graduate School–New Brunswick offers programs of concentration that complement formal degree programs. These programs do not themselves offer degrees, but are designed to facilitate certain interdisciplinary specializations without impeding the student's progress toward the degree. These specialized options are of several kinds. Some are done without formal acknowledgment, such as that in packaging science and engineering (q.v.), while others are extensions of existing degree programs, such as the museum studies certificate offered in connection with the M.A. degree in art history. Programs leading to an interdisciplinary Ph.D. may also be arranged (see the section on Interdisciplinary Ph.D. Programs).

Interdisciplinary certificate programs and core curricula provide a more formal means for participating in a cross-disciplinary area and for encouraging collaborative work. Students who complete their degrees while also meeting the requirements of a certificate program will receive a certificate indicating their specific concentration of study. All certificate options require students to take courses outside of their degree programs and to write a major paper or thesis on a topic appropriate to the particular certificate. Some programs also offer interdisciplinary seminars.

Core curricula are designed somewhat differently. In contrast to certificate programs, students must formally apply to and be admitted into core curricula. They typically provide fellowship or traineeship support for enrolled students. Each curriculum is flexible to accommodate the diverse backgrounds and varied interests of the students. Basic courses, seminars, and laboratory rotations allow students to explore problems at the boundaries of degree programs and even postpone commitment to a given degree program for a time. Students completing such curricula must also meet the requirements of the degree program in which they are matriculated.

Specific details concerning the certificate programs and core curricula may be found in the Programs, Faculty, and Courses chapter.

Certificate Programs

Alcohol Studies
 Asian Studies
 Cognitive Science
 Environmental Change,
 Human Dimensions of
 Medieval Studies
 Museum Studies
 Quaternary Studies
 Russian, Central and
 East European Studies
 Wireless Communications
 Women's Studies

Core Curricula

Biotechnology
 Molecular and Cell Biology
 Molecular Biophysics

Nondegree Graduate Study

The Nondegree Graduate Study Office, 18 Bishop Place (732/932-8351, or 8352), cooperates with the Graduate School–New Brunswick in facilitating the admission of part-time, nonmatriculated students and by administering the enrollment of these students in selected graduate courses. Not all programs are able to accommodate nondegree students, and in others enrollment may be restricted to certain courses.

With the approval of the appropriate graduate program director, up to 12 credits earned in courses successfully completed in the nondegree program may be applied to satisfy requirements for students subsequently admitted to degree programs. Admission to a nondegree program, however, is completely independent and distinct from admission to a degree program. Each requires a separate application and fee. Admission to nondegree study does not guarantee admission to a degree program. Students are not permitted to accumulate more than 12 credits in nondegree study prior to matriculation in a degree program. Students admitted to nondegree study are subject to, and must comply with, the rules, regulations, and deadlines of the Graduate School–New Brunswick.

Admission

REQUIREMENTS

A bachelor's degree, or its equivalent, from a recognized institution of higher education is required of applicants to the Graduate School–New Brunswick. An average of B or better in previous academic work is expected. Additional evidence of potential for graduate study is demonstrated by letters of recommendation and by scores on the Graduate Record Examination, which are required for all programs. Applicants should refer to the current application form and instructions for the specific requirements and prerequisites of each program. Admission is competitive; some applicants who meet or surpass minimum requirements may be denied acceptance. Admission is recommended by faculty of the graduate program to which the individual applies and must be approved by the dean of the Graduate School–New Brunswick or the dean's representative.

APPLICATIONS

Admission materials are available from the Office of Graduate and Professional Admissions, Rutgers, The State University of New Jersey, 18 Bishop Place, New Brunswick, NJ 08903 (732/932-7711). A complete application consists of the application form, letters of recommendation, the application fee, official transcripts of previous academic work, personal statement or essay, and test scores. Additional materials may be required by some programs. Detailed procedures and instructions accompany the application form.

DEADLINES

Application deadlines vary by program and are listed in current admissions materials. Applications for assistantships and fellowships that are received after March 1 are disadvantaged but are considered as long as awards are available. Many programs have established different financial aid deadlines, which are cited in the application information. International students applying from abroad must submit application materials by November 1 for spring term admission and April 1 for fall term admission, unless the individual program deadline is earlier. Programs reserve the right to change stated deadlines.

TESTS

The Graduate School–New Brunswick requires applicants for matriculated status to submit results of the Graduate Record Examination (GRE). GRE information and application forms may be obtained by writing the Graduate Record Examination Program, Educational Testing Service,

P.O. Box 6000, Princeton, NJ 08541-6000. The Educational Testing Service takes at least six weeks to process scores from paper-based administrations. Scores from computer-based administrations are reported in ten to fifteen days.

Tests taken within a period of three years prior to the time of application are not questioned on grounds of age. Graduate programs may require that test scores more than three years old be validated, either by evidence of continued work in the field or by reexamination.

INTERNATIONAL APPLICANTS

International applicants are required to take the Test of English as a Foreign Language (TOEFL) if English is not their native language. For further information about the test, write to TOEFL/TSE Services, P.O. Box 6151, Princeton, NJ 08541-6151, U.S.A. Satisfactory English proficiency is a prerequisite for graduate study at the university. Admitted students may be required to take a test of English proficiency soon after arrival at the university and may be obligated to take course work in English as a Second Language (ESL). These courses are cited in the Programs, Faculty, and Courses chapter.

New international students appointed as teaching assistants are required to take an oral proficiency test regardless of their TOEFL scores. Nonimmigrant students must also present evidence of adequate financial resources to meet educational and living expenses.

The university may deny admission to international applicants for lack of English proficiency, insufficient financial resources, or because of improper visa status.

NOTIFICATION OF DECISIONS

Applicants will receive written notification of admissions decisions from the Office of Graduate and Professional Admissions. Admission will be confirmed on a Certificate of Admission, which may list certain conditions. Such conditions should be satisfied prior to registration unless otherwise indicated. Admission to the Graduate School–New Brunswick does not constitute admission to candidacy for an advanced degree.

Candidacy is explained elsewhere in this catalog. Students who fail to register for the term to which they were admitted should contact the graduate admissions office for further instructions.

Tuition and Fees

FEE SCHEDULE

1997–1998 Academic Year

Note: The university reserves the right to alter the amounts indicated on the following schedule at any time before the first day of classes of a term.

Application Fee, nonrefundable	\$ 40.00
Tuition *	
Full-time New Jersey resident, per term	3,033.00
Full-time non-New Jersey resident, per term	4,447.00
Part-time New Jersey resident, per credit	250.00
Part-time non-New Jersey resident, per credit	369.00
Student Fee, per term	
Full-time (12 or more credits)	317.00
Part-time (11 or fewer credits)	84.00
Matriculation continued or 1 credit of research	7.00
Meal Plans, per term	
Full meal plan (19 meals per week)	1,101.00
Selective meal plan (any 12 meals per week)	1,012.00
Fraternity meal plan (14 meals per week– full meal plan less weekday dinners)	818.00
Apartment meal plan (any 5 meals per week)	556.00
Commuter meal plan (any 5 lunches per week)	417.00
Miscellaneous Fees	
Computer fee (full-time)	50.00
Computer fee (part-time) progressive	20.00-47.00
Basic health insurance program (optional) †, per term (part-time students only)	88.13
Major medical insurance plan, per year †	207.00/282.00
Spouse, per year ‡	207.00/282.00
Each child, per year ‡	207.00/282.00
Late registration fee	50.00
Late payment fee (for one day to one week and/or check not honored for payment)	50.00
Partial payment fee	10.00
Late payment fee for partial payments (for one day to one week)	10.00
For each additional week or part thereof	5.00
Drop/add fee, per change	5.00
(applies to change of registration due to student error or choice after the second week of classes)	
Microfilming of doctoral dissertation	50.00
Transcript of record fee, per copy	3.00
Student I.D. fee	4.00
Restoral Fee	
Fee, per term	236.50
Maximum fee (through five terms) (applies to certain students who allow their registration to lapse and wish to be restored to active status as degree candidates)	1,182.50

Note: All breakage and damage to university property is charged for in full. The university is not responsible for loss by fire or theft of private property in its buildings.

* For an explanation of New Jersey residency status, see Student Residency for Tuition Purposes in the Academic Policies and Procedures chapter.

† Required for international students.

‡ This insurance is optional (\$50,000 limit/\$100,000 limit).

STUDENT FEE AND OTHER CHARGES

The student fee covers student use of the student centers and the health centers, membership in the Graduate Student Association, and certain administrative services. The relatively low fee charged to graduate students does not include the fee for intercollegiate athletics which entitles undergraduates to discounted prices for tickets.

Special fees charged for some undergraduate courses apply also to graduate students enrolling in those courses. Deposits of varying amounts, covering the cost of materials and breakage, are required in certain laboratory courses in the sciences; unused portions of such fees are returned.

TERM BILLS

Instructions for registration and payment of term bills are sent by mail to all students for the first and second terms with due dates indicated. Students who do not receive a term bill by July 15 for the fall term and by December 5 for the spring term should notify their local student accounting office promptly. Students who register after July 4 for the fall term or after Thanksgiving for the spring term do not receive a term bill automatically. It is the student's responsibility to pay term bills at the time of registration to avoid being deregistered for the following term.

It is the student's responsibility to obtain, complete, and return the term bill on time. Students who fail to do so are charged a late payment fee of \$50 for the first week, plus \$5 for each additional week or part of a week that payment is late. Graduate students enrolled for 6 or more credits who are unable to pay their term bills in full by the stipulated time may pay their bill according to the partial payment plan outlined below.

Payment of the term bill may be made in person or by mail. Checks or money orders are preferred and should be made payable to Rutgers, The State University. Cash should not be sent through the mail.

PARTIAL PAYMENT PLAN

Students enrolled for 6 or more credits who are unable to pay their term bill in full may arrange with the local cashier's office to pay their bill, if it indicates a net balance due of \$200 or more, in three installments under the partial payment plan, as follows:

1. First payment: 50 percent of the net balance due plus a \$10 nonrefundable partial payment fee payable on or before the date indicated on the term bill.
2. Second payment: 25 percent of the net balance due on or before September 15 for the fall term and on or before February 1 for the spring term.
3. Third payment: net balance due on or before October 15 for the fall term and on or before March 1 for the spring term.

Any student submitting a term bill after classes have begun for the term must make payment according to the following schedule:

1. First payment: 75 percent of net balance due plus a \$10 nonrefundable partial payment fee.
2. Second payment: net balance due on or before October 15 for fall term and on or before March 1 for spring term.

The nonrefundable fee for this partial payment plan is \$10 per term and must be included with the first payment. Any subsequent installment not paid on time incurs an initial late fee of \$10 for the first week or part of a week that payment is late, plus a \$5 late fee for each additional week or part of a week that payment is late.

LIVING EXPENSES

Full-time graduate students, who are New Jersey residents without financial assistance from the university, paid tuition and student fees totaling \$6,460 for the 1996-1997 academic year. Single students living in university housing paid rent of \$3,726 for the academic year. Food for the academic year was \$2,128 if the full meal plan was selected. Books and supplies may have cost another \$1,000. The expenses of clothing, laundry, travel, treats, etc., vary according to individual circumstances, but may be estimated at \$3,000. A total figure of approximately \$16,500 per academic year is realistic.

Students who are not New Jersey residents pay higher tuition and may incur additional expenses during the summer period. As much as \$3,000 more may be required.

REGISTRATION

Activation of Registration

A student's registration is activated through the proper submission of a term bill, accompanied by payment, or through an appropriate claim of financial aid. Activation of registration will not take place if there are "holds" placed on a student's records because of failure to meet outstanding obligations.

Termination of Registration

The university exercises the right to terminate the registration of any student who has an outstanding financial obligation to the university, after sufficient notice has been given to the student. A student whose registration is terminated at any time during the refund period because of nonpayment of amounts owed the university will receive a revised bill based on a refund calculated as if it were a voluntary withdrawal. The university reserves the right to "hold" transcripts and diplomas as a result of nonpayment of obligations and to forward delinquent accounts to collection agencies and to levy a collection fee. "Holds" are removed upon satisfaction of the outstanding obligation. The terminated student may petition for reinstatement of enrollment by satisfying the indebtedness to the university and paying a \$50 reinstatement fee.

Cancellation of Registration

To cancel registration and obtain a full refund of tuition and fees, students must notify the registrar in writing prior to the first day of classes. A student whose registration is cancelled by the registrar will receive a full refund of tuition and fees, and prorated charges for room and board, if applicable. Notification of cancellation received on or after the first day of classes is treated, for billing purposes, as a withdrawal, and a refund will be made based on the general refund policy.

GENERAL REFUND POLICY

A student who voluntarily withdraws from all courses during the first six weeks of a term will receive a partial reduction of tuition (and charges for room and board, if applicable) according to the week of withdrawal as follows:

First and second week:	80%
Third and fourth week:	60%
Fifth and sixth week:	40%

No reduction is granted after the sixth week.

The effective date of withdrawal is the date on which a written statement of withdrawal is received by the registrar. No part of the student fee is refundable.

“W” grades will be assigned, and no reductions will be granted, after the second week of classes to students who withdraw from one or more courses but who remain registered in others. If withdrawal from one or more courses amounts to complete withdrawal from a program, the provision for full withdrawal applies.

Failure to attend class is not equivalent to a withdrawal, and a student will not receive an adjustment of charges unless a formal withdrawal is filed with and approved by the registrar, regardless of whether the student actually attended classes or took examinations.

Refund Policies for Title IV Funds Recipients

There are two additional refund schedules that differ from the General Refund Policy schedule for Title IV funds recipients. First-time Title IV funds recipients who withdraw completely from Rutgers are provided with a separate schedule under the Pro-rata Refund policy. Title IV funds recipients who are not first-time attendees are provided a schedule of refunds via the Appendix A Refund Policy.

For further information, please contact the financial aid office.

Financial Aid

The majority of full-time graduate students at the university, like most graduate students in America, receive some measure of financial aid. The amount of support each student receives depends in part, of course, upon the availability of funds. The availability of support is often dependent upon the specific graduate program and degree status. Support ranges from loans to grants covering tuition charges to awards sufficient to pay all educational and living expenses. The sources of support include university funds, federal and state government funds, corporate and individual bequests to the university, and grants from educational and scientific foundations.

Applications for fellowships and assistantships are due on or before March 1, although awards are occasionally available at later dates. A prospective full-time graduate student may apply for an assistantship or fellowship at the time of application or before admission is complete. Applicants completing the appropriate section of the admission application are considered for those financial awards granted by the university for which they may be eligible. To be considered for an assistantship or fellowship, the student must matriculate on a full-time basis. Please keep in mind that applications for assistantships and fellowships are competitive and the number of requests exceeds availability.

MERIT-BASED FINANCIAL AID

Fellowships, Assistantships, Scholarships, and Grants

All applicants are automatically considered for university-based fellowships, scholarships, and assistantships. Inquiries should be addressed to the director of the graduate program to which the student has applied.

Students are encouraged to apply for externally funded fellowships as well. See the Nonuniversity Fellowships heading later in this chapter.

Rutgers Excellence Fellowship Awards. Rutgers Excellence Fellowship Awards are made by the Graduate School–New Brunswick to doctoral students of exceptional promise. The awards carry stipends of \$10,000 to \$14,000 plus tuition for varying periods of time. Outstanding doctoral students are also eligible for Marion Johnson Fellowships and Graduate School–New Brunswick Fellowships, which carry comparable stipends.

Minority Advancement Program in Teaching and Research. Trustees’ Minority Graduate Fellowships in the Humanities and Social Sciences. MAP excellence and Trustees’ Minority Graduate Fellowship awards support African-American, Hispanic, or American Indian students who are seeking a Ph.D. These fellowships include stipends of \$10,000 to \$14,000 plus tuition. For more information, contact MAP, Rutgers, The State University of New Jersey, 25 Bishop Place, New Brunswick, NJ 08903, or call 732/932-8122.

Ralph Johnson Bunche Distinguished Graduate Award. Established in 1979, this distinguished graduate award is named after Ralph Johnson Bunche, the African-American statesman, Nobel Peace Laureate, and recipient of an honorary Doctor of Laws from Rutgers in 1949.

Bunche fellowships provide \$12,000 plus tuition remission per academic year, renewable for one additional year, to exceptional full-time students with backgrounds of substantial educational or cultural disadvantage. To apply, check the appropriate box on the graduate and professional school application form and attach a statement (in duplicate) with the application that describes the reasons for consideration in the program. Only those applicants receiving awards will be notified. The award is contingent upon acceptance to a graduate and professional school program and upon full-time enrollment. The application deadline for fall term awards is March 1, unless the program to which the student is applying has an earlier deadline.

Bevier and University Fellowships. Graduates of Rutgers, The State University of New Jersey, and students already at the university may apply for Louis Bevier Fellowships and University Fellowships. Funds provided by the state and by the Louis Bevier Memorial Fund (established through the generosity of Dr. and Mrs. Ralph G. Wright in honor of the late Dean Louis Bevier), respectively, support a limited number of fellowships that carry stipends of \$7,000 or more. Applications should be made before March 1 to the Graduate School–New Brunswick, Rutgers, The State University of New Jersey, 25 Bishop Place, New Brunswick, NJ 08903 (732/932-7449).

Graduate and Professional Scholar Awards. Outstanding entering students are eligible for merit scholarships of \$2,000 to \$3,000 per year for full-time study.

Russell Scholarships. Walter C. Russell Graduate Scholarships provide for the cost of tuition. Applications should be made to the director of the graduate program in which the student is enrolled before March 1 for awards for the ensuing academic year, and before December 1 for vacancies that might occur in the spring term.

Bunting-Cobb Graduate Residential Fellowship for Women in Mathematics and the Sciences. Bunting-Cobb Graduate Fellowships for Women in Mathematics and the Sciences are offered by Douglass College, the women's undergraduate unit of Rutgers, for women enrolled as full-time students in mathematics and science programs in the Graduate School–New Brunswick. The award provides a two-year fellowship to women graduate students in mathematics or the sciences. Bunting-Cobb Graduate Fellows live in residence in the Bunting-Cobb Math and Science Hall at Douglass and serve as mentors to undergraduate women in mathematics and the sciences. The award includes a stipend and a single room with board for the academic year. Stipend and responsibilities are based upon the fellow's year in graduate study. Bunting-Cobb Fellows have the opportunity to be part of a unique program of support for women in math and science. For more information, contact the Douglass Project for Rutgers Women in Math and Science, Douglass College, P.O. Box 270, New Brunswick, NJ 08903-0270 or call 732/932-9197.

Robert White-Stevens Graduate Fellowship. The Robert White-Stevens Graduate Fellowship, named in memory of Dr. Robert White-Stevens who was an agriculturist and former chairman of the Bureau of Conservation and Environmental Science, biology professor, assistant director of

the New Jersey Agricultural Experiment Station, and faculty member of Cook College, Rutgers, The State University of New Jersey, supports an advanced doctoral student committed to enhancing the role of science in alleviating world hunger by increasing the food supply through plant or animal research. Applicants must be nominated by a graduate program director.

Other Fellowships and Scholarships. Students should be aware that each department is continually seeking funds from outside agencies to help defray student expenses. Grants and awards of this nature will vary each year. Inquiries regarding the availability of such monies can be made through graduate program offices and advisers.

Nonuniversity Fellowships. Some graduate students at the university are supported by fellowships funded by sources outside the university. A major source of funding is the National Science Foundation. It offers talented graduate students in the sciences significant funding to pursue their academic programs. Special awards are given to minority students who have been traditionally underrepresented in the sciences. Information and applications are available from the Fellowship Office, National Research Council, 2101 Constitution Avenue N.W., Washington, DC 20418. Other sources of prestigious fellowships are the Mellon Fellowships in the Humanities, administered by the Woodrow Wilson National Fellowship Foundation and the National Defense Science and Engineering Fellowships sponsored by the Department of Defense. Students may wish to consult standard reference material for other sources of nonuniversity fellowships.

Many national, state, and regional associations make special awards. Students should contact clubs, fraternal, religious, and national professional organizations, and local interest groups for possible aid through stipends and tuition credits. A student who receives any of these awards is required to notify the Office of Financial Aid.

Assistantships Awarded by the University. The beginning salary for teaching and graduate assistantships is \$11,086 (1996–1997) for an academic year.

Applications for assistantships are due on or before March 1, although awards are occasionally available at later dates. Prospective graduate students may apply for assistantships when they are sent an application form for admission. Applicants completing the appropriate section of the admission application are considered for those financial awards granted by the university for which they may be eligible. In most cases, the letters of recommendation required for admission also serve as letters of recommendation for assistantships. Should a separate application be required for a newly established program, notice of this will be included with the admissions packet. A graduate student already enrolled at the university who wishes to apply for an assistantship should inquire at the office of the director of the graduate program in which the student is enrolled.

NEED-BASED FINANCIAL AID

Limited funds are available from grants, low-interest loans, and part-time employment to students at the school. Application for such aid is made by completing the Free Application for Federal Student Aid (FAFSA). These forms are available from most college and university financial aid offices as well as from the Rutgers Office of Financial Aid. All students are encouraged to compete this application.

The following is a brief description of each program. All students are strongly encouraged to file an application for financial aid.

How to Apply

All applicants must complete the Free Application for Federal Student Aid (FAFSA) annually and submit it to the federal processor at the address listed on the envelope provided with the form. Applications should be received by the federal processor by March 1 of the academic year preceding the academic year for which aid is sought. The forms are available at all Rutgers financial aid offices. The FAFSA should be filed at the same time the admission application is submitted but no later than March 1 to ensure full consideration for all available funds.

Letters announcing financial aid decisions are mailed to all students as soon as possible after admission. Funds are limited and awards are made based on financial need and limited by the March 1 priority filing date. Therefore, there is a definite advantage to submitting an early, accurate, and complete application. In addition, a financial aid transcript from each prior college attended must be sent to the Rutgers financial aid office.

Counseling is available by appointment at the financial aid office to all students regardless of whether or not they qualify for financial aid. When comparing aid offers from Rutgers with other institutions, students should remember that charges often differ significantly from school to school. Therefore, the important thing to consider is not the dollar value of a financial aid offer, but the difference between the total value of the financial aid package awarded by the institution and the cost of attending that institution.

Part-Time Students

Since financial need is determined by comparing a student's resources with the cost of attending school, most part-time students who are gainfully employed do not demonstrate financial need.

The federal student financial aid sources (Federal Perkins Loan, Federal Work-Study Program and Federal Direct Student program) require that a student enroll in a minimum of 6 credits per term to be eligible.

The university has extremely limited financial aid funds for part-time students. All application procedures and deadlines applicable to full-time students apply to part-time students.

Grants

State Grant. Full-time graduate students, who are classified as New Jersey residents for tuition purposes and who demonstrate financial need, are eligible to receive a New Jersey State Grant. Amounts vary from \$200 to \$1,000 per year and are dependent upon available funds. Application is made by submitting a FAFSA. EOF grant recipients are not eligible.

Educational Opportunity Fund (EOF). New Jersey residents who are full-time students and who can demonstrate backgrounds of financial and academic hardship are eligible for EOF grants ranging from \$200 to \$2,650. Students who received EOF grants as undergraduates are presumed eligible if they fall below the maximum income parameters required for all recipients of this state grant. Graduate students who did not receive EOF grants as undergraduates, but feel that they come from backgrounds of financial hardship and wish to be considered, should write to the financial aid office for

consideration. The grants are renewable for the duration of the student's degree work, subject to continued student eligibility and provided satisfactory academic progress is made. Students must complete the FAFSA.

Loans

Federal Perkins Loan (formerly National Direct Student Loan-NDSL)

Federal Perkins Loans are available to students who are enrolled in a minimum of 6 credits per term, who are citizens or permanent residents of the United States, and who demonstrate need through the FAFSA. The maximum amount a graduate student can borrow under this program at Rutgers is \$2,000 per academic year, with maximum aggregate loan amount not to exceed \$30,000 (including undergraduate NDSL and Perkins loan total).

Interest at the rate of 5 percent simple begins nine months after the borrower ceases to enroll in a minimum of 6 credits per term and extends over a maximum repayment period of ten years. Monthly payments of at least \$40 are required. Deferral of repayment is permitted for certain kinds of federal service and cancellation of loans is permitted for certain public services.

Consistent with federal regulations, all first-time Federal Perkins Loan borrowers at Rutgers are required to attend an entrance interview in order to be informed of their rights and responsibilities regarding the loan. In addition, Federal Perkins Loan recipients must attend an exit interview prior to graduation or withdrawal from school. Further details and procedures regarding the repayment of the Federal Perkins Loan are sent to each student recipient by the student loan office, Division of Accounting, Rutgers, The State University of New Jersey, Administrative Services Building, New Brunswick, NJ 08903.

William D. Ford Federal Direct Loans

Federal Direct Student Loans (Direct Loans) are available for students directly from the federal government to pay for educational costs. These loans eliminate the need for an outside lender, such as a bank. To be considered for a Direct Loan, students must complete the FAFSA. Subsequently, the award letter issued by Rutgers will list eligibility for the program. Money for which students are eligible will be credited directly to their accounts. Because Rutgers has chosen to participate in Direct Lending, the university cannot accept any Federal Stafford applications from students or their lenders. Since the U.S. Department of Education is the lender for the Federal Direct Loan Program, borrowers will send all loan repayments to the department, rather than to several lenders.

In general, to be eligible for a Direct Loan, a student must have a high school diploma or a General Education Development (GED) certificate or meet other standards approved by the U.S. Department of Education, be a United States citizen or an eligible noncitizen, be enrolled at least half-time per term, be making satisfactory academic progress, have a Social Security number, sign a statement of educational purpose, not be in default on prior loans or owe refunds to a federal grant program, and register with the U.S. Selective Service Administration, if required.

In addition to these requirements, all first time Direct Stafford/Ford and Direct Unsubsidized Stafford/Ford Loan borrowers must attend an entrance interview in order to be informed of their rights and responsibilities regarding the loan.

The aggregate limit for Federal Direct Stafford/Ford Loans, including both subsidized and unsubsidized amounts, is \$138,500 for a graduate or professional student (including loans for undergraduate study).

Federal Direct Stafford/Ford Loan. This loan is based on financial need. The government pays the interest on the loan while the student is attending school. The interest rate is variable; that is, it is adjusted each year. Effective July 1, 1994, the maximum rate for the Federal Direct Stafford/Ford Loan was 8.25 percent. Additionally, borrowers are charged an origination fee of 4 percent. Graduate students may borrow \$8,500 per year. The total debt may not exceed \$65,000 including loans for undergraduate years.

Federal Direct Unsubsidized Stafford/Ford Loan. This loan is not based on financial need, but all interest charges must be paid by the student. The interest rate is the same as the Federal Direct Stafford/Ford Loan. Students may borrow up to \$10,000 per year.

Emergency Loans

Students who are experiencing a financial emergency may apply for a university loan for up to \$500. The interest rate is 3 percent simple interest, and the loan must be repaid within the same semester. An emergency need must be demonstrated and funds must be available.

Students must contact their local financial aid office for additional information. If loans in excess of this amount are required, an appointment with a counselor is recommended to discuss long-term assistance. Students do not need to be recipients of financial aid nor to have filed a financial aid application to be considered for emergency loans.

A number of graduate schools offer low interest or interest-free short-term loans to students in their program. Students should request additional information from the various deans or directors of each program.

Employment on Campus

Preceptorships and Residence Counselorships. Appointments as preceptors or counselors in the various undergraduate residence halls are available to a limited number of graduate students. The offices of the deans of students of the undergraduate colleges will, on request, provide information regarding the duties required of preceptors and counselors, the benefits, such as room, board, and tuition grants, and the procedures for application. Applications for September appointments must normally be received before May 1.

Federal Work-Study Program (FWSP). Federal work-study employment may be offered as a self-help portion of the financial aid award. Application for this program is made by filing the FAFSA. On-campus jobs are available in many areas. Selection for a particular job is based on skills, job availability, university needs, and student preference. The assigned employment opportunity is based on an expectation that the student will work an average of fifteen hours weekly throughout the fall and spring academic terms; in the case of summer assignments, the expectation is that the student will work between fifteen and thirty-five hours per week. Once a job is assigned, it is anticipated that the student will continue in that position through the entire academic year.

Any change in work study jobs must be made through the Student Employment/Financial Aid Office. Off-campus employment is also available through the college work-study program. These jobs can be in nonprofit or for-profit agencies. Jobs are related to the student's major whenever possible. No job assignments are made until all paperwork required to accept the aid is complete.

Employment with Any Administrative Office Not Listed with the Student Employment Office. Any graduate student enrolled at the university may check directly with the individual academic or administrative offices for available openings. Students receiving financial aid must be cleared by the Office of Financial Aid prior to employment.

Other Financial Resources

Job Locator Program. The job locator program is open to all graduate students enrolled in the university. Most often, employment opportunities found through the program are located outside the university. Students interested in the job locator program should contact the student employment office at 732/932-8817.

Veterans Benefits. The United States Veterans Administration operates various education assistance programs for eligible veterans, war orphans, surviving spouse or child of any veteran killed while on duty with the Armed Forces, disabled veterans, dependents of a veteran with service related total disability, and certain members of the selected reserve. Inquiries concerning eligibility may be directed to the Veterans Administration office in Newark, New Jersey (telephone 1-800/827-1000); the New Jersey Department of Military and Veterans Affairs in New Brunswick, NJ (732/937-6347); or to the veterans coordinator on each campus. For New Brunswick, the number is 732/932-7067.

Veterans and others mentioned above who plan to utilize veterans' education benefits should initially present the Veterans Administration Certificate of Eligibility Form(s) and/or discharge papers (certified copy of the DD214) when registering for courses. If applying for other financial aid with the university, veterans must report the fact that they will receive veterans' education benefits to the Office of Financial Aid.

Veterans planning to train under Chapter 32 VEAP, Chapter 30 of the New (Montgomery) GI Bill of 1984, or Chapter 106 for Reservists, are required by the university to pay cash for tuition, fees, books, and supplies, when due. Veterans, in turn, receive an allowance for each month of schooling based upon credit hours and the number of dependents.

No veteran may officially withdraw from a course (or courses) without prior approval from the academic services and/or dean of students offices. All withdrawals must be submitted in writing. The date of official withdrawal will be the determining date for changes in benefits. Failure to comply with the official school withdrawal procedure may affect both past and future benefits. Any change in schedule must also be reported to the campus Office of Veterans Affairs.

RESTRICTIONS ON FINANCIAL AID AND EMPLOYMENT

Graduate students may not ordinarily hold two different fellowships, assistantships, or other substantial forms of employment simultaneously. Students who have been offered two different awards should inquire at the Office of the Graduate School–New Brunswick before acceptance. Students who hold fellowships, assistantships, traineeships, or Russell Scholarships may not accept employment outside of their academic department without the permission of the graduate director and the dean of the Graduate School–New Brunswick.

Graduate students who have received aid administered by the Office of Financial Aid must report to that office any change in income, such as scholarships, loans, gifts, assistantships, or other employment received subsequent to the original aid award.

Student Services

LIBRARIES

With holdings of more than three million volumes, the university's library system ranks among the top twenty-five research libraries nationally. Comprising eighteen units on the university's three campuses, the library system supports a broad range and depth of instruction and faculty and student research in a wide array of disciplines.

The system's largest units are the Archibald Stevens Alexander Library on the College Avenue campus and the Library of Science and Medicine on the Busch campus, both in New Brunswick, with the former housing the principal collections of research materials in the humanities and social sciences and the latter housing the principal research collections in science, technology, psychology, medicine, engineering, and pharmacy.

There is a reading room for graduate students located in the Alexander Library. In addition to study space, the Graduate Reading Room includes the graduate reserve collection, a noncirculating collection of standard works in the social sciences and humanities, and locked carrels for students working on their dissertations.

Other libraries in New Brunswick are the Mabel Smith Douglass and Blanche and Irving Laurie Music libraries on the Douglass College campus; the Kilmer Area Library on the Livingston College campus; the Mathematical Sciences, Chemistry, and Physics libraries on the Busch campus; the Art Library and the East Asian Library on the College Avenue campus; and the Chang Science Library and the Entomology Library on the Cook College campus. The specialized collections of the School of Management and Labor Relations Library are located in the Labor Education Center, Ryders Lane, New Brunswick; and those of the Center of Alcohol Studies Library are on the Busch campus. The Newark campus is served by the John Cotton Dana Library, the Institute of Jazz Studies Library, and the Criminal Justice Collection, as well as the Justice Henry Ackerson Library of Law; the Camden campus is served by the Paul Robeson Library and the Camden Law Library. Most libraries maintain one or more reserve reading rooms.

The Rutgers University libraries function as one system. The holdings of all units in the system are accessible via IRIS, the libraries' on-line catalog, which contains listings for the majority of the acquisitions since 1972 and is accessible through public terminals in each library, through telephone dial-up from outside the libraries, and through INFO, the university's campus computer network. Each library in the system, including those located in Camden and Newark, is accessible to all members of the university community through the materials delivery service and telephone reference service. In addition to the collections internal to the Rutgers library system, members of the faculty and student body have access to other libraries through cooperative agreements that link Rutgers to the Princeton University library, the State Library in Trenton, and other libraries in the region.

Of particular interest to faculty and graduate students is Rutgers' membership in the Research Libraries Group, a nationwide consortium that allows members of the university community access to the collections of the most distinguished research libraries in the country, including those at Yale, Berkeley, Stanford, and the New York Public Library. Through a shared database, there is access to most of the books and other materials of Research Library Group members that are available for interlibrary loan.

Additional services provided by the library system include computer-assisted searches of on-line databases in a variety of disciplines. Members of the reference departments provide assistance in both computerized and noncomputerized reference searches. Reference librarians are available to assist with research projects, classroom instruction, or research strategies and with intra- and interlibrary loans.

The libraries make every attempt to ensure accessibility to their facilities and services by individuals with disabilities.

COMPUTER FACILITIES

Rutgers University Computing Services (RUCS) provides extensive centralized and decentralized computing and network services for students, faculty, and staff of all academic and administrative units of the university. In addition to the RUCS facilities, many departments and schools operate computing facilities of various types.

For instructional applications and general student use, a group of SUN computer systems collectively called "eden" is available. Any registered student can create his or her own account on these systems. These systems run the UNIX operating system and provide: electronic mail; access to the Rutgers University data communications network, RUNet; access to the Internet; applications software such as SAS and SPSS; and programming language compilers. Machine readable data files are available for census data, social science data, and other areas.

For research applications, a second group of SUN computer systems with greater capacity is available.

Public computing facilities are located on each campus. These facilities include Apple Macintosh and DOS/Windows personal computers and X-terminals. All of the workstations in the hubs are connected to RUNet. Software is available for word-processing, spreadsheets, desktop publishing, graphics, statistical analysis, and other applications.

For further information, call 732/445-2296 or write Rutgers University Computing Services, Rutgers, The State University of New Jersey, Information Center, Room 128, Hill Center for the Mathematical Sciences, Busch Campus, P.O. Box 879, Piscataway, NJ 08855-0879.

TEACHING ASSISTANT PROJECT (TAP)

The Teaching Assistant Project (TAP) is a multitiered program designed to promote excellence in undergraduate and graduate education at Rutgers-New Brunswick through the professional development of the teaching assistant staff. The four main components of this project are a pre-semester orientation, ongoing training during the semester,

discipline-specific training within each program, and written materials designed for TAs. The two major publications of TAP are the Teaching Assistant Handbook, a comprehensive introduction to the university and teaching, and TapTalk, a newsletter that focuses on topics of interest to TAs. A dedicated telephone line, the TA HelpLine, provides daily assistance to TAs who have questions about teaching. Videotaping equipment is available for TAs who wish to have a class videotaped as a means of improving teaching performance. TAP recognizes the dual role of TAs in the university and seeks to assist them in teaching on the college level while balancing their responsibilities as students engaged in graduate study. Questions about TAP should be directed to the Office of the Dean, Graduate School-New Brunswick.

HOUSING

Attractive and comfortable residence facilities for graduate students are available on all of the New Brunswick campuses.

Single graduate students may choose to reside in furnished residence halls located on the Douglass, College Avenue, and Livingston campuses or in furnished apartments available on the Cook and Busch campuses. The residence halls have shared bath and kitchen facilities. The graduate apartments (Starkey Apartments at Cook College and Buell Apartments at Busch Campus) house four students in single bedroom accommodations and offer full kitchens and bathrooms.

Graduate families are housed in efficiency and one- and two-bedroom unfurnished apartment units located on the Busch campus. These units fill rapidly and a waiting list is maintained. Early application is recommended.

Single graduate students may select housing for a full calendar year or for the academic year. For additional information, call the Division of Housing at 732/445-2215 (single graduate housing) or 732/445-3222 (graduate family housing).

OFF-CAMPUS HOUSING SERVICE

As part of Campus Information Services, the Off-Campus Housing Service is the information and referral center for off-campus renting and housing needs at the New Brunswick campus and can be reached by calling 732/932-7766, or via e-mail at <ochs@communications.rutgers.edu>. The service is located at 542 George Street, at the corner of George Street and Seminary Place on the College Avenue campus, where trained staff can offer help with just about any topic regarding off-campus housing and living. Computers are available at the office to search our rental database and receive a printout of the results. Maps, informational items, staff assistance, and a pay phone are also available. The Off-Campus Housing Service can assist students, faculty, and staff in finding information about available rentals and "for sale" properties in the area. For a modest charge, the office is able to mail or fax listing printouts to any location in the United States. The service

is available year round with hours of 8:30 A.M. to 4:30 P.M. Monday through Friday and Wednesday from 8:30 A.M. to 7:30 P.M. During off-hours, callers have the option of recording their questions and having them answered when the staff returns.

The Off-Campus Housing Service website can be accessed via the Internet at <<http://cis.rutgers.edu/rent>>. It contains a large database of available rentals, apartment complex information, landlord-tenant rights information, tips to finding housing and preventing problems, and forms for a variety of renting purposes. The Off-Campus Housing Service also conducts a Free Legal Clinic that meets weekly throughout the year. Students and staff may make appointments in person or by phone to speak to a volunteer lawyer. These attorneys specialize in landlord-tenant matters and provide free advice on any housing-related problem or question.

DINING SERVICES

The Division of Dining Services operates six major dining halls and several cash snack bars on the New Brunswick campuses. Students may purchase any one of several meal plan options ranging from five to nineteen meals per week; single meals may also be purchased at any of these locations.

A variety of commercial food establishments is located around the various campuses. The services range from typical fast food operations to fine dining restaurants. For additional information, call the Rutgers University Division of Dining Services at 732/932-8469.

STUDENT HEALTH SERVICE

The Rutgers Student Health Service provides a comprehensive set of ambulatory medical, outpatient, and health education services for all full-time students. Part-time students may become eligible by paying the student health service and insurance fee to the Office of Student Health Insurance, Hurtado Health Center, Rutgers, The State University of New Jersey, 11 Bishop Place, New Brunswick, NJ 08903.

During the fall and spring terms, three student health centers provide services for students in the New Brunswick/Piscataway area. The Busch/Livingston Health Center, located at Hospital Road and Avenue E on the Livingston campus, is open from 8:30 A.M. to 5:30 P.M., Monday through Friday. The Hurtado Health Center, located at 11 Bishop Place on the College Avenue campus, is open seven days a week when classes are in session during the academic year. (8:00 A.M. to 8:00 P.M., Monday through Friday; 9:00 A.M. through 5:00 P.M., Saturday and Sunday.) The Willets Health Center, located on Suydam Street on the Douglass campus, is open from 8:30 A.M. to 5:30 P.M., Monday through Friday. The Hurtado Health Center is the only one of these clinics that operates year-round. During the summer, it is open 8:30 A.M. to 4:30 P.M. only.

Health centers are staffed by physicians, nurse practitioners, and registered nurses. A wide range of services is provided, including general primary care, gynecology, mental health services, alcohol and substance abuse outpatient

treatment programs, health education, immunizations, allergy desensitizations, laboratory tests, physical examinations, referrals, and X-rays. Surgical and critical medical conditions are referred to the student's personal physician, the proper specialist, or an outside hospital for treatment.

The Department of Health Education, a part of the Health Service, offers a variety of programs and services on topics including alcohol and other drugs, nutrition, sexual assault, stress management, weight control, smoking cessation, AIDS, and human sexuality issues.

Pharmacies are located at each health center and are open during the following hours: Busch-Livingston Pharmacy, 9:30 A.M. to 5:00 P.M., Monday through Friday; Rutgers Pharmacy (Hurtado), 9:30 A.M. to 5:30 P.M., Monday through Friday, and 10:00 A.M. to 3:00 P.M., Saturday (no Saturday hours during summer session); Willets Pharmacy, 9:00 A.M. to 5:00 P.M., Monday through Friday.

The Rutgers Student Health Service is accredited by the Joint Commission on Accreditation of Healthcare Organizations for meeting national standards of ambulatory health care delivery.

SEXUAL ASSAULT SERVICES AND CRIME VICTIM ASSISTANCE

The Office of Sexual Assault Services and Crime Victim Assistance offers support to crime victims, survivors, and other members of the university community through advocacy, crisis intervention, short-term counseling, education, and referrals. Programs and services are available throughout the university for students, faculty, and staff to promote ways of reducing the risk of being a crime victim with a special emphasis on interpersonal violence. Educational programming on issues concerning sexual assault, dating violence, stalking, sexual harassment, and other types of interpersonal violence are an integral part of the programmatic initiatives.

For more information or to schedule an appointment or program, call 732/932-1181. The office is located at 3 Bartlett Street on the College Avenue campus.

STUDENT HEALTH INSURANCE

All full-time students, by paying the student fee, and those part-time students who elect to pay the student health service and insurance fee, are insured for up to \$3,500 in medical expenses brought about by illness or injury. This policy provides excess coverage over any other insurance plans. Students have the option to purchase a major medical policy sponsored by the university that provides more extensive coverage. Students may also purchase coverage for their spouse and children at additional cost. Any student not covered by individual or family policies should consider this more extensive coverage. Information and applications are available from the Office of Student Health Insurance, Hurtado Health Center, Rutgers, The State University of New Jersey, 11 Bishop Place, New Brunswick, NJ 08903 (732/932-8285).

Compulsory International Student Insurance Fee

All students in F or J immigration status whose visa documents are issued by Rutgers are required to have both the basic and the major medical insurance coverages. The costs for insurance are charged to such students on their term bills. All accompanying family members (spouse and children) must also be insured. Insurance coverage for spouses and children must be purchased at the Center for International Faculty and Student Services, Rutgers, The State University of New Jersey, 180 College Avenue, New Brunswick, NJ 08901 (732/932-7015).

COUNSELING SERVICES

Psychological Counseling Centers

Students with personal, educational, or interpersonal problems can receive free counseling at any of the Rutgers University counseling centers in New Brunswick: 50 College Avenue (732/932-7884), Federation Hall on the Douglass campus (732/932-9070), and Tillett Hall on the Livingston campus (732/445-4140). Counseling, short-term psychotherapy, and workshops in skills such as handling depression and anxiety or communication in intimate relationships are available on both an individual and a group basis. Marriage, relationship, and sex counseling are also available. Services are free for all students and are completely confidential.

Peer Counseling Services

There are four telephone hotlines and/or drop-in services on campus that offer supportive and anonymous listening and talk, help with crises, and a wide range of referral information. Each is staffed primarily by undergraduate students with special training. They are open mostly on Sunday and weekday evenings, and their current hours are given on answering machines at each service. The services include: Rutgers Peer Counseling, Bishop House, 732/247-5555; Women's Support and Resource Center (focused on women's issues), 732/828-7273; Gatehouse Peer Counseling Hotline, Cook-Douglass campus, 732/846-0957; and the Rutgers University Lesbian/Gay Alliance Hotline (focused on issues of interest to gays and lesbians), 732/932-7886.

Services for Students with Disabilities

Students with disabilities on the New Brunswick campus of Rutgers University are entitled to the same benefits of the university's educational mission, the same quality of student life, and are subject to the same academic and procedural requirements as other students. Committed to providing reasonable accommodations inside and outside the classroom to meet students' diverse needs, Rutgers' services include special assistance in academic advising, scheduling or rescheduling classes in barrier-free buildings, on-campus transportation for students with permanent or temporary mobility disabilities, assistive devices and equipment, learning assistance, and communication with faculty regarding students' general or specific needs. Each school in New Brunswick has a designated coordinator of services

to students with disabilities to assist students enrolled in their school. Students with disabilities may also contact the New Brunswick campus coordinator for students with disabilities at 115 College Avenue, Bishop House, Room 105 (732/932-1711) for more information. The New Brunswick campus coordinator is TDD-accessible through the Student Information and Assistance Center, located at 542 George Street (732/932-9090). The designated employee for university compliance with the Americans with Disabilities Act of 1990 is located at 3 Bartlett Street (College Avenue campus) and may be contacted at 732/932-7312.

Graduate Student Career Services

The university provides a comprehensive career service for students enrolled in graduate and professional studies throughout New Brunswick. Graduate students concerned with career issues, career decisions, preparing résumés/vitae, developing interviewing skills, and conducting a job search are encouraged to take advantage of this service. Seminars, workshops, and special programs designed to meet the needs of students with advanced degrees are offered each term. Individual counseling is available by appointment.

Career libraries at three locations house resource materials to assist in the career development and job search process. These include career planning and development books, sample résumés/vitae, current job listings, employer directories, federal and state job information, company literature, testing information, and internship, fellowship, and grant information. A credentials service is available for students and alumni who wish to compile letters of recommendation for future use in applying for employment or advanced degree programs.

The Career Services Office also sponsors an on-campus recruitment program. Through this program, three hundred to four hundred employers from business, industry, and government agencies are invited each year to come to the campus to interview qualified students.

For further information concerning career services at Rutgers, students should visit one of the career offices located at 61 Nichol Avenue on the Douglass campus (732/932-7942), 46 College Avenue on the College Avenue campus (732/932-7997), or the Busch Campus Center (732/445-6127).

STUDENT INFORMATION AND ASSISTANCE

Campus Information Services

Campus Information Services is the central information and referral center for Rutgers University and can be reached by calling 732/932-INFO or e-mail at <colhenry@communications.rutgers.edu>. Trained student information assistants offer help and answers to just about any area of campus or community life. The service is available year round with hours of 8:30 A.M. to 4:30 P.M. Monday through Friday. During off-hours, callers have the option of recording their questions and having them answered promptly when the staff returns. A TDD device for the hearing impaired is also available at 732/932-INFO.

Rutgers INFO

Campus Information Services oversees Rutgers INFO, the university's on-line information system. It can be accessed via the Internet at <http://info.rutgers.edu> and is a great resource of detailed university information including library connections; directories for people, colleges, and departments; campus maps and directions; and special sections devoted to student and faculty/staff matters.

Rutgers INFO Radio

Rutgers INFO Radio on the New Brunswick/Piscataway campus is also operated by Campus Information Services. The station operates twenty-four hours a day, and is found at dial setting 530 AM. It can be heard within a six-mile radius of the campus. Rutgers INFO Radio broadcasts timely transportation, parking, traffic, special events, and general information, and gives weather emergency updates.

SERVICES FOR INTERNATIONAL FACULTY AND STUDENTS

The Center for International Faculty and Student Services, 180 College Avenue (732/932-7015; e-mail: rucifss@email.rutgers.edu; web address <http://info.rutgers.edu/Service/International>), coordinates services for the university's international students, scholars, and faculty. The center provides direct support in the following areas: U.S. immigration regulations and procedures; liaison to campus offices, community groups, and U.S. and foreign government agencies; advice on nonimmigrant status, employment, medical care, adjustment to American life, cross-cultural differences, family concerns, financial planning, and other personal matters. In addition, the center sponsors programs of interest to the international community, including a comprehensive orientation, a community-based International Friendship Program that gives students the opportunity to get to know American families, informational and cross-cultural seminars, and a variety of support programs for students and their families.

To ensure personal contact, all international students are assigned an international student adviser at the center and are encouraged to establish and maintain a close working relationship with center staff throughout their stay at Rutgers.

Nonimmigrant students in F-1 or J-1 status must register with the center upon arrival in New Brunswick and inform the center of any change in their academic program, address, or enrollment status. All questions regarding one's status as a foreign student or exchange visitor in the United States are addressed to this office.

STUDENT ASSISTANCE

Since the personal welfare of students must be the concern of an academic community, redress of grievances for graduate students at the university is provided for through a number of informal arrangements. Depending upon the subject at issue, students matriculated in the Graduate School-New Brunswick may approach their graduate director, the Office of the Dean of the Graduate School, or their departmental representative to the Graduate Student

Association. In addition, many graduate programs have departmental student associations. Further information may be obtained from the Graduate Student Association at the student center on College Avenue or from the Office of the Graduate School.

DAY-CARE CENTERS

In New Brunswick, day care is available on the Cook, Douglass, and Livingston campuses. On the Cook campus, the Department of Nutritional Sciences runs a half-day pre-school for three- and four-year olds, which is open during the academic year only. The fee is set for the academic year with limited scholarships available based upon financial need. For information, call 732/932-8895.

On the Douglass campus, the Department of Psychology runs the Douglass Psychology Child Study Center. This center offers full-time day care for children who are two-and-a-half through five-and-a-half years of age and are toilet trained. Hours are from 7:30 A.M. to 6:00 P.M., Monday through Friday, year round. Kindergarten is offered in two and one-half hour sessions Monday through Friday within the day. The fee for care is based on the number of days. Different payment plans are available, i.e., weekly, monthly, and yearly. For information call 732/932-8881.

The Rutgers-Livingston Day-Care Center on the Livingston campus is a private, nonprofit center that offers a full-time developmental program for children two years of age through kindergarten age. Hours are 7:00 A.M. to 5:30 P.M., Monday through Friday, year round. There are two fee rates: 1) set rate tuition and 2) reduced rate tuition based on family size and income. For an application form and information, call 732/445-8881.

All the day-care services are heavily used and there is frequently a waiting list. Students should contact the centers early.

RUTGERS UNIVERSITY POLICE DEPARTMENT

The Rutgers University Police Department (RUPD) is dedicated to the protection of life and property on campus and to the prevention and detection of crime. The department operates from its headquarters at 5 Huntington Street on the College Avenue campus. Police officers patrol the campuses on foot, in vehicles, on bicycles, and on horseback. They enforce laws and university regulations, respond to emergencies, investigate criminal activities, provide security for campus facilities and events, and provide crime prevention and other services. Security guards also patrol the campuses, serving as "eyes and ears" for the police as well as securing facilities, providing escort services, and operating security shuttle buses.

To contact RUPD to report emergencies (police, fire, or emergency medical), dial 911. From university centrex telephones, dial 6-911. For nonemergency telephone calls to the police, dial 932-7211; from university centrex telephones, dial 2-7211. You can also contact the police by using one of the more than fifty blue emergency telephone boxes on the campuses or by using the housing telephones located near dormitory entrances.

The Rutgers University Police Department's efforts help create a safer environment, but the department cannot guarantee the safety and security of individuals and their property. Individuals can reduce their vulnerability to crime by practicing common sense preventive measures such as the following:

1. Avoid isolation.
2. Maintain awareness of the persons and circumstances around you.
3. Keep doors and windows locked and do not allow strangers into your residence building.
4. Do not leave property unattended or unprotected.
5. Avoid the use of alcohol or other drugs and persons who are intoxicated.

All members of the university community are urged to immediately report any suspicious persons or activities to the university police. A cooperative effort between the police and the community can make the campuses safer places to work and learn.

TRANSPORTATION AND PARKING

Parking facilities are available for resident and commuter students on each campus. Resident students' vehicles are assigned to their residence lots only. Commuter students are assigned to a parking zone on a particular campus only. Maps indicating resident and commuter student lots are included in the Parking and Transportation Services brochure, available at the Department of University Parking and Transportation Services, 26 Mine Street, College Avenue campus. Any vehicles using campus parking facilities must be registered and must display a valid permit at all times. Fees for students holding assistantships and fellowships vary according to their classification.

An intercampus bus transportation service, partially funded by student fees, is available to all Rutgers students, faculty, and staff. This bus service provides transportation within walking distance of all major campus areas and the major public transportation centers in New Brunswick. Schedules for the campus bus service are published each fall and are available at the information booths in the college centers on each campus and at the parking and transportation office, 26 Mine Street, College Avenue campus.

Van transport is available for students with permanent disabilities who are unable to use the campus bus to get to and from class. Requests for this service should be made through the dean's office.

For additional information, call 732/932-7744.

GRADUATE STUDENT ASSOCIATION

The Graduate Student Association (GSA) is the main clearinghouse for information for graduate student affairs on campus and is entirely student governed. It sponsors a variety of social and cultural activities for graduate students and represents their interests to the university and the agencies of the state through its legislative body. The GSA provides free legal advice, and it sponsors academic events, graduate publications, Internet publishing projects, films, and community action programs.

Every graduate student, full-time or part-time, in any of the six New Brunswick graduate and professional schools, automatically becomes a member of the GSA. A president, vice-president, treasurer, and secretary are elected at large. The GSA's main legislative body is its Council, which meets once a month. Every graduate program and department may elect one representative for every 40 students enrolled; schools not organized into departments elect their representatives at large, one for every 40 students enrolled. (Departments with less than 40 students are also allowed one elected representative.) If you are interested in being a department representative, check with your departmental organization or the GSA office. The GSA offices are located in the Graduate Student Lounge (GSL) in the Rutgers Student Center on College Avenue in New Brunswick and may be contacted at 732/932-7995 (GSA) or 7994 (GSL).

Graduate student lounges, located in the Rutgers Student Center, Busch Campus Center, and Douglass College Center, are primarily for the use of graduate students and for the functions sponsored by and for graduate students. These provide a comfortable atmosphere for socializing, lounging, and studying.

PAUL ROBESON CULTURAL CENTER

The Paul Robeson Cultural Center, established in 1969, serves to document, preserve, and present the contributions of African peoples to world civilizations, with particular reference to the artistic, scientific, social, and political contributions of people of color in the Americas and New Jersey. The center provides leadership, vision, and support for the more than 4,730 African-American students of Rutgers through cultural programs and educational opportunities that broaden their understanding and appreciation of the American diaspora. Further, the center works closely with the tiers of communities served by Rutgers University in local, state, national, and international spheres.

The center is open Monday through Friday 8:30 A.M. to midnight; Saturday noon to 8:00 P.M.; and Sunday 1:00 P.M. to 9:00 P.M. The center is located on Bartholomew Road, Busch campus, adjacent to the Busch Campus Center. For more information, call 732/445-3545.

CENTER FOR LATINO ARTS AND CULTURE

Opened in April 1992, the center's primary mission is to research, promote, document, and interpret Latino culture. The center identifies scholars, artists, and experts who help develop interdisciplinary programs that define and examine Latino culture, history, literature, and the arts. These programs, as well as special projects, are designed to foster academic excellence and advance the appreciation, growth, and well-being of the Latino cultural community.

The center builds a broader understanding of Latinos and their culture through conferences, exhibitions, lectures, theater productions, symposia, workshops, artists' forums, concerts, academic seminars, publications, and collaborative projects with community organizations outside the university.

Also housed at the center is the office of the Latino Student Council (LSC), which is made up of representatives of all Latino student organizations from the New Brunswick

campuses. Located at 122 College Avenue, the center is open weekdays from 9:00 A.M. to 5:00 P.M. For special events, the center is also open on weeknights and weekends. Please call 732/932-1263, 1494 for further information.

OFFICE OF DIVERSE COMMUNITY AFFAIRS AND LESBIAN-GAY CONCERNS

The Office of Diverse Community Affairs and Lesbian-Gay Concerns, established in the spring of 1992 as a resource for the campus community, provides coordination, assistance, information, educational activities, and public programs to staff, faculty, and students in the areas of lesbian-gay-bisexual-transgender awareness, the concerns of students with disabilities, and bias awareness, prevention, and intervention.

Undergraduate and graduate students interested in becoming involved in lesbian-gay-bisexual-transgender issues and programs, students with disabilities who wish to identify resources, and students who have experienced, witnessed, or are concerned about bias and intolerance on the basis of race, ethnicity, language, color, national origin, religion, sexual orientation, gender, and/or physical ability may contact the director of the office at 115 College Avenue, Bishop House, Room 105, College Avenue campus (732/932-1711) for assistance, advisement, counseling, and referral. Faculty, staff, and student groups who wish to obtain technical assistance, staff development, or in-service training in these areas may also contact the director.

The office is TDD-accessible by calling 732/932-8670.

ACTIVITIES

Athletic Facilities

The athletic facilities at Rutgers include several gymnasiums, swimming pools, tennis courts, and baseball fields, and an eighteen-hole golf course. A fee is charged for the use of the golf course; graduate students are otherwise entitled to make use of these facilities without charge. Several of the athletic clubs in the undergraduate colleges—bowling, judo, lacrosse, rugby, skiing, and others—are also open to graduate students.

Athletic Ticket Policies

Tickets to intercollegiate football and basketball games are available at a special rate. All ticket information is available at the ticket office located in the Louis Brown Athletic Center.

Concerts, Dramatic Productions, and Lectures

Several series of concerts by world-famous musicians, bands, dancers, and musical organizations are presented on campus each year by the Office of University Arts Services, the departments of music and dance of the Mason Gross School of the Arts (MGSA), the New Brunswick Programming Committee, the student center programming boards, and the concert organizations of the different campuses. Many events are free.

The Department of Theater Arts of the Mason Gross School of the Arts presents fifteen to eighteen productions a year at the Philip J. Levin Theater, the Jameson and Levin Studio Theaters, and the New Theater. The Cabaret Theater Society and the College Avenue Players are student organizations that provide students who are not in the professional MGSA program with the opportunity to express their theatrical talents and to broaden their acting experience.

Numerous lectures are presented regularly by academic departments, lecture series groups, and other organizations. Several concert series, movie series, and numerous lectures are sponsored at the university throughout the year.

ALUMNI

Alumni Relations

The university seeks the support of its alumni and, in return, offers them a number of services and programs. The responsibility for working with the university's entire alumni body, now numbering over 270,000, is vested in the Department of Alumni Relations. The department has two main objectives. First, it maintains contact with Rutgers alumni, informing them of the university's programs with the hope that they will assist Rutgers in fulfilling its educational goals. Second, the department encourages alumni to continue their college friendships after graduation through social, educational, and reunion activities.

All undergraduate colleges and most graduate and professional schools have their own alumni associations that sponsor programs based on the interests of the alumni of that college. Active membership is maintained through payment of regular alumni dues. Each alumni association is represented in the Rutgers University Alumni Federation, which sponsors university-wide programs such as homecoming, distinguished alumni awards, legislative receptions, group travel, and insurance. The Department of Alumni Relations provides guidance and administrative services to each of the college associations, as well as to a network of regional alumni clubs throughout the country.

The university publishes an award-winning magazine for alumni and friends of the university.

The department's New Brunswick office is located at Winants Hall, Rutgers, The State University of New Jersey, 7 College Avenue, New Brunswick, NJ 08901-1262 (732/932-7061).

Rutgers University Foundation

The Rutgers University Foundation was incorporated in 1973 as a semiautonomous division of the university responsible for soliciting funds from private sources.

With a full professional staff and a national network of volunteers who sit on advisory committees and assist in the solicitation of funds, the foundation has steadily—indeed, dramatically—increased the amount of annual private support for Rutgers, private support that provides funding for more than 1,500 university programs that encompass every division of the university and every campus.

In the process of developing new ways to finance programs at Rutgers from nonpublic sources, the foundation has garnered national recognition and awards for its fundraising and communications. The professional staff includes experts in corporate and foundation relations, an area that accounts for more than half of the private monies received by the university. It also includes specialists in deferred and

planned giving, in fund-raising for athletics, in soliciting annual gifts, in obtaining major and special gifts, and in managing campaigns to fund capital needs. The foundation manages one of the largest volunteer phonothons in the nation: more than 1,800 callers, many of whom are students, parents, and faculty members who volunteer their time to solicit funds for their schools and organizations.

In 1984, the foundation undertook the most ambitious fund-raising endeavor in the university's history, the \$125 million Campaign for Rutgers. Using advanced fund-raising methods to identify new philanthropic sources for Rutgers, the foundation structured the campaign to raise funds for areas that have direct bearing on the quality of education and research at the university. Campaign funds were earmarked to support distinguished professorships, to underwrite new program development and departmental research, to allow for renovation of campus facilities, to endow scholarships and fellowships, and to establish a pool of "opportunity resources" for all university divisions. In 1990, the campaign concluded 34 percent over goal and in the process increased annual contributions to the university from \$9 million to \$27 million.

Since the conclusion of the Campaign for Rutgers, annual contributions have continued to rise, and the foundation has undertaken several successful multimillion-dollar "special purpose" campaigns: the 75th Anniversary Fund for Douglass College, the 25th Anniversary Campaign for the Jane Voorhees Zimmerli Art Museum, the Campaign for Undergraduate Biological Sciences, The Campaign for Rutgers Stadium and Women's Athletic Scholarships, the Alexander Library Campaign, and the university-wide Campaign for Community, Diversity, and Educational Excellence.

Further information about the foundation may be obtained from the Rutgers University Foundation, Winants Hall, Rutgers, The State University of New Jersey, 7 College Avenue, New Brunswick, NJ 08901-1261 (732/932-7777).

Academic Policies and Procedures

STUDENT RESPONSIBILITY TO KEEP INFORMED

This catalog provides a compendium of the rules governing graduate work at the university, and students are therefore advised to keep their copy as a reference handbook. The principal rules are contained in this chapter and the chapter on Degree Requirements, and students are expected to familiarize themselves with them. The academic and other regulations established by the faculty and administration of the Graduate School–New Brunswick and the Board of Governors of the university are subject to amendment at any time; any significant changes made after the publication of the catalog will be circulated to registered students by the Graduate School–New Brunswick. Exceptions to the rules can be made only through the dean's office.

In general, students should address their questions to their graduate program director. Questions related to general graduate student rules under the jurisdiction of the Graduate School–New Brunswick may also be directed to the Office of the Dean, Rutgers, The State University of New Jersey, 25 Bishop Place, New Brunswick, NJ 08901 (732/932-7034).

Graduate Student Mailing Address

Official communications among faculty, students, and staff in the Graduate School–New Brunswick are delivered via campus mail to the mailboxes available to each faculty member and student. In certain circumstances, however, official communications are mailed to the student's home address via U.S. mail. It is the student's responsibility to keep the registrar informed of a current mailing address. New students should consult with their graduate director about the most appropriate location for their first mailbox assignment. When other addresses are not significantly more convenient, students ordinarily assign themselves mailboxes at the offices of their graduate directors.

REGISTRATION AND COURSE INFORMATION

A prepared registration form for each newly admitted student is sent or made available to the student before the start of the fall and spring terms. Advising arrangements vary according to the needs of particular graduate offices, but the official registration and billing forms should be received by the student well before the first day of class. It is the responsibility of the student to remain in communication with the Office of the Graduate Director. The forms must be submitted by the student to the Office of the Graduate Registrar and must be received at that location by the announced deadlines. Overdue forms may require subsequent correspondence, entail additional fees, and necessitate reregistration. Forms

may be returned by mail, but allowances of up to ten days have to be made for campus mail delivery, and it is more prudent to deliver them by hand. Additions or changes of courses are routinely permitted during the first week of classes.

Registration in subsequent terms is made through the touchtone telephone registration system.

Once enrolled, students register early for subsequent terms. Registration instructions are distributed at that time. Changes of registration may be made at indicated times after early registration. In all other respects, the provisions of the above paragraph hold.

A student admitted into a degree program of the Graduate School–New Brunswick is expected to remain registered in every fall and spring term thereafter until completing the program and earning the degree. Normally a student registers for courses or research, and, if necessary, may register for matriculation continued (leave of absence), but a student who fails to maintain continuous registration may not resume formal graduate study or register again in the Graduate School–New Brunswick without first applying through the Office of the Graduate School for readmission. Master’s degree students and doctoral students not yet admitted to candidacy may apply for readmission after one or two terms during which they were not registered. After two terms, they must file a new application with the Office of Graduate and Professional Admissions.

Students who have been admitted to candidacy for the Ph.D. degree must apply for restoration of active status and pay a restoral fee. There is no time limit for readmission of such students.

Matriculation Continued

Students who are obliged to interrupt their studies, or for whom no other registration is appropriate for a given term, may, with the approval of their graduate director, register for matriculation continued for a maximum of two consecutive terms. For example, students in many humanities and social sciences fields who have completed their formal course work and are preparing for examinations but are appropriately not registered for research would register for matriculation continued. There is no tuition fee for this registration, although a student fee is charged. This category of registration is not available to post-qualifying doctoral students, who are expected to register for research in their fields until they have completed their degrees. Those students who are away from campus but working on their theses or dissertations and in contact with their committees are required to register for a minimum of 1 credit of research per term. Doctoral degree students who are on campus and engaged in research must register for a minimum of 3 credits per term. Master’s degree students who are on campus and engaged in research must register for a minimum of 1 credit per term.

Summer Registration

The requirement of the Graduate School–New Brunswick that its students remain in continuous registration from the time they are admitted until their degrees are earned applies only to the regular academic year (spring and fall terms), not the summer sessions.

Summer Session registration forms and instructions are sent to each student with the fall term registration instructions. Summer Session catalogs are available at the Summer Session Office, 191 College Avenue, or at the Registrar’s Office.

Change of Registration and Withdrawal

After the second week of classes, the only routinely permissible changes of registration are withdrawals from individual courses or withdrawal from all courses, both of which are allowed without academic penalty until the end of the seventh week, and either of which may be accomplished by means of a form that is available from the Office of the Graduate Registrar and the Office of the Graduate School. The date on which the graduate registrar receives notice of withdrawal from the student governs the academic and financial consequences of the withdrawal. Students withdrawing from a course after the seventh week need the approval of the dean’s office, are required to provide a letter indicating academic status in the course from the course instructor, and are subject to receiving failing grades at the discretion of the instructor. A student who stops attending a course without notifying the registrar will receive a grade of F in that course. No refunds of tuition are given in the case of individual course withdrawals after the second week of classes, although a student who withdraws from all courses may receive a partial refund according to the rules described in the section on refunds in the Tuition and Fees chapter. Withdrawal of any sort is not permitted during the last two weeks of classes.

Transfer of Credit

Credit for graduate courses taken at other institutions may not be transferred until 12 credits of graduate courses with grades of B or better have been completed in the Graduate School–New Brunswick as a matriculated student. Transfer of credit is allowed only for formal graduate-level course work specifically related to the student’s program of study and in which grades of B or better were received. No credit may be transferred for thesis research work, course work done as independent study, or work in courses that were not graded. P or S grades are eligible for transfer if equivalent to a grade of B or better and accompanied by a letter of equivalency from the instructor of the course.

Special permission is required to transfer credit for courses taken more than six years prior to the application for transfer of credit.

No more than the equivalent of one year of course work may normally be transferred toward the Ph.D. (i.e., 24 credits); No more than 40 percent of the credits required for a master’s degree may be transferred from another institution.

Quarter credits will be converted to term credits by reducing the total by one-third.

For transfer of graduate courses taken as an undergraduate student, a letter is required from the registrar of the institution involved stating that the course(s) was (were) not used toward an undergraduate degree. Applications for transfer of credit are available at the Office of the Graduate School.

Intercollege Registration

A student in the Graduate School–New Brunswick may apply to take a course offered by another division of the university by enrolling via the Touchtone Registration System or in person at the registrar’s office. Other approvals may be required. Consult the Schedule of Classes. Students registering for courses in the University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical

School, in the New Brunswick Theological Seminary, or at Princeton University will also need to complete appropriate forms for that purpose available from the Office of the Graduate Registrar.

Multiple School Registration

A student may not simultaneously be registered in two or more units of the university. Students wishing to take courses in more than one unit in the same term (or wishing to take courses in units in which they are not enrolled) may accomplish this through intercollegiate registration.

When, through multiple applications, a student is offered admission to more than one unit of the university, the student may register in only one. When a student has been admitted to a graduate and undergraduate unit, the registration will be in the graduate unit.

This policy is in no way intended to abridge a student's freedom to pursue two degrees in two units simultaneously. Such students must make special arrangements to keep both units informed of their academic progress since they will be registered in only one unit.

Rutgers-Princeton Cooperative Exchange Program

Rutgers and Princeton universities have been engaged in an exchange program since 1964. The program is informal in that admission to and registration at the host institution are not required. No funds are exchanged between the two institutions; the student pays tuition only at the home institution. The policies and procedures related to this program are that (1) participants must be matriculating, (2) exchange is limited to one or two graduate courses per term per student, and (3) the course must be part of the student's degree program and unavailable at the home institution. To participate, a Rutgers student must register for 16:001:816 Princeton Exchange (BA) (normally 3 credits) and have the forms (obtained from the Rutgers graduate registrar) signed by his or her adviser, dean, and Princeton course instructor. The form is then submitted to the dean of the Graduate School, Princeton University. Princeton grades are assigned and are recorded on the student's record via the above form.

New Brunswick Theological Seminary and UMDNJ-RWJMS Exchanges

Cross registrations are available in these two schools. Forms are available at the Office of the Graduate Registrar.

Courses Taken "Not-for-Credit"

Students who wish to enroll in a graduate or a 100- through 400-level undergraduate course and perform all the assigned work without receiving credit may do so if they secure the advance approval of their advisers. When they register they must indicate "not-for-credit" status by entering the symbol N. They must pay the normal graduate tuition fee for the course and fulfill the same requirements during the term, including the execution of any written assignments, as all other students. At the end of the term, however, they do not take the final examination, and they are assigned a grade of S (satisfactory) or U (unsatisfactory). The course and the letter grade are included on the student's record, but no credit toward a degree is given. See Grades and Records in this chapter for information regarding credit prefixes.

Auditing Courses without Registration

Upon obtaining the permission of the instructor of the course and subject to the availability of space, full-time students of the school may audit courses without registration. It is understood that no academic credit is earned in this manner. No official record of audited courses is kept.

Graduate Enrollment in Undergraduate Courses

Any course numbered 500 or above is designed for graduate students and normally carries credit toward one of the graduate degrees. Certain advanced undergraduate courses numbered in the 300s and 400s may also be approved for a given graduate student, either as a regular part of his or her graduate program or as a means of remedying a deficiency in preparation. When a graduate student is permitted to enroll in a course numbered below 500, the credit prefix G, N, or E may appear on the registration and record forms. See Grades and Records later in this chapter for rules related to credit prefixes. No more than 12 credits of courses numbered between 300 and 499 may be offered in fulfilling the requirements for advanced degrees. (There are exceptions to this policy in the M.A.T. or M.S.T. programs.) Students registering in undergraduate courses are subject to the policies of the undergraduate division offering the course.

Undergraduate Enrollment in Graduate Courses

Qualified undergraduate students in the university who wish to study in courses offered by the graduate faculty should understand that they are welcome to do so if they receive the written approval of the instructor offering the course and of the Graduate School-New Brunswick. Students should have senior standing and a cumulative grade-point average of at least 3.0. Forms are available in deans' offices for this purpose.

Minimum and Maximum Programs

The unit of credit used in Rutgers registration is based in part upon a measure of time, with one credit equal to one class hour a week through a fifteen-week term; for a 3-credit course, a qualified and competent student should require, on average, nine hours a week (in and out of classroom or lab) to carry out the work expected. One credit of laboratory requires three class hours of work per week. A full-time program consists of 12 credits a term. The maximum program is normally 15 credits, although under some circumstances registration to a limit of 18 credits (time-and-a-half) is permitted with approval of the dean. All graduate fellows must register for at least 12 credits (a full-time program). All graduate and teaching assistants holding the normal half-time (one-third line) appointments are obliged to pursue at least 6 credits (half time) of academic courses or research during the fall and spring terms of their assistantship appointments. Fellows and assistants must also register their appointments according to directions provided by the registrar at the time of registration and submit form RT100 to the Office of Student Accounts.

Students engaged in part-time employment outside the university averaging sixteen or more hours per week may not register for more than 9 credits per term, and students employed thirty or more hours per week may not register for more than 6 credits per term.

In interpreting conflicts about program limits, the general rule followed by the dean's office is to regard thirty-five to forty hours a week as a full-time commitment, whether in a nonuniversity job or a full-time student's program of study, with the understanding that the enthusiastic participant is apt to devote well above this amount of time, and that formal commitments of time become more difficult to credit as they approach the upward limit of time-and-a-half.

Full- and Part-Time Students

For most purposes, a full-time student is defined as one who is registered for 12 or more credits; one who registers for 11 or fewer credits is a part-time student. Graduate and teaching assistants who hold half-time (one-third line) academic appointments register their assistantships for 6 credits (for which no tuition fee is to be paid). These 6 credits, together with the required minimum program of 6 credits of courses or research qualify them as full-time students in the Graduate School–New Brunswick. All courses, including both courses of research, and regular courses undertaken “not for credit” (E and N prefixes), are counted in measuring the student's recordable program of work. These regulations govern tuition charges, student fees, statistical records, residence requirements, and other issues affected by definitions of full-time and part-time status.

Change of Program

A change of field within the Graduate School–New Brunswick requires the approval of the new graduate director and the Graduate School–New Brunswick, and is not complete until notice of the approval change has been received from the Office of the Graduate School.

Change of Status

Students desiring a change of status, e.g., from nonmatriculated to matriculated or from master's to doctorate, within a graduate program should file the appropriate form with the Office of the Graduate School.

Any student who has earned a terminal degree in the Graduate School–New Brunswick and who desires to continue as a nonmatriculated student should apply for a “change of status.” In this case, application must be made without any lapse in registration to avoid the need to also apply for readmission. After an interrupted registration of two terms, the prospective student must submit a new application for admission to the Office of Graduate and Professional Admissions. Foreign students must notify the Center for International Faculty and Student Services of a change in status.

Readmission or Restoration of Active Status

Students who have interrupted their graduate registration without receiving a degree in the program for which they were enrolled must apply for readmission. Appropriate forms are available from the Office of the Graduate School. Doctoral students who have passed their qualifying examination are subject to a restoral fee of one credit of tuition at the current resident rate for each term missed (up to five terms). Students who have completed a Master of Philosophy degree at the university and have let their registration lapse are not subject to restoral fee payments for a period up to four years.

All students, except candidates for the doctoral degree, who have interrupted their graduate registration must request readmission within two terms following their last registration. After this, the prospective student must submit a new application for admission to the Office of Graduate and Professional Admissions. (Applicants may request that previously submitted records be used.) The letters of recommendation should originate from faculty members at Rutgers with whom the student previously studied. In all other respects, including payment of the application fee and submission of official transcripts of all previous academic work, the application procedure is identical with that of the first application for admission.

CLASS SCHEDULES AND HOURS

Starting and closing dates for each term, scheduled holidays, and other important scheduling information can be found in the academic calendar. All class periods are 160 minutes in length, meeting once a week, unless otherwise specified. There will be fifteen weeks of instructional activity for each course.

Attendance

Each instructor is required to maintain an accurate record of attendance of each class or section of which he or she is in charge. Students are expected to be present at each meeting of their classes. Exceptions to this rule may be made in the case of illness and in such other circumstances as seem justified to the instructor.

University examinations shall not be scheduled on Saturdays except in those courses that regularly meet on Saturday.

Absence Due to Religious Observance

It is the policy of the university to excuse without penalty students who are absent because of religious observances and to allow the make up of work missed because of such absence. Examinations and special, required, out-of-class activities will ordinarily not be scheduled on those days when such students refrain from participating in secular activities. Absences for reasons of religious obligation will not be counted for purposes of reporting. A student absent from an examination because of required religious observance will be given an opportunity to make up the examination without penalty.

Cancellation of Classes

It is the general policy of the university not to cancel classes because of inclement weather. However, because of the occasional hazards of night driving in winter, exceptions may be made for evening classes and, under exceptionally hazardous conditions, exceptions may be made for day-time classes.

During severe weather conditions, announcements are made over the following radio stations concerning the cancellation of classes: WCTC, WMGQ, WRSU, WCBS, WINS, WHWH, WPST, WJLK, WMTR, WDHA, WRNJ, WERA, WBUD, WXKW, and WZVU.

Arrangements for makeup work are announced by individual instructors.

In addition, class cancellation and office closing information is available on the recorded message system at 732/932-7799 for the New Brunswick campuses and at 973/353-1766 for the Newark campus.

GRADES AND RECORDS

In the Graduate School–New Brunswick, outstanding work is graded A and good work is graded B. Some programs require students to achieve grades of A in at least half their courses if they are to be accepted as serious candidates for the doctorate. The grade of C is for satisfactory work. The B+ and C+ grades are intermediate grades. The graduate faculty accepts for graduate credit only a limited number of courses in which a student earns a grade of C+ or C; see the paragraphs on academic standing in the Degree Requirements chapter. A grade of F is assigned both to students who fail to earn credit in a course they complete and to students who do not complete a course from which they have not officially withdrawn. The Graduate School–New Brunswick does not assign the grades of D or D+ in its courses.

In addition, the Graduate School–New Brunswick uses the following grade symbols:

S/U—Satisfactory/Unsatisfactory. For 700-level courses of research carrying credit or in regular courses taken “not-for-credit” (N prefix). Also for certain designated laboratory rotation and studio courses taken for credit.

Pass/No Credit. For certain specifically designated courses; applies to all students enrolled in those courses.

W—(Withdrawal). Officially withdrew.

IN—(Incomplete). May be assigned at the discretion of an instructor who believes that an extension of time is warranted for a student whose work is incomplete at the end of the term. Incomplete work may be made up, and a change of grade may be authorized by the instructor, within any period agreed to by the instructor and the student up to two additional terms beyond the original course registration, excluding summer session. Incompletes generated in a summer session must be completed by the end of the following summer session. Programs may establish shorter time limits. Students with two or more incompletes are not permitted to register for additional courses after one term until incompletes are completed.

Credit Prefixes

The number of credits appearing on course records and registration cards may be preceded by a letter prefix as follows:

E. Course excluded from credit toward a degree; all course requirements must be completed and a regular grade is assigned.

G. A 300- or 400-level undergraduate course for which credit toward the graduate degree sought has been approved.

N. Course taken “not-for-credit,” the final examination is not required, final grade of S (satisfactory) or U (unsatisfactory) is assigned.

Graduate students registering for undergraduate courses are subject to the rules concerning credit prefixes of the undergraduate division offering the course.

Transcripts

Requests for official transcripts should be addressed to the Office of the Registrar, Department of Records, Rutgers, The State University of New Jersey, P.O. Box 1360, Piscataway, NJ 08855-1360. The request should indicate that the student

was enrolled in the Graduate School–New Brunswick, identify the dates of attendance, and give any other relevant information. It must be received at least ten working days prior to the date the transcript is desired. Forms for making the request may be obtained from the recorder. A fee of \$3 for each copy desired, payable to Rutgers, The State University of New Jersey, must accompany the request.

Student Identification Cards

Student identification cards are sent by campus mail to the student’s graduate program office on or about November 1 for fall admissions and March 1 for spring admissions. Thereafter, continuing students are sent a revalidating sticker for these cards on or about October 15 during each fall term. Students should contact the registrar, Room 200L, Administrative Services Building, Busch Campus, to replace missing or lost I.D. cards. The replacement fee is \$5.

ACADEMIC STANDING

Student Review

Each program is expected to have established procedures for monitoring on an annual basis the progress of all students registered in the program. Each doctoral program has a formal program-wide procedure whereby students who have completed the equivalent of approximately one year of full-time study are reviewed for the purpose of deciding whether or not they may be permitted to continue toward the doctorate. This procedure may be linked to the master’s degree or to the qualifying examination or may be independent of either, but it may in no case be postponed beyond the equivalent of one and one-half years of full-time study toward the degree. In connection with this procedure, faculty in a position to comment on the student’s performance and progress are asked to do so by the graduate director or a designate; review shall not be limited by the student’s choice of faculty from whom to solicit recommendations.

Termination of Studies

Students may be required to terminate their graduate studies and withdraw from the Graduate School–New Brunswick if they fail to maintain satisfactory academic or professional standards in any phase of their graduate program. Conditions imposed at the time of admission must be satisfied by each student. Nonadherence to the schedule of Time Limits for Degrees may constitute a basis for termination. See the Degree Requirements chapter.

When such problems occur, the program notifies the student in writing of the program’s concern about the student’s performance. Such a warning specifies the source of the concern, the applicable program or graduate school rules, and the proposed action. Warnings specify when and on what basis a recommendation for academic dismissal will be considered by the faculty. A probationary period of one term is normal.

Following the probationary period, a student who fails to meet the provisions of the warning is considered by the faculty for dismissal. A faculty vote is recorded on any motion to recommend dismissal, and a letter is written to the student stating the faculty action and its rationale.

When termination is recommended, the graduate program director communicates to the dean of the Graduate School–New Brunswick in writing the specific reasons involved, all warnings communicated to the student, the faculty procedures and actions leading to the recommendation, the recorded faculty vote for dismissal, and the mailing address of the student. The dean of the Graduate School–New Brunswick will write the actual letter of termination to the student. The student’s transcript will subsequently bear the notation, “Academic Dismissal.”

Due Process

Students are entitled to fairness in the procedures by which their academic performance is assessed. Each program has a statement of the procedures by which student academic progress is monitored and by which comprehensive, qualifying, and final examinations are conducted and graded. Each also has a procedure for academic appeals. The Graduate School–New Brunswick provides a further opportunity for appeal for students who wish to proceed beyond the program level (see below).

All students in the Graduate School–New Brunswick are entitled to expect that regularly scheduled examinations will be graded and grades announced within two weeks of completion of said examinations by the student. In the event that a student fails a comprehensive, qualifying, or final (defense) examination, he or she is entitled to an explanation of the reasons for the negative decision.

Student Academic Appeals

Student academic appeals are, where possible, handled within the structure of the graduate degree program. The student should take the issue to the director of the graduate program or a designate for review and mediation. The director, or a designate, consults with all parties and proposes a resolution. If this is unsuccessful, the matter is referred to a faculty committee, as designated in the bylaws of the program. The committee may consult with whomsoever it chooses in arriving at a recommendation in the matter and may, in extraordinary cases, ask third parties from among the faculty to review previous decisions by the faculty involved.

While action within the faculty normally is final, a student may appeal to the Graduate School–New Brunswick in cases where he or she feels that the process by which the program reached its decision was unfair. The case shall be reviewed by a representative of the dean of the Graduate School–New Brunswick, who attempts to informally resolve the dispute. Should the issue remain unresolved, the student is notified in writing that he or she may request that the dispute be brought to the Appeals Committee. Such a request must be made within thirty days of notification. The Appeals Committee is composed of four members of the elected Committee on Rules of Procedure named by the dean at the beginning of each academic year to serve in this capacity.

The function of this committee is to hear appeals that have not been resolved by the Office of the Graduate School. The student must make his or her case in writing. A written response to the student’s statement will be solicited from the director of the degree program whose action is being appealed. The committee normally bases its judgment on written submissions only. Should the committee deem it necessary, it may call upon the student and/or a faculty member or members for written or oral responses to questions raised by the committee.

The student may request an appearance before the committee. The members of the committee may grant it if it appears to them that unusual circumstances warrant it. They may limit the amount of time granted, which normally will not exceed thirty minutes. The committee reports its recommendations to the dean of the Graduate School–New Brunswick, whose decision is final.

Student Complaints about Grades

Students wishing to file a complaint about a course grade or a grade received for a particular piece of work in a course should first attempt to resolve the matter through discussion with the instructor. If the issue cannot be satisfactorily resolved between student and instructor, the student may specify in writing the basis for the complaint and request a review by the director of the graduate program offering the course. A written complaint about a grade for work completed while the course is in progress must be submitted to the program director no later than two weeks after notification of the grade. A student must submit a written complaint about a final course grade with the program director no later than four weeks after the postmarked date of the official notification of grades.

A student who wishes to appeal the decision of the graduate program must appeal in writing to the office of the dean. Written notification of the action taken by either the graduate director or the dean is sent to the student within four weeks of the filing of the appeal, excluding those weeks in which classes are not in regular session.

Holds

The privileges of registration, advance registration, receipt of a diploma at commencement, and receipt of transcripts of record are barred to students having outstanding obligations to the university. Obligations may take the form of unpaid monies, unreturned or damaged books and equipment, parking fines, other charges for which a student may become legally indebted to the university, and failure to comply with disciplinary sanctions or administrative actions.

University departments and offices may place “holds” on registration, diplomas, and transcripts for any students having an outstanding obligation.

POLICY ON ACADEMIC INTEGRITY SUMMARY

“Academic freedom is a fundamental right in any institution of higher learning. Honesty and integrity are necessary preconditions to this freedom. Academic integrity requires that all academic work be wholly the product of an identified individual or individuals. Joint efforts are legitimate only when the assistance of others is explicitly acknowledged. Ethical conduct is the obligation of every member of the university community and breaches of academic integrity constitute serious offenses” (Academic Integrity Policy, p. 1).

The principles of academic integrity entail simple standards of honesty and truth. Each member of the university has a responsibility to uphold the standards of the community and to take action when others violate them.

Faculty members have an obligation to educate students to the standards of academic integrity and to report violations of these standards to the appropriate deans.

Students are responsible for knowing what the standards are and for adhering to them. Students should also bring any violations of which they are aware to the attention of their instructors.

Violations of Academic Integrity

Any involvement with cheating, the fabrication or invention of information used in an academic exercise, plagiarism, facilitating academic dishonesty, or denying others access to information or material may result in disciplinary action being taken at either the college or university level. Breaches of academic integrity can result in serious consequences ranging from reprimand to expulsion.

Violations of academic integrity are classified into four categories based on the level of seriousness of the behaviors. Brief descriptions are provided below. This is a general description and is not to be considered as all-inclusive.

Level One Violations

These violations may occur because of ignorance or inexperience on the part of the person(s) committing the violation and ordinarily involve a very minor portion of the course work.

Examples: Improper footnoting or unauthorized assistance on academic work.

Recommended Sanctions: Makeup assignment at more difficult level, or assignment of no-credit for work in question, or required attendance at a workshop on ethics.

Level Two Violations

Level two violations involve incidents of a more serious nature and affect a more significant aspect or portion of the course.

Examples: Quoting directly or paraphrasing without proper acknowledgment on a moderate portion of the assignment, failure to acknowledge all sources of information and contributors who helped with an assignment, submission of the same work for more than one course without permission from the instructor.

Recommended Sanctions: Probation, a failing grade on the assignment, or a failing grade in the course.

Level Three Violations

Level three offenses involve dishonesty on a significant portion of course work, such as a major paper, hourly, or final examination. Violations that are premeditated or involve repeat offenses of level one or level two are considered level three violations.

Examples: Copying from or giving others assistance on an hourly or final examination, plagiarizing major portions of an assignment, using forbidden material on an hourly or final, using a purchased term paper, presenting the work of another as one's own, altering a graded examination for the purposes of regrading.

Recommended Sanctions: Suspension from the university for one or more terms with a notation of "academic disciplinary suspension" placed on a student's transcript for the period of suspension.

Level Four Violations

Level four violations are the most serious breaches of academic integrity. They include repeat offenses of level three violations.

Examples: Forgery of grade change forms, theft of examinations, having a substitute take an examination, dishonesty relating to senior thesis, master's thesis, or doctoral dissertation, sabotaging another's work, the violation of the ethical code of a profession, or all infractions committed after return from suspension for a previous violation.

Recommended Sanctions: Expulsion from the university and a permanent notation on the student's transcript.

Faculty who believe that violations have occurred should immediately contact the dean's office of their college/school. Students who suspect that other students are involved in actions of academic dishonesty should speak to the instructor of the course.

The New Brunswick Committee on Academic Integrity monitors this policy. Questions concerning the policy can be addressed to faculty members or to the offices of the college or school deans. Copies of the complete policy are available at deans' offices. The procedures followed and the due process rights afforded to students facing disciplinary charges are described in the University Code of Student Conduct.

UNIVERSITY CODE OF STUDENT CONDUCT SUMMARY

A university in a free society must be devoted to the pursuit of truth and knowledge through reason and open communication among its members. Its rules should be conceived for the purpose of furthering and protecting the rights of all members of the university community in achieving these ends.

All members of the Rutgers University community are expected to behave in an ethical and moral fashion, respecting the human dignity of all members of the community and resisting behavior that may cause danger or harm to others through violence, theft, or bigotry. All members of the Rutgers University community are expected to adhere to the civil and criminal laws of the local community, state, and nation, and to regulations promulgated by the university. All members of the Rutgers University community are expected to observe established standards of scholarship and academic freedom by respecting the intellectual property of others and by honoring the right of all students to pursue their education in an environment free from harassment and intimidation.

*Preamble
University Code of Student Conduct*

Overview

Communities establish standards in order to ensure that they are able to fulfill their mission and keep their members from harm. The University Code of Student Conduct (referred to as "the code" in the remainder of this summary) defines those kinds of behavior that violate the standards of the Rutgers University community and also provides the mechanism for addressing alleged violations. In doing so, the code protects the rights of those accused of offenses (referred to as "respondents" in the remainder of this summary) by providing due process while also protecting victims of those offenses and the university community as a whole.

Process

The following summary presents key aspects of the code. Students should consult the code itself for complete information on each point.

Filing a Complaint

Any individual may file a complaint against a student suspected of violating the code by notifying the Dean of Students (or equivalent) of the respondent's college or the Director of Judicial Affairs in the Division of Student Affairs.

Preliminary Review

Upon receipt of a complaint, a preliminary review is conducted by the Dean of Students or his or her designee to assess the evidence and determine if it is sufficient to proceed to a hearing. The dean conducting this review also assesses the seriousness of the charges. The most serious charges can, upon a finding of responsibility, result in separation from the university (suspension or expulsion) and are heard at university hearings. Less serious offenses (nonseparable offenses) are heard according to the procedures in place at the student's college or school of affiliation.

Separable Offenses

The following offenses are deemed serious enough to potentially result in separation from the university should a student be found responsible at a hearing:

1. violations of academic integrity
2. forgery, unauthorized alteration or unauthorized use of any university documents or records or any instrument or form of identification
3. intentionally furnishing false information to the university or intentionally initiating or causing to be initiated any false report, warning, or threat of fire, explosion, or other emergency
4. use of force against any person or property or the threat of such force
5. sexual assault or nonconsensual sexual contact
6. hazing
7. violation of the university's Student Life Policy against Verbal Assault, Defamation, and Harassment (Copies are available from the Judicial Affairs Office or Dean of Students' office.)
8. unauthorized entry into, unauthorized use of, or misuse of university property, including computers and data and voice communication networks
9. intentionally or recklessly endangering the welfare of any individual or intentionally or recklessly interfering with any university activity or university sponsored activity
10. use, possession, or storage of any weapon, dangerous chemical, fireworks, or explosive, whether or not a federal or state license to possess the same has been issued to the possessor
11. the distribution of alcohol, narcotics, or dangerous drugs on university property or among members of the university community, if such distribution is illegal, or the possession of a sufficiently large quantity as to indicate an intention to distribute illegally
12. theft of university services or theft of, or intentional or reckless damage to, university property or property in the possession of, or owned by, a member of the university community; including the knowing possession of stolen property (Intentional or reckless misuse of fire safety equipment is regarded as damage under this section of the code.)

13. the violation of the ethical code of one's intended profession either by graduate students enrolled in any of the university's professional or graduate schools or by undergraduate students in clinical courses or settings related to their intended profession
14. violations of federal, state, or local law where such violations have an adverse effect on the educational mission of the university
15. failure to comply with the lawful directions of university officials, including campus police officers acting in performance of their duties
16. knowingly providing false testimony or evidence; disruption or interference with the orderly conduct of a disciplinary conference or hearing; violating the terms of any disciplinary sanction imposed in accordance with this code, or any other abuse of the university's disciplinary procedures.

Campus Advisers

Both complainants and respondents may select a campus adviser to assist them during the disciplinary process. Campus advisers may fully represent students, including speaking on their behalf. The Office of the Vice President for Student Affairs maintains a list of trained campus advisers for this purpose. Students are free to select any member of the university community to serve as their advisers, whether they are on the list or not.

Attorneys

Complainants and respondents may also, at their own expense, seek the advice of an attorney in addition to that of a campus adviser. Attorneys are free to advise students, to assist in the preparation of their cases, and to attend hearings, but may not speak on behalf of their clients or question witnesses.

University Hearings

University hearings are presided over by a hearing officer and heard by a hearing board composed of students and faculty (with students always being in the majority). It is the hearing board's responsibility to determine whether the accused student is responsible or not responsible for violating the code. If the hearing board determines a student to be responsible by the standard of clear and convincing evidence, it also recommends a sanction for the offense to the Vice President for Student Affairs. The Vice President for Student Affairs considers the hearing board recommendation and determines the sanction.

Appeals

A student found responsible for violating the code may appeal the finding, the sanction, or both. Appeals are filed through the Office of the Vice President for Student Affairs, which forwards them to the Appeals Committee of the appropriate campus (Camden, Newark, New Brunswick).

Authority for Student Discipline

Ultimate authority for student discipline is vested with the Board of Governors of Rutgers, The State University of New Jersey. This authority has been delegated to university administrators, faculty, students, committees, and organizations as set forth in the University Code of Student Conduct. The above summary is intended to present some key facts of the code. Copies of the code are available

from all Dean of Students' offices and have been placed at the reference desks of all university libraries. In addition, the Director of Judicial Affairs in the Division of Student Affairs will provide copies of the code upon request and is available to answer any questions about the code or related judicial matters.

ADMINISTRATIVE PROCEDURES FOR RESPONDING TO DISRUPTIONS

An academic community, where people assemble to inquire, to learn, to teach, and to reason together, must be protected for those purposes. While all members of the community are encouraged to register their dissent from any decision on any issue and to demonstrate that dissent by orderly means, and while the university commits itself to a continual examination of its policies and practices to ensure that causes of disruption are eliminated, the university cannot tolerate demonstrations that unduly interfere with the freedom of other members of the academic community.

With this in mind, the following administrative procedures have been formulated to guide the implementation of university policy:

1. The president of the university and the executive vice president will have the authority throughout the university to declare a particular activity to be disruptive. In the three geographic areas of Camden, Newark, and New Brunswick, the respective provost will have the same authority.
2. Broadly defined, a disruption is any action that significantly or substantially interferes with the rights of members of the academic community to go about their normal business or that otherwise unreasonably interrupts the activities of the university.
3. A statement will be read by the appropriate officers as specified in (1) or by such officers as they may designate for the purpose of such reading and will constitute the official warning that the activity is in violation of university policy, that it must cease within a specified time limit, and where appropriate, that no commitments made by university officials will be honored if those commitments are made under duress.
4. If the activity continues beyond the specified time limit as determined by the official in authority, the authorized officers as specified in (1) will have the discretion to call upon the university police to contain the disruption. Ordinarily, the president of the university alone, or in his or her absence the executive vice president, will have the authority to decide that civil authorities beyond the campus are to be called upon to contain those disruptions that the university police are unable to handle. In extraordinary circumstances, where neither the president nor the executive vice president is available to make such a decision, the provosts of the three geographic areas have the same authority.
5. The deans of students are the chief representatives of the deans of the colleges in all matters of student life. Members of the university community who are aware of potentially disruptive situations are to report this to the dean of students on their respective campuses. In a disruption, the deans of students and their staff members have a two-fold responsibility: to protect against personal injury and to aid in providing for the order of the university. In the latter case, the deans of students, as well

as other university personnel, may be called upon to coordinate or assist members of the academic community in ending the disruption, directing it to legitimate channels for solution, or identifying those who have violated the rights of others.

NONDISCRIMINATION POLICY

It is the policy of Rutgers, The State University of New Jersey, to make the benefits and services of its educational programs available to students without discrimination on the basis of race, religion, color, national origin, ancestry, age, sex (except Douglass College, which is entitled under the law to remain a single-sex institution), sexual orientation, disability, marital status, or veteran status. The university complies with Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, the Age Discrimination Act of 1975, and the Americans with Disabilities Act of 1990. Questions about these laws, or allegations of student rights violations, should be directed to Brian T. Rose, Director of Compliance and Student Policy Concerns and Designated Employee for Student Rights Compliance, Rutgers, The State University of New Jersey, 3 Bartlett Street, New Brunswick, NJ 08903 (732/932-7312).

Nondiscrimination in University-Recognized Clubs and Organizations

University-sponsored clubs or organizations have certain obligations with regard to Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, the Older Americans Act of 1975, the Americans with Disabilities Act (ADA) of 1990, and to policies established at Rutgers through the Board of Governors. Consideration should be given to:

Membership: Clubs and organizations may not deny membership to anyone on the basis of race, sex, sexual orientation, disability, handicap, or age, with the exception of social sororities or fraternities which are entitled by law to remain single-sex organizations if tax exempt under 504a of IRS code 1954.

Benefits: Clubs and organizations may not discriminate on the basis of race, sex, sexual orientation, disability, handicap, and age in providing aids, benefits, or services to students.

Holding Office: Race, sex, sexual orientation, disability, handicap, or age may not limit any person from the ability to hold office.

As a condition of recognition, all clubs and student organizations must include a statement in their constitutions assuring nondiscrimination on the basis of race, sex, sexual orientation, disability, handicap, and age. Social fraternities and sororities are asked to include a statement assuring nondiscrimination on the basis of race, disability, handicap, or age.

Questions regarding students' obligations under the law may be directed to the dean of students or to the Director of Compliance and Student Policy Concerns, 3 Bartlett Street, New Brunswick, NJ 08903 (732/932-7312).

POLICY AGAINST VERBAL ASSAULT, DEFAMATION, AND HARASSMENT

Statement of Principles

Intolerance and bigotry are antithetical to the values of the university, and unacceptable within the Rutgers community. One of the ways the university seeks to effect this value is through a policy of nondiscrimination, which prohibits discrimination on the basis of race, religion, color, sex, age, sexual orientation, national origin, ancestry, disability, marital status, or veteran status in university programs. In order to reinforce institutional goals of nondiscrimination, tolerance, and civility, the following policy against verbal assault, defamation, and harassment is intended to inform students that the verbal assault, defamation, or harassment of others violates acceptable standards of conduct within the university. (This policy is not intended to supersede the university's policy against sexual harassment.)

Verbal assault, defamation, or harassment interferes with the mission of the university. Each member of this community is expected to be sufficiently tolerant of others so that all students are free to pursue their goals in an open environment, able to participate in the free exchange of ideas, and able to share equally in the benefits of our educational opportunities. Beyond that, each member of the community is encouraged to do all that she or he can to ensure that the university is fair, humane, and responsible to all students.

A community establishes standards in order to be able to fulfill its mission. The policy against verbal assault, defamation, and harassment seeks to guarantee certain minimum standards. Free speech and the open discussion of ideas are an integral part of the university community and are fully encouraged, but acts that restrict the rights and opportunities of others through violence, intimidation, the destruction of property, or verbal assault, even if communicative in nature, are not protected speech and are to be condemned.

Prohibited Conduct

Any of the following acts, even if communicative in nature, are prohibited "separation offenses" (charges that could lead to suspension or expulsion from the university) under the provisions of the University Code of Student Conduct:

1. Use of force against the person or property of any member of the university community or against the person or property of anyone on university premises, or the threat of such physical abuse. (Verbal assault may be prosecuted as a "threat of...physical abuse.")
2. Theft of, or intentional damage to, university property, or property in the possession of, or owned by, a member of the university. (Acts of graffiti or other vandalism may be prosecuted as "intentional damage to...property.")
3. Harassment, which is statutorily defined by New Jersey law to mean, and here means, purposefully making or causing to be made a communication or communications anonymously or at extremely inconvenient hours, or in offensively coarse language, or in any other manner likely to cause annoyance or alarm, or subjecting or threatening to subject another to striking, kicking, shoving or other offensive touching, or engaging in any other course of conduct or of repeatedly committed acts with purpose to alarm or seriously annoy any other person. Harassment is considered a separation offense under the University Code of Student Conduct as a "heinous act."

4. Defamation, which is judicially defined to mean, and here means, the unprivileged oral or written publication of a false statement of fact that exposes the person about whom it is made to hatred, contempt, or ridicule, or subjects that person to loss of the good will and confidence of others, or so harms that person's reputation as to deter others from associating with her or him. Defamation is considered a separation offense under the University Code of Student Conduct as a "heinous act."

While any of the four categories of acts listed above is a separation offense, that, if proven, could lead to a sanction of expulsion or suspension from the university under the provisions of the University Code of Student Conduct, clearly minor instances of such prohibited behavior should be resolved at the college level and not be treated as separation offenses requiring a university-level hearing. The initial judgments of whether a particular act is of a separable or nonseparable level are made by the appropriate college official and are subject to review by the assistant vice president for student life policy and services.

Students who believe themselves to be victims of verbal assault, harassment or defamation should report such incidents to the dean or the dean of students of their college or school. In addition, the following individuals have been identified to handle complaints:

Brian T. Rose, director of compliance and student policy concerns, 3 Bartlett Street, College Avenue campus, 732/932-7312;

Cheryl Clarke, director of diverse community affairs and lesbian/gay concerns, Bishop House, Room 105, College Avenue campus, 732/932-1711;

Sheila P. Fleishman, director of student judicial affairs, 3 Bartlett Street, College Avenue campus, 732/932-9414;

Rory P. Maradonna, associate provost for student life, Armitage Hall, Room 248, Camden campus, 609/225-6050;

Raymond T. Smith, associate provost for student affairs, S.I. Newhouse Center, Newark campus, 973/353-5541.

Some complaints can be and should be resolved by informal methods, while others will require the implementation of formal procedures. All complaints are treated confidentially; complainants are encouraged to report incidents even if they do not wish to pursue the matter beyond the reporting stage.

SEXUAL HARASSMENT POLICY

Sexual harassment of students by faculty, administrators, other employees, or fellow students is a form of sex discrimination prohibited by university policy and by Title IX of the Education Amendments Act of 1972. The university has both informal and formal procedures for resolving complaints. Students are encouraged to raise questions and bring problems for confidential discussion to the Office of the Dean or to the Director of Affirmative Action, 3 Bartlett Street, College Avenue campus, 732/932-2136. A brochure entitled Tell Someone is available from the above administrators upon request.

In differentiating between actions that constitute sexual harassment and those that establish a strictly personal, social relationship without discriminatory effects, the university applies the following criteria:

Unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitute sexual harassment when:

1. submission to such conduct is made, explicitly or implicitly, a term or condition of an individual's education or employment;
2. submission to or rejection of such conduct is used as the basis for decisions affecting an individual's academic or employment status; or
3. such conduct has the purpose or effect of unreasonably interfering with an individual's learning or work performance or creating an intimidating, hostile, or offensive learning or work environment.

STUDENT RECORDS AND PRIVACY RIGHTS

Rutgers, The State University of New Jersey, complies with the Family Educational Rights and Privacy Act of 1974 (FERPA) and makes public announcement of the law. FERPA was designed to protect the confidentiality of student records, guarantee student access to certain records, regulate disclosure of information from student files, provide opportunities for students to correct or amend records and add explanatory statements, and provide opportunities for students to file complaints with the U.S. Department of Education alleging infractions of the law.

The confidentiality of student educational records is protected by FERPA. However, the university is permitted to provide directory information without the student's consent unless he or she requests in writing that such information be kept confidential. Rutgers defines directory information as name, campus address and telephone number, permanent address and telephone number, school of attendance, major field of study, class year, dates of attendance, current credit load, credit hours earned, degree(s) received, and date(s) of degree(s).

Three of the most common ways by which the university releases student directory information are:

- through the Verifications Division of the Office of the Registrar or similar offices that have access to student records. (The office is called upon to verify that a student is enrolled at the university by potential employers and credit agencies, among others.)
- through the campus-wide information system known as INFO on the Rutgers University Computer Network (RUNet), which is accessible via the Internet.
- through the publication of the student directory each fall.

Students may request that directory information be kept confidential by obtaining a form for this purpose from their dean's office or from the registrar's office. This form must be completed and received by the registrar before September 10 to avoid publication in the printed directory in that academic year. Students should be aware that requesting confidentiality of directory information makes this information unavailable to all, including prospective employers, credit agencies, and others to whom you may want this information known or verified. Thus, it is recommended that students carefully consider whether personal

privacy concerns outweigh the possible inconvenience and detriments of having directory information withheld. Subsequent to filing the request, directory information remains confidential while a student is enrolled or until a written request that this restriction be lifted is received from the student by the registrar's office. As with all confidential records, Rutgers will release a student's confidential directory information only with the student's written consent.

The university uses a student's social security number as a student identification number. While this number is not released as directory information and its confidentiality is protected in the same manner as are other educational records as defined by FERPA, the university offers students the opportunity to acquire a substitute student number. Students wishing to have a substitute number assigned should fill out the appropriate forms in the registrar's office. The university recommends that those receiving financial aid not acquire a substitute number because the social security number is key to student identification by state and federal financial aid agencies. Thus, it is recommended that a substitute number be obtained only if student privacy concerns outweigh the possibility of a serious disruption in financial aid.

Further information on the law and Rutgers' policy and procedures on compliance with FERPA is available from the Office of Compliance and Student Policy Concerns in the Division of Student Affairs (732/932-7312).

STUDENT RESIDENCY FOR TUITION PURPOSES

A determination of residency status for the purpose of tuition assessment is made by the university based on information provided by the applicant in accordance with the procedure outlined in the policy. A copy of the policy may be secured from the registrar's office or the admissions office.

Procedure

The Initial Determination

At the time an individual initially applies for admission into any graduate or undergraduate college or division of the university, the respective admissions office determines an admitted applicant's resident status for tuition assessment.

The determination made at this time prevails for each term unless a change is authorized as provided hereinafter.

After the Initial Determination

The status of residency for tuition purposes of students continuing in a college or division of the university is determined by the registrar of the respective college or division. The determination made by the registrar either conforms to the initial determination of the admissions office or reflects a change as provided hereinafter.

Request for a Change of Status

Requests for a change in residency status are accepted no later than the last week of the term for which changed status is sought. All supporting affidavits, deemed appropriate by the adjudicating official pursuant to New Jersey Administrative Code, Volume 9, Section 5 et seq., must be filed by

the petitioner in accordance with the time limit specified in the preceding sentence, but in no case later than four weeks from the conclusion of the term for which the residency assessment is requested. Failure to comply with this provision, unless judged otherwise by the adjudicating official, voids the petition for the term in question. If, based on the information submitted in the request, the student qualifies for resident tuition assessment, such change relates only to the current and subsequent terms. No adjustments in tuition assessments are made and no refund vouchers are processed for any prior term.

Appeals

Appeals from the initial determination and any determination made after a request by a student for a change in residency status are accepted no later than three months after the date of notification of any such determination. Unresolved appeals are forwarded to either the director of admissions or to the university registrar. These officers respond to the student within thirty working days of the receipt of the appeal in the appropriate office. Appeals from this determination should be submitted to the associate vice president for student services by the student within two weeks after the director of admissions or the university registrar has issued a determination. The decision of the associate vice president for student services will be final.

Students' Responsibilities

Students are responsible for providing relevant information upon which a residency determination can be made. The burden of proving his or her residency status lies solely upon the student. Moreover, it is considered the obligation of the student to seek advice when in doubt regarding eligibility for in-state tuition assessment. If the student delays or neglects to question his or her eligibility status beyond the period specified above, the student forfeits his or her right to a residency assessment to which he or she might have been deemed to be eligible had he or she filed an appeal at the appropriate time.

Penalties

If a student has obtained or seeks to obtain resident classification by deliberate concealment of facts or misrepresentation of facts or if he or she fails to come forward with notification upon becoming a nonresident, he or she is subject to disciplinary action.

RESEARCH POLICY AND RESEARCH CENTERS

Research at the university, apart from that conducted by students in connection with their academic course work, is intended, in general, to lead to publication in some form such that its results are available to interested persons everywhere. The university does not accept grants from or enter into contracts with governmental agencies or any other sponsors for research projects of which the results may not be made publicly accessible; all university-conducted research must be available for public scrutiny and use.

Most research projects at the university are carried on by faculty members and students within the facilities offered by their own departments, but for on-campus research that cannot be conducted in department facilities, laboratories, or the library, the university has provided a number of cooperative research centers and bureaus. A list of the university's research centers may be found in the Divisions of the University chapter.

Many members of these organizations are active in graduate instruction. Information about their programs and activities may be found in Research at Rutgers, a handbook and bibliography published by the Research Council, the university agency that sponsors and coordinates faculty research.

PATENT POLICY

All students are governed by the university's patent policy, which is described in a statement available in the Office of Research and Sponsored Programs and the offices of all deans and department chairpersons.

Degree Requirements

This chapter outlines the minimum requirements of the Graduate School–New Brunswick for each of the advanced degrees under its jurisdiction. The faculty in charge of each program may impose additional requirements of its own; the most significant of these additional requirements are announced in the program descriptions to be found, arranged alphabetically by subject, in the Programs, Faculty, and Courses chapter.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (Ph.D.), introduced to this country by Yale in 1861, is the highest degree in courses offered in American education. It is conferred in recognition of, first, marked ability and scholarship in a broad field of learning (such as chemistry or classics) and, second, distinguished critical or creative achievement within a special area of the general field (the special area being the subject of the doctoral dissertation). A student must devote a minimum of three years of full-time study beyond the bachelor's degree for the Ph.D., of which at least one year must be devoted to dissertation-related research. Full-time study for one year is represented by 24 credits of course work or research. The minimum requirement for the Ph.D. degree is, therefore, 72 credits, of which at least 24 credits must be devoted to research. If any of the work is conducted on a part-time basis, the minimum time required will, of course, be longer.

Doctoral programs are normally arranged in two phases: the preliminary general phase, during which the student usually pursues courses of study, is completed when the qualifying examination is successfully passed; and the later special phase, during which the student usually pursues courses of research, is concluded when the dissertation has been accepted and the defense of it approved. Between admission to the Graduate School–New Brunswick and the conferral of the Ph.D. degree, the student must: (1) satisfy the course and other preliminary requirements of the particular graduate program in which the student is enrolled, (2) pass the comprehensive qualifying examination, (3) present the results of the special research in an acceptable dissertation, and (4) pass a final examination related to the subject of the dissertation. The student becomes a formal candidate for the doctorate only after completing the qualifying examination.

Residence Requirements

Residence requirements for advanced degrees are separately determined by the faculty of each program. Students should consult their graduate directors for information concerning minimum expectations of concentration for their programs of study.

Transfer of Credit

Graduate courses completed at other institutions, if they would normally form a part of the student's field of concentration, may be accepted for credit toward the doctorate at the university. The student must have been registered in these courses during the preceding six-year period (although an exception to this rule may be granted by the dean, where it can be shown that the student has kept abreast of the subject matter in question) and must have earned a grade of B or better in them. Graduate credit may not be transferred until 12 credits of graduate courses with grades of B or better have been completed in the Graduate School–New Brunswick as a matriculated student. The limit to the number of courses for which transfer of credit may be granted is normally one-half of the courses required in the student's program toward the doctorate. In no case may the amount exceed 24 credits. The faculty of a graduate program may recommend transfer of credits earned in a graduate professional school toward a student's Ph.D. in the Graduate School–New Brunswick. The maximum number of such credits acceptable is normally 50 percent of the total number of course credits, exclusive of research, required by the program, but approval may be sought for as many as 24 credits. No credit may be transferred for thesis-related research work, course work done as independent study, or course work that was not graded with an A or B grade. Other letter or numerical grades are eligible for transfer if equivalent to the grade of B or better and accompanied by a letter from the instructor of the course testifying to that equivalence. See the Academic Policies and Procedures chapter for additional information.

Language Requirements

Language requirements for advanced degrees in the Graduate School–New Brunswick are separately determined by each program. Information on requirements may be found in the Programs, Faculty, and Courses chapter under each program.

When programs require that proficiency in one or more foreign languages be demonstrated by a written examination, they may supervise their own examinations or ask their students to pass the examinations offered on several dates throughout the year by the Graduate School–New Brunswick. Examinations (available in Greek, Latin, French, German, Russian, Chinese, Spanish, Italian, and Portuguese) consist of passages for translation with the aid of a dictionary, and they are graded either pass or fail. A student must apply in advance to take the examination.

Registration information and instructions are available at the FAS–NB Language Laboratory, Seminary Place, College Avenue campus. A fee of \$15 is charged. The results of the examinations are reported to graduate offices as soon after the examinations dates as they become available—usually about two weeks. The student's program director will certify the results of the exam(s) on the student's Ph.D. candidacy form.

Courses of study to gain a reading knowledge for several languages are available on the undergraduate level at the university. Students interested in those courses should consult the current New Brunswick Undergraduate Catalog.

Program of Study

A student who wishes to qualify for the doctorate should formulate a program of study in consultation with his or her graduate adviser or committee. The course and research requirements for the doctoral degree in each subject are determined by the faculties concerned, although all programs are subject to review by the dean of the Graduate School–New Brunswick. The minimum total requirement in nonresearch courses varies by program, although it rarely exceeds 48 credits. The student must offer a minimum of 24 credits in research toward the degree. The minimum combined total credit requirement is 72 credits. No more than 12 credits of advanced undergraduate courses (300- or 400-series with added G-prefixes) may be offered toward the degree. No more than 50 percent of a student's formal course work may be taken in professional school courses. In most programs, a student is able to complete course work in two years of full-time study. Courses taken to satisfy the requirements for a master's degree may, with program approval, be counted toward the doctorate. The time of transition from course work to guided or independent research is determined by the faculty of the student's program. The entire doctoral program should be completed no later than seven years after the student first registers in the Graduate School–New Brunswick.

Academic Standing

Prospective candidates for the doctorate should understand that they will not ordinarily be permitted to proceed to the qualifying examination unless their record in course work shows evidence of distinction. The standard of work required is left largely in the hands of the students' program committee, but it is expected that no more than 9 credits offered in partial fulfillment of the requirement for the doctorate, and for which letter grades have been given, shall bear grades of C or C+. Most programs expect graduate students to achieve grades of B or better in all their courses, and the regulations in some programs assume that a student should probably not continue to the doctorate unless he or she demonstrates a capacity to perform with distinction (grade A) in at least half the formal studies in course.

Admission to Candidacy:

The Qualifying Examination

The purpose of the qualifying examination is to determine whether a student has acquired sufficient mastery of the field of concentration to warrant admission to candidacy for the Ph.D. degree. It should be taken as soon as a student has completed the major portion of the course requirements; it should be taken not later than six years after the student first registered in the Graduate School–New Brunswick and not later than two terms before taking the final dissertation examination. Normally, the qualifying examination should be taken near the end of the fall or spring term to provide an opportunity for the student to register for additional courses without undue loss of time if the outcome of the qualifying examination leads the examining committee to require them. Certain programs specify that the qualifying examination be taken at stated times that meet this condition.

The examination, conducted by a committee of at least four members (the chairperson must be a member) or associate members of the graduate faculty from the program, is comprehensive in character and may be written or oral or both.

Once a student has fulfilled the language requirements, if applicable, and other relevant program requirements, and has passed the qualifying examination, he or she is admitted to candidacy for the doctoral degree. The application for admission to candidacy for the degree of Doctor of Philosophy, on which the results of the language examination will be certified by the program, is to be obtained by the student from the Office of the Graduate School and submitted to the chairperson of the committee at the time of the examination; it should then be returned, properly signed by the four members of the candidate's committee and the graduate director, to the Office of the Graduate School. Once the examination has been passed, the student must continue in registration, whether for courses or research, or lose his or her status as a candidate. An exception to this rule may be granted to recipients of the Master of Philosophy degree (see the section concerning that degree later in this chapter).

Dissertation and Dissertation Committee

Each candidate for the doctorate pursues, under faculty direction, an original investigation of a problem or problems in a field of concentration and presents the results of the investigation in a dissertation. The dissertation must be approved by a minimum of three members of a faculty committee of four members, chaired by a member of the graduate faculty of the student's program who supervises the investigation, and including three other members (two who are members or associate members of the program faculty and one who is approved as an "outside" member), appointed by the program director in consultation with the student's adviser. Whenever possible, "outside" shall be interpreted to mean "outside the university," but in all cases "outside" shall be interpreted to mean outside the program. The outside member is expected to be a recognized authority on the subject of the dissertation. For appointments of committee members who do not hold any membership in the graduate faculty, the program director will forward to the Office of the Graduate School a letter appointing the individual to the committee. This letter should explain the basis for the appointment and must include the address of the appointee.

For committees having more than four members, only one nonapproval is permitted. Substitutions in committee membership, once it has been determined, are the responsibility of the program director and will occur only if a member is unable to serve or if a student's dissertation topic changes, requiring a new dissertation director and/or modification in the committee. In cases other than these, approval for changes in committee membership rests with the dean of the Graduate School–New Brunswick.

Once the student has developed, with the advice of the dissertation supervisor, preliminary guidelines for a dissertation, a meeting of the committee, including the outside member whenever possible, and the candidate, will be held to discuss the candidate's dissertation proposal. Subsequently, the committee must be kept informed of the student's progress and must agree to follow the candidate's work and assist in its development. The committee shall also agree to give ample and early warning of any reservations concerning the student's progress and must specify in writing the changes required for dissertation acceptance.

The final copy of the dissertation should be prepared in strict accordance with the instructions given in the pamphlet *Style Guide for Thesis and Dissertation Preparation*,

available at the Office of the Graduate School. After the dissertation has been accepted by the committee, the required copies are to be filed with the Office of the Graduate School no later than the announced deadlines for completion of degree requirements. One copy will be bound and made available in a university library.

With the dissertation, the candidate is required to submit an abstract not exceeding 350 words, embodying the principal findings of his or her research. As in the case of the dissertation, the abstract must be approved by the professor in charge of the work for the dissertation and accepted by the other members of the student's committee.

Final Examination

A final public examination is held under the auspices of the committee in charge of the candidate's course of study. A candidate must defend the dissertation and otherwise satisfy the committee and other faculty in attendance that he or she is qualified to receive the degree of Doctor of Philosophy.

At the time of the final examination, it is the responsibility of the candidate to obtain from the Office of the Graduate School the candidacy application (on which the result of the qualifying examination is recorded) for completion by the committee at the final examination. The same committee members must also sign the title page of the dissertation, signifying their acceptance of it. Once the program director certifies that all program requirements have been completed for the degree of Doctor of Philosophy, the candidate must return the candidacy application to the Office of the Graduate School. The two required copies of the thesis or dissertation submitted must be of excellent quality, correct in margin and format, and on 100 percent rag or cotton content bond paper. All of the above materials must be submitted to the Office of the Graduate School no later than the announced deadlines for completion of degree requirements. The names of those failing to meet these deadlines will be automatically removed from the commencement list for that degree date.

Application for the Conferral of the Degree

The candidate must file a diploma application according to announced deadlines in order to receive a diploma at commencement. For further information regarding the application procedure, see Graduation at the end of this chapter. A certificate of completion is issued, upon request, in advance of the awarding of the diploma in May.

Publication of Dissertation and Academic Data

After the granting of the doctorate, the Graduate School–New Brunswick will have the dissertation microfilmed. The dissertation must, therefore, be prepared with the same care as if it were to appear in printed form. The abstract that must accompany the dissertation will be published in Dissertation Abstracts and, therefore, must also be ready for publication when it is submitted to the dean.

University Microfilms of Ann Arbor, Michigan, will microfilm the dissertation and publish the abstract. Information concerning the preparation of the dissertation and abstract, and the agreement with University Microfilms that the candidate is to sign, are available in the Office of the Graduate School. The fee for microfilming the dissertation and publishing the abstract is \$50. Registration of copyright is also available for a fee of \$35.

Calendar for the Doctoral Degree Program

The following deadlines should be observed by a candidate for the doctorate. Admission conditions must be satisfied early in the academic program. The candidate must complete any language requirements before taking the qualifying examination. The candidate must take the qualifying examination at least two terms before the final examination. The required copies of the dissertation must be filed and the final examination must be completed and the candidacy form recording its result returned by the announced deadlines for completion of degree requirements. Finally, the diploma application must be filed by the appropriate deadline. At no point during this sequence may students allow their registration in the Graduate School–New Brunswick to lapse (with the exception of a recipient of the Master of Philosophy degree). The entire program must be completed within the period specified under Time Limits for Degrees later in this chapter.

MASTER OF PHILOSOPHY

The Master of Philosophy (M.Phil.) degree is offered by the faculties of certain Ph.D. programs to students who achieve records of distinction during the predissertation phase of those programs. Doctoral programs in which the Master of Philosophy degree may be conferred are indicated in the Programs, Faculty, and Courses chapter. It should be noted that the Master of Philosophy is not designed as a terminal degree and that its requirements are integrated with the requirements for the Doctor of Philosophy degree. The Graduate School–New Brunswick does not admit potential candidates for the Master of Philosophy degree to graduate study unless they are clearly qualified to pursue the doctorate, and prospective students interested in the degree are advised to apply for admission to doctoral programs.

This degree, introduced by the University of Toronto in 1962 and established by Yale University in 1966, requires a minimum of two years of advanced study beyond the baccalaureate degree. It is thus intermediate between the Master of Arts or Master of Science degree and the Doctor of Philosophy, and it is designed to mark that point in a program of graduate study at which the student has successfully completed all requirements for the doctorate except the final phase of research culminating in a dissertation. The regulations governing the Master of Philosophy degree at the university are designed to encourage students in their progress toward the doctorate. The degree is intended to provide recognition that a prospective doctoral candidate has successfully and expeditiously completed a major phase of graduate study and has achieved a comprehensive mastery of the general field of concentration. Recipients of the degree automatically proceed toward the Ph.D. degree.

Programs leading to the Master of Philosophy degree are substantially similar to the predissertation phase of doctoral programs, differing primarily in the stipulations regarding minimum grade requirements, completion of all work within the specified time limit, and the requirement that either a thesis or essay must in all cases be completed. Eligible students who intend to proceed toward the doctorate and who wish to acquire a master's degree in the course of their doctoral studies are advised to seek the Master of Philosophy degree instead of (or in addition to) the degree of Master of Arts or Master of Science.

Transfer of Credit

Credit for graduate-level courses taken elsewhere may be accepted toward the Master of Philosophy degree under the same conditions outlined under transfer of credit in the description of Ph.D. requirements. It is a special requirement for the Master of Philosophy degree, however, that in at least one-quarter of the courses for which transfer of credit is desired the student must have earned a grade of A or its equivalent. Further restrictions concerning the transfer of credit may be found in the Academic Policies and Procedures chapter.

Program of Study

The requirements for the Master of Philosophy degree include a minimum of 48 credits of work, of which at least 42 credits must consist of course work and the remainder, with the approval of the student's program, may consist of research associated with an M.A. or M.S. thesis. At least 33 credits of the course requirements must be fulfilled in graduate-level courses numbered in the 500s and 600s, and of these at least 24 credits must be earned in courses taken at the university.

Academic Standing

In order to qualify for the Master of Philosophy degree, the student must earn a grade of A in at least 12 credits of the graduate-level courses that are taken at the university. No more than 3 credits bearing the grade of C or C+ may be counted toward the degree, and students earning 9 credits or more bearing grades of C or C+ or below are ineligible for the degree.

Writing Requirement

Students who earn an M.A. or M.S. degree at the university are required either to submit a master's thesis or a critical or expository essay in partial fulfillment of the requirements for the degree. Students who wish to earn the Master of Philosophy degree, having submitted a formal thesis for the lower-level master's degree, will be considered as having already fulfilled the writing requirement for the Master of Philosophy degree. Students whose programs at the university have not included a formal master's thesis may fulfill the Master of Philosophy writing requirement with the critical or expository essay already accepted by their program faculty for the lower master's degree or with another such essay prepared in the course of their graduate work at the university. The thesis or essay must have been written under the direction of a member of the graduate faculty and approved by two other members of the graduate faculty.

Time Limits

All requirements for the Master of Philosophy degree must be completed within four consecutive academic years of first registration at the university, and students for whom transfer of credit is granted for graduate work done elsewhere must complete their program within commensurately shorter limits. Extensions of time normally will not be granted in connection with this degree.

Other Requirements

All other requirements for the Ph.D. degree established by the Graduate School–New Brunswick and by the faculty in charge of the student's program, other than the doctoral dissertation and the dissertation examination, must be fulfilled by applicants for the Master of Philosophy degree. These include the completion of all doctoral program requirements and the passing of the qualifying examination.

Continuing for the Ph.D. Degree

Students who have been awarded the Master of Philosophy degree may, if they wish, proceed directly to the final stage of their doctoral program, in which case they must continue their registration, or they may allow their registration in the Graduate School–New Brunswick to lapse without a restoral fee and resume their doctoral studies at any time within four years by submitting an application for readmission to the Graduate School–New Brunswick. See Readmission in the Academic Policies and Procedures chapter. Readmission with the graduate program director's endorsement will be granted automatically within this period; after a period greater than four years, holders of the Master of Philosophy degree may also apply for readmission, but their readmission may be made conditional upon special additional requirements, e.g., "refresher" courses, at the discretion of their graduate director.

MASTER OF ARTS/MASTER OF SCIENCE

Candidates for the Master of Arts (M.A.) or Master of Science (M.S.) degrees must satisfy the requirements of the Graduate School–New Brunswick and of the program in which they are enrolled. The requirements of the Graduate School–New Brunswick are given below, and additional requirements established by various program faculties may be found in the Programs, Faculty, and Courses chapter. Certain programs have a foreign language requirement.

The minimum requirement to earn the master's degree is 30 credits of successful graduate study in course work. The candidate must also pass a final comprehensive examination in the student's field of concentration, and, in some but not all programs, the candidate may (and sometimes must) do a research project culminating in a thesis, with this thesis project usually replacing 6 credits of the regular graduate courses ordinarily undertaken in a nonthesis program. The 30 credits, representing at least one academic year of advanced study, must be completed no later than three years after first registration unless an extension of time is granted by the Graduate School–New Brunswick. For further information, see Time Limits for Degrees later in this chapter.

The student's registration in the Graduate School–New Brunswick must be continuous from the time of admission to graduate study until the time the degree is conferred. In fulfilling course requirements, courses may be selected from a single program or from several related programs.

All programs of study are subject to review by the dean of the Graduate School–New Brunswick.

Transfer of Credit

On the recommendation of the program and with the approval of the Graduate School–New Brunswick, a student may transfer up to 12 graduate credits as partial fulfillment of the 30-credit degree requirements. For further information, see Transfer of Credits in the Academic Policies and Procedures chapter.

Program of Study

In programs that include the pursuit of a research problem developed in a master's thesis, 6 credits (of the total 30 credits) are normally devoted to the research for and writing of the thesis. In exceptional cases, when it is desirable to give greater emphasis to the research project, the dean of the Graduate School–New Brunswick may, upon recommendation of the candidate's program, approve a maximum of 12 credits for research on an unusual problem and its treatment in the thesis.

In master's programs pursued wholly through work in regular courses of study, i.e., those that exclude a research thesis, the candidate must demonstrate to the satisfaction of the faculty that he or she has the ability to write a creditable expository or critical essay, either as part of a regular course or seminar or in a special course designed for such a purpose.

In programs consisting entirely of course work, at least 18 of the 30 credits of study must be undertaken in graduate-level courses (those numbered in the 500s and 600s); in programs in which a master's thesis accounts for a normal portion of the credit recorded, at least 12 credits of study must be undertaken in graduate-level courses. With the approval of the candidate's program faculty, the balance of his or her study in courses may be undertaken either in advanced undergraduate courses (numbered in the 300s and 400s) or in additional courses designed primarily for graduate students. In no case may the candidate for the Master of Arts or Master of Science degrees offer more than 12 units of credit of advanced undergraduate course work.

Academic Standing

Candidates for the master's degree normally are expected to earn grades of B or better in their course work. No more than 9 credits bearing grades of C or C+ (fewer in some programs) may be used in meeting the requirements for a master's degree.

Committees and Advisers

When a student's program includes a thesis, the supervision of the course of study, the research for the thesis, and the conduct of the final examination is entrusted to an appointed committee whose members are selected in consultation with the director of the graduate program. Each committee consists of at least three members or associate members of the graduate faculty in the student's graduate program. One nonprogram member is permitted but must be approved by the director of the graduate program. If the student's program does not include a thesis, the committee is appointed shortly before the final examination. A non-thesis committee consists of at least three members or associate members of the graduate faculty in the student's graduate program. No substitutes are permitted. In either case, the student is encouraged to seek advice during the course of study from the graduate director, committee chairperson, and professor supervising his or her courses.

No graduate student should regard a program of study as the mere accumulation of numerical credits and meeting of formal requirements; progress toward mastery of a discipline depends to a large extent upon the interested guidance of the professors in charge and the student's own initiative.

Submission of the Thesis

For a student whose program includes a thesis, the thesis must be approved by the professor in charge and accepted by the other members of the student's committee. The final draft of the thesis should be prepared in strict accordance with the instructions given in the pamphlet *Style Guide for Thesis and Dissertation Preparation*, available at the Office of the Graduate School. After the thesis has been accepted by the committee, the required copies are to be filed with the Graduate School–New Brunswick by the announced deadlines for completion of degree requirements.

Master's Examination

An application for candidacy for the master's degree must be submitted to the dean of the Graduate School–New Brunswick at least two months prior to the time of the final examination.

If a student expects to take the final examination at the end of the summer session or at the beginning of the fall term, the application must be filed prior to the opening of the summer session. Forms for this purpose are available at the Office of the Graduate School, and the responsibility for making the application lies with the student.

The final comprehensive examination may be written or oral or may be a combination of both. At the time it is to be taken, the candidate must obtain from the Office of the Graduate School the previously filed application and submit it to the chairperson of the committee. The chairperson and committee members record the result on this form, and it is then the responsibility of the candidate to obtain the approval of the graduate program director and to return the form to the Office of the Graduate School; it should be returned soon after the examination and no later than the announced deadlines for completion of degree requirements. The names of those failing to meet the deadline will be removed automatically from the commencement lists.

Qualifying Examination for the Doctorate Used for the Master's Degree

A student who has satisfied all other requirements for a master's degree except the final examination may, with the permission of the program faculty, elect to take the qualifying examination for the doctorate in place of the final master's examination, and, after passing the qualifying examination, may be recommended for the appropriate master's degree. This use of the qualifying examination does not invalidate the status of a student as a candidate for the doctor's degree. A student who desires to use the qualifying examination as the final examination for the master's degree must file an application for the master's degree in accordance with the preceding directions.

Application for the Conferral of the Degree

The candidate must file a diploma application before posted deadlines in order to receive the degree at commencement. For further information regarding the application procedure, see Graduation at the end of this chapter.

Calendar for the Master's Degree Program

The following deadlines should be observed by a candidate for a master's degree. The application for a master's degree, as explained above, must be filed early in the term (when grades from previous courses are available) in which the final examination is to be scheduled. If the program includes a thesis, the required two copies of the thesis and the completed candidacy form must be filed according to the announced deadlines for completion of degree requirements. Finally, the diploma application must be filed by the appropriate deadline. At no point during this sequence should the student allow academic year registration in the Graduate School–New Brunswick to lapse. The entire program must be completed within the period specified under Time Limits for Degrees later in this chapter.

MASTER OF ARTS FOR TEACHERS/ MASTER OF SCIENCE FOR TEACHERS

Programs leading to the degree of Master of Arts for Teachers (M.A.T.) or Master of Science for Teachers (M.S.T.) are offered in the Graduate School–New Brunswick to teachers in service at secondary schools who wish to further their education in academic subjects. Prospective students should be advised that these programs do not in themselves lead to certification in teaching nor are they degrees in education, which are offered by the Graduate School of Education. The programs of study for the M.A.T. and M.S.T. degrees are designed on an individual basis. All M.A.T. and M.S.T. programs at the university are composed primarily of work in regular courses of study; none provides for the submission of a thesis. The other requirements governing the degree may be found in the preceding account of requirements for the degrees of Master of Arts and Master of Science.

TIME LIMITS FOR DEGREES

Degree programs should be completed within the following periods of time after first registration in the Graduate School–New Brunswick:

	Normal Minimum (full-time study)	Normal Maximum
Master of Arts	1 year	3 years
Master of Science	1 year	3 years
Master of Arts for Teachers	1 year	3 years
Master of Science for Teachers	1 year	3 years
Master of Philosophy	2 years	4 years
Doctor of Philosophy	3 years (2 years beyond master's)	7 years (4 years beyond master's)

All students are urged to consider carefully the educational and economic benefits of completing their programs as expeditiously as possible. Soon after being admitted to graduate study each student should consult with a faculty adviser and work out a reasonable timetable for meeting the requirements. Extensions beyond the normal limits shown above may (for all degrees except the Master of Philosophy)

be granted to students in good standing. A student requiring an extension should petition the dean of the Graduate School–New Brunswick on a form available from the Office of the Graduate School. If the petition is supported by reasons of weight, and if the faculty in charge of the student's program certify that satisfactory progress is being made, the extension normally is granted. Part-time students should consult their program concerning their expected times of completion.

THESIS AND DISSERTATION PREPARATION

A pamphlet entitled *Style Guide for Thesis and Dissertation Preparation* is available at the Office of the Graduate School. All theses, dissertations, or essays submitted to the Graduate School–New Brunswick in partial fulfillment of the requirements for master's and doctor's degrees must conform to the instructions in this pamphlet, and candidates should familiarize themselves with these instructions before they proceed to their final drafts. A thesis may be rejected by the graduate school office if it does not adhere to the stylistic and technical requirements specified in *Style Guide for Thesis and Dissertation Preparation*.

The Office of Academic Services provides a series of Dissertation and Thesis Workshops to help students prepare their manuscripts for submission in accordance with the requirements of the Graduate School–New Brunswick. In addition to examining the various guidelines for dissertation and thesis preparation, the workshops give students the opportunity to ask specific questions about the format of their project.

GRADUATION

When entering their final term, candidates who anticipate faculty recommendation for conferral of the degree are required to follow the procedures listed below:

1. Ensure that all academic requirements are being completed. If a student is unable to do so by the deadline date, both forms listed below must be refiled for a later-dated diploma.
2. Ensure that related fees and any outstanding debts to the university are paid.
3. Submit the completed candidacy application form by the announced deadline, normally in early January, May, or October.
4. Submit a diploma application form by the announced deadline, normally January 2, April 1, or October 1.

The degree cannot be conferred as scheduled, and graduation will be delayed, if this form is filed after the deadline. Students must refile this form if the deadline has passed. All forms are available from the Office of the Graduate School. Students are urged to submit the appropriate forms in advance of the deadlines, if possible. It is the responsibility of the student to complete all requirements for graduation by the scheduled dates. Each student should consult with the graduate director of his or her program and with the Office of the Dean of the Graduate School with respect to the completion of the requirements for graduation.

Conferral of degrees and diplomas occurs once a year at the annual spring commencement. However, students who file the applications and complete all other requirements for the degree by the announced October or January dates will get a diploma dated for the respective month, although they will not receive it until the following spring. Students may, therefore, request a temporary certificate of completion by submitting a written request to the university registrar (Administrative Services Building, Busch Campus). This request form may be obtained at the dean's office. At the time of commencement, degrees may be conferred in absentia only if the prospective candidate has notified the university registrar that he or she cannot attend the commencement exercises.

The diploma will be withheld from any student who is under financial obligation to the university.

Programs, Faculty, and Courses

In this chapter, detailed descriptions of the programs offered by the Graduate School–New Brunswick appear in alphabetical order by subject name. Under each program will be found the degree or degrees offered, the name and campus address of the program director, a list of the members of the graduate faculty in charge of the program and their research interests, a description of the program's special purposes and requirements, and a list of courses. Note: For a comprehensive list of the degree programs offered by the Graduate School–New Brunswick, see the Degree Programs Available chapter.

COURSE INFORMATION

Courses numbered in the 500s and 600s are offerings of the graduate faculty for graduate students in advanced-degree programs. Undergraduate or nonmatriculated graduate students and students from the university's graduate professional schools are admitted to these courses according to rules printed elsewhere; information about special prerequisites for some courses may be obtained from graduate program offices and from instructors at initial class meetings. Courses numbered in the 700s are intended for students preparing individual research theses or dissertations for advanced degrees.

Advanced undergraduate courses (numbered in the 300s and 400s) do not appear in this catalog, but among them are many that may serve as useful prerequisites to particular graduate courses and which, under certain conditions, may be accepted for credit toward graduate degrees. Within the limits described in the Degree Requirements and the Academic Policies and Procedures chapters, a student in the Graduate School–New Brunswick may register for an undergraduate course with the approval of his or her graduate adviser. Information about undergraduate course offerings must be sought in the appropriate undergraduate catalogs and separate schedules of classes. Graduate-level courses at the Rutgers professional schools and Princeton University must also be sought out in the catalogs of those schools.

Explanation of Three-Part Course Numbers

The number preceding each course title is divided into three parts. The first two digits are the administrative code (standing for a faculty or a school), the next three digits are the subject code, and the final three digits are the course code.

Administrative Codes

The administrative code for the Graduate School–New Brunswick is 16. The following administrative codes may be relevant for graduate students in New Brunswick:

- 01 Faculty of Arts and Sciences–New Brunswick
- 08 Mason Gross School of the Arts (graduate courses)
- 15 Graduate School of Education (graduate courses)
- 16 Graduate School–New Brunswick
- 17 School of Communication, Information and Library Studies (graduate courses)
- 18 Graduate School of Applied and Professional Psychology
- 19 School of Social Work (graduate courses)
- 26 Graduate School–Newark
- 34 Edward J. Bloustein School of Planning and Public Policy
- 37 School of Management and Labor Relations
- 53 School of Business–Camden
- 56 Graduate School–Camden

Subject Codes

A subject code comprises the third through fifth digits in all course numbers and indicates the subject matter of the course. The following subject codes are used in this catalog:

030	Agricultural Economics
047	Alcohol Studies
067	Animal Sciences
070	Anthropology
082	Art History
098	Asian Studies
115	Biochemistry
125	Biomedical Engineering
126	Biotechnology
127	Bioresource Engineering
148	Cell and Developmental Biology
150	Ceramic Science and Engineering
155	Chemical and Biochemical Engineering
160	Chemistry
180	Civil and Environmental Engineering
185	Cognitive Science
190	Classics
194	Communication, Information, and Library Studies
195	Comparative Literature
198	Computer Science
215	Ecology and Evolution
220	Economics
332	Electrical and Computer Engineering
350	English
352	English (American Literature)
356	English as a Second Language
370	Entomology
375	Environmental Sciences
390	Environmental Change, Human Dimensions of
400	Food Science
420	French
450	Geography
460	Geological Sciences
470	German
510	History
540	Industrial and Systems Engineering
545	Industrial Relations and Human Resources
554	Interdisciplinary Studies
560	Italian
615	Linguistics
617	Literature and Language
640	Mathematics
642	Mathematics, Applied
650	Mechanical and Aerospace Engineering
654	Mechanics
667	Medieval Studies
681	Microbiology and Molecular Genetics
695	Molecular and Cell Biology
696	Molecular Biophysics
700	Music
709	Nutritional Sciences
711	Operations Research
712	Oceanography
718	Pharmacology, Cellular and Molecular
720	Pharmacy (Pharmaceutical Science)
730	Philosophy
750	Physics and Astronomy
761	Physiology and Neurobiology
765	Plant Biology
790	Political Science
830	Psychology
832	Public Health
833	Public Policy
841	Quaternary Studies
859	Russian, Central and East European Studies
910	Social Work
920	Sociology
940	Spanish
960	Statistics

963	Toxicology
970	Urban Planning and Policy Development
988	Women's Studies

Course Codes

The course code comprises the sixth, seventh, and eighth digits in all course numbers.

Two course codes separated by a comma indicate that each term course may be taken independently of the other. Two course codes separated by a hyphen indicate that satisfactory completion of the first term course is a prerequisite to the second term; the first term may be taken for credit without taking the second, except if a statement is added to indicate that both term courses must be completed in order to receive credit.

Other Course Notations

Courses noted (F) and (S) indicate fall and spring anticipated schedule. Not all courses are offered every term or year.

Credits awarded for the successful completion of each course are indicated in parentheses following the course title. The notation BA indicates that the number of credits is determined by arrangement with the program offering the course.

Unless otherwise indicated, a course normally meets for a number of lecture hours equal to the number of credits to be earned. Special hours or modes of class, other than lecture, are usually indicated in italics below the course title.

Abbreviations

The following abbreviations are used in the faculty listings:

CABM	Center for Advanced Biotechnology and Medicine
CAFT	Center for Advanced Food Technology
CAMB	Center for Agricultural Molecular Biology
CAS	Center of Alcohol Studies
CC	Cook College
CCACC	Center for Critical Analysis of Contemporary Culture
CCAS	Camden College of Arts and Sciences
CCES	Center for Coastal and Environmental Studies
CCR	Center for Ceramic Research
CE	College of Engineering
CGS	Center for Government Services
CINJ	Cancer Institute of New Jersey
CMBN	Center for Molecular and Behavioral Neuroscience
CN	College of Nursing
CNCR	Center for Negotiation and Conflict Resolution
CP	College of Pharmacy
CTAG	Center for Theoretical and Applied Genetics
CUPR	Center for Urban Policy Research
EIP	Eagleton Institute of Politics
EJBSPPP	Edward J. Bloustein School of Planning and Public Policy
FAS-C	Faculty of Arts and Sciences-Camden
FAS-N	Faculty of Arts and Sciences-Newark
FAS-NB	Faculty of Arts and Sciences-New Brunswick
FM	Faculty of Management
GS-C	Graduate School-Camden
GS-N	Graduate School-Newark
GS-NB	Graduate School-New Brunswick
GSAPP	Graduate School of Applied and Professional Psychology
GSE	Graduate School of Education
GSM	Graduate School of Management
IHHCPAR	Institute for Health, Health Care Policy, and Aging Research
IMCS	Institute of Marine and Coastal Sciences
IRC	Interdisciplinary Research Center
MGSA	Mason Gross School of the Arts
NTI	National Transit Institute
RuCCS	Rutgers Center for Cognitive Science
SB-NB	School of Business-New Brunswick
SCILS	School of Communication, Information and Library Studies
SCJ	School of Criminal Justice

SL-C	School of Law-Camden
SL-N	School of Law-Newark
SMLR	School of Management and Labor Relations
SSW	School of Social Work
UC-C	University College-Camden
UC-N	University College-Newark
UC-NB	University College-New Brunswick
UMDNJ-	University of Medicine and Dentistry of New Jersey-
RWJMS	Robert Wood Johnson Medical School
UMDNJ-	University of Medicine and Dentistry of New Jersey-
SOM	School of Osteopathic Medicine
WIM	Waksman Institute of Microbiology

AGRICULTURAL ECONOMICS 030

Degree Program Offered: Master of Science

Director of Graduate Program: Professor Peter J. Parks,
108 Cook Office Building, Cook Campus (732/932-9161, ext. 46)

Members of the Graduate Faculty

Adesoji O. Adelaja, Associate Professor of Agricultural Economics, CC; Ph.D., West Virginia	Agricultural production economics; economics of the food industry; agricultural policy in urbanizing areas
Robin G. Brumfield, Associate Professor of Agricultural Economics and Marketing, CC; Ph.D., North Carolina State	Production economics of the horticultural industry
Donn A. Derr, Associate Professor of Agricultural Economics, CC; Ph.D., Ohio State	Natural and community resource economics
Pritam S. Dhillon, Associate Professor of Agricultural Economics, CC; Ph.D., Pennsylvania State	Production economics; farm management
Ramu Govindasamy, Assistant Professor of Agricultural Economics, CC; Ph.D., Iowa State	Agricultural marketing; resource and production economics; operations research
Rodolfo M. Nayga, Jr., Assistant Professor of Agricultural Economics, CC; Ph.D., Texas A&M	Consumer economics; agribusiness marketing
Peter J. Parks, Associate Professor of Agricultural Economics, CC; Ph.D., California (Berkeley)	Environmental and resource economics; econometrics
Carl E. Pray, Associate Professor of Agricultural Economics, CC; Ph.D., Pennsylvania	Agricultural development; international development science and technology policy
Leslie E. Small, Professor of Agricultural Economics, CC; Ph.D., Cornell	Agricultural development and irrigation management in Asia
Edmund M. Tavernier, Assistant Professor of Agricultural Economics, CC; Ph.D., Minnesota	Agricultural policy; trade
Daymon W. Thatch, Professor of Agricultural Economics, CC; Ph.D., Maryland	Economic theory; transportation economics; computer applications

Programs

The objective of the graduate program in agricultural economics is to develop the ability of students to apply economic theory and methods to significant problems facing society, with emphasis in the areas of natural resources and the environment, food distribution and processing, and international agricultural development.

The program offers the Master of Science degree. Two options are available: 24 credits of course work and the successful completion of a research thesis (for which 6 credits are granted); or 30 credits of course work and the submission of an acceptable 3-credit research paper. A full-time student normally takes two years to complete the program. Teaching and research assistantships that include tuition remission are available for a limited number of full-time students. To the extent that space is available, full-time students are assigned office space in the Cook Office Building, which houses the Department of Agricultural Economics.

All students are required to take introductory econometrics in their first term (unless taken prior to entering the program). The remaining core course requirements consist of three graduate courses: microeconomic theory, research methods, and applied econometrics. A comprehensive examination must be passed after completing the required core courses. In addition, at least two other

courses in agricultural economics must be taken. Selected courses may be taken from other programs including anthropology, computer science, economics, environmental sciences, geography, political science, psychology, sociology, statistics, and urban planning and policy development. There are no language or residency requirements for the degree.

A dual master's degree program is available with the graduate programs in urban planning and policy development, leading to a Master of Science degree in agricultural economics and either a Master of Science in urban planning and policy development or a Master of City and Regional Planning. Students are accepted independently into both graduate programs after separate application to each. Students must meet the requirements of both programs; however, with proper course selection, 9 credits of course work from each program may be applied to the other degree.

Applicants to the graduate program in agricultural economics are normally accepted only for matriculation in the fall term of each year. Applicants must submit scores of the general test of the Graduate Record Examination, three letters of recommendation, and a statement of personal objectives. Foreign applicants whose native language is not English must also take the Test of English as a Foreign Language (TOEFL), and should score at a level of approximately 600 or better. For applicants wishing to receive full consideration for financial aid, the application and all supporting credentials should be received by the Office of Graduate Admissions by March 1.

Individuals interested in the program but who have a limited undergraduate background in economics or agricultural economics should complete the following courses prior to applying to the program: an undergraduate course in intermediate microeconomic theory and one in intermediate macroeconomic theory; calculus (minimum of one, but preferably two terms); and introductory statistics. In a few cases, outstanding students who lack these courses may be admitted on a conditional basis, subject to successful completion of the specified courses. Credits from these courses may not be used to fulfill the requirements of the master's degree. Financial aid is not available to entering students admitted on a conditional basis, although such students may subsequently apply for aid upon completion of the conditions imposed at the time of admission.

Further details concerning the program can be found in a brochure entitled Graduate Program in Agricultural Economics, which is available upon request from the office of the graduate director.

Graduate Courses

- 16:030:502. (F) INTERNATIONAL AGRICULTURAL DEVELOPMENT (3)
Pray
The role of agriculture in economic development of low-income nations. Analysis of induced technical and institutional innovations, human capital investments, and public policies to promote development.
- 16:030:503. (F) RESEARCH METHODS (3)
Pray
The scientific method and applied research in economics. Planning of research, including problem definition and preparation of research proposals. Overview of commonly used analytical techniques.
- 16:030:504. (S) MARKETING AND FOOD SYSTEMS (3)
Nayga
Trends and issues in a consumer-driven food system; changing organization and structure of food markets; analysis of food consumption, prices, and expenditures.
- 16:030:506. (S) APPLIED ECONOMETRICS (3)
Adelaja
Applications of econometrics to agricultural demand and price related problems. Specification, estimation, and verification of single equation and simultaneous equation models. Topics include multicollinearity, autocorrelation, heteroscedasticity, dummy variables, analysis of variance, time series analysis and forecasting, and specification error.

16:030:507,508. (F,S) AGRICULTURAL ECONOMICS WORKSHOP (1.5,1.5)

Critical evaluation of the current research of faculty, graduate students, and invited scholars.

16:030:509. (S) ENVIRONMENTAL AND RESOURCE ECONOMICS (3) Parks

Externalities, public goods, and causes of environmental problems. Efficiency and welfare aspects of environmental policies. Common property resource problems and optimum extraction rates for renewable and nonrenewable resources.

16:030:511,512. (F,S) CONTEMPORARY TOPICS IN AGRICULTURAL ECONOMICS (3,3)

Hughes
Economic theory as it relates to problems in agriculture, environmental and resource economics.

16:030:530. (S) PRODUCTION ECONOMICS (3) Dhillon

Principles of production economics covering factor-product, factor-factor, and product-product relationships of the firm. Analysis of production costs, product supply, resource demand, and production equilibrium. Productivity analysis and location theory. Emphasis on application of theory to the agricultural sector of the economy.

16:030:562. (S) AGRICULTURAL POLICY (3) Small

Rationale of agricultural policies. Analysis of policies of selected nations for agricultural input and output prices, incomes, and trade. Effects of macroeconomic policies on the agricultural sector.

16:030:620. INDEPENDENT STUDY IN AGRICULTURAL ECONOMICS (3)

16:030:701,702. RESEARCH IN AGRICULTURAL ECONOMICS (BA,BA)

Research topic approved by graduate committee.

AGRICULTURAL ENGINEERING (see Bioresource Engineering 127)

ALCOHOL STUDIES 047

Program Offered: Certificate in Alcohol Studies

Director of the Certificate Program: Professor Erich W. Labouvie,
Center of Alcohol Studies, Smithers Hall, Busch Campus
(732/445-3580)

Participating Faculty

The following members and associate members of the graduate faculty, identified more fully under the subject headings indicated, are among those who participate in the certificate program in alcohol studies:

Marsha Bates, Psychology
Brenna Bry, Psychology
Elizabeth Epstein, Psychology
Dennis Gorman, Sociology
Valerie Johnson, Sociology
Erich W. Labouvie, Psychology
James Langenbucher, Psychology
Barbara S. McCrady, Psychology
Robert Pandina, Psychology
Regina Pietruszko, Biochemistry
Larissa Pohorecky, Pharmacology
Arthur Tomie, Psychology
Helene Raskin White, Sociology
G. Terence Wilson, Psychology

Certificate Program

Students with a special interest in any aspect of alcohol studies may pursue, in the course of their regular program of studies toward an advanced degree, a special concentration in alcohol studies. Those who fulfill the requirements are awarded a certificate in alcohol studies upon completion of their degree. The requirements for the certificate, many of which may be used to satisfy the student's graduate degree requirements, are:

1. Fifteen credits of course work in alcohol studies passed with a minimum grade average of B, of which 9 credits must be earned from the course offerings described below. The remaining 6 credits may also be distributed among approved courses within the student's or another discipline.
2. For students in graduate programs with a clinical component, e.g., clinical psychology, some applied clinical experience with alcoholic and alcohol-abusing clients is expected. To fulfill this requirement, students must have the equivalent of two terms of a one-day-per-week practicum in an alcoholism treatment setting. This is equivalent to N6 credits, 3 of which may be applied to the above 9-credit course requirement. Nonclinical practica, e.g., criminal justice, are available to interested students in other disciplines through special arrangement, but are not required.
3. Satisfactory completion of a research or scholarly project in the field of alcohol studies, including, but not limited to, the master's thesis or doctoral dissertation.
4. Approval by the director of the certificate program and by the director of the student's graduate degree program. Only students matriculated in a degree program may participate in the certificate program, although others may take courses with permission of course instructors. Further information is available from the director.

Graduate Courses

16:047:501. FOUNDATIONS IN ALCOHOL STUDIES: BIOLOGY, PSYCHOLOGY, AND SOCIOLOGY (3)
Bates, White

This course provides a review of the essential information about alcohol's acute and chronic effects on biology and behavior and the sociology of its use and misuse.

16:047:502,503. INDEPENDENT STUDY OF ALCOHOL-RELATED ISSUES (3,3)

Opportunity to pursue an area of interest concerning alcohol use and abuse under the supervision and guidance of a faculty member.

16:047:601,602. PRACTICUM: CLINICAL TREATMENT OF ALCOHOLIC PATIENTS (N-BA, N-BA)

Prerequisite: Previous experience in direct patient care. Required for students in degree programs that provide specific training in counseling or psychotherapy, such as clinical psychology (Ph.D. or Psy.D.), counseling psychology, social work, or psychiatric nursing.

16:830:565. PREVENTION OF ALCOHOL ABUSE AND ALCOHOLISM (3)

Gorman. Offered in alternate years.

History, philosophy, and research evidence concerning the impact of education and public policy measures on the prevention of alcohol abuse and other forms of drug abuse.

16:830:566. ASSESSMENT AND TREATMENT OF ALCOHOL ABUSE AND ALCOHOLISM (3)

McCrady. Offered in alternate years.

Review of theoretical models, research, and clinical techniques related to the assessment, diagnosis, and treatment of alcohol abuse and alcoholism, with discussion of ongoing clinical cases carried by students.

16:920:567. SOCIOLOGY OF ALCOHOL USE (3)

Overview of social issues and research.

ANIMAL SCIENCES 067

Degree Programs Offered: Master of Science, Doctor of Philosophy

Director of Graduate Program: Professor Michael Sukhdeo,
Bartlett Hall, Cook Campus (732/932-9406)

Members of the Graduate Faculty

- Juan P. Advis, Professor of Animal Sciences, CC; Ph.D., Southwestern Medical School (Dallas); D.V.M., Chile
Neuroendocrine control of reproduction
- Carol A. Bagnell, Associate Professor of Animal Sciences, CC; Ph.D., Medical College of Georgia
Endocrinology; corpus luteum function
- Rocco V. Carsia, Associate Professor of Anatomy, UMDNJ-SOM; Ph.D., Rutgers
Adrenocortical and adrenomedullary cell physiology
- Wendie Cohick, Assistant Professor of Animal Sciences, CC; Ph.D., Cornell
Regulation of mammary gland physiology by peptide growth factors
- Julie M. Fagan, Associate Professor of Animal Sciences, CC; Ph.D., Arizona
Proteases; mechanisms of protein breakdown in mammalian cells; muscle growth
- Harold Hafis, Visiting Professor of Animal Sciences, CC; Ph.D., Cornell
Physiology and endocrinology of reproduction
- Barry W. Jesse, Associate Professor of Animal Sciences, CC; Ph.D., Michigan State
Ruminant nutritional biochemistry; molecular biology
- Henry B. John-Alder, Associate Professor of Animal Sciences, CC; Ph.D., California (Irvine)
Hormonal regulation; organismal significance of reproductive physiology and behavior
- Larry S. Katz, Associate Professor of Animal Sciences, CC; Ph.D., California (Davis)
Endocrine regulation of reproductive behavior
- Gordon J. MacDonald, Professor of Anatomy, UMDNJ-RWJMS; Ph.D., Rutgers
Anterior pituitary, placenta, uterine, ovarian relationships
- Sasha Malamed, Professor of Anatomy, UMDNJ-RWJMS; Ph.D., Columbia
Adrenocortical cell structure and function; somatotroph secretions
- Karyn Malinowski, Associate Professor of Animal Sciences, CC; Ph.D., V.M.D., Pennsylvania
Clinical nutrition and behavior in horses
- Kenneth H. McKeever, Associate Professor of Animal Sciences, CC; Ph.D., Arizona
Neuroendocrine control of cardiorenal function in exercising horses
- Sarah L. Ralston, Associate Professor of Animal Sciences, CC; Ph.D., Pennsylvania; D.V.M., American College of Veterinary Medicine
Equine clinical nutrition; stress and immune function; aging metabolism
- Patricia A. Schoknecht, Assistant Professor of Animal Sciences, CC; Ph.D., Cornell
Nutritional physiology in swine
- Michael V.K. Sukhdeo, Associate Professor of Parasitology, CC; Ph.D., McGill
Biological processes contributing to successful parasitism in the vertebrate host
- Malcolm Watford, Associate Professor of Nutrition, CC; D.Phil., Oxford
Regulation of glutamine metabolism
- James E. Wohlt, Professor of Animal Sciences, CC; Ph.D., Illinois
Nutritional requirements for growth and lactation of livestock
- Edward J. Zambraski, Professor of Physiology, CC/FAS-NB; Ph.D., Iowa
Renal and exercise physiology

Associate Members of the Graduate Faculty

- Do Won Hahn, Technical Specialist/Research Collaborator, Ortho Pharmaceutical;
Ph.D., Missouri
Reproductive pharmacology
- John L. McGuire, Vice President, Basic Sciences, Ortho Pharmaceutical;
Ph.D., Princeton
Endocrine pharmacology
- Michael Westendorf, Extension Specialist for Animal Sciences, CC;
Ph.D., Kentucky
Livestock

Adjunct Members of the Graduate Faculty

- William Baumbach, Senior Research Biologist, American Cyanamid;
Ph.D., Princeton
Growth, molecular biology
- Larry Clark, Research Biologist, Monell Chemical Senses Center;
Ph.D., Pennsylvania
Molecular modeling and avian ecology
- Michael J. Daley, Project Leader and Senior Research Immunologist of Animal Sciences, CC; Ph.D., New Mexico School of Medicine
Cellular biology, tumor biology; immunology
- Norberto A. Guzman, Principal Scientist, R.W. Johnson Pharmaceutical Research Institute; Ph.D., University of Medicine and Dentistry of New Jersey/Rutgers
Capillary electrophoresis based assays for biological substances
- Alan Johnson, Professor of Physiology, Notre Dame; Ph.D., Cornell
Avian reproduction

- J. Russell Mason, Research Psychologist, Monell Chemical Senses Center;
Ph.D., Clark
Chemical sensory cues
- Larry Muir, A.L. Laboratories; Ph.D., Ohio State
Animal growth
- Catherine Ricks, Embrex, Inc.; Ph.D., Michigan State
Growth, molecular biology
- Kathleen Young, American Cyanamid; Ph.D., Florida
Reproductive biology, prolactin
- Lloyd H. Waxman, Research Scientist, Merck, Sharp, and Dohme Research Laboratories; Ph.D., Harvard
Mammalian and retroviral proteases; novel antihemostatic compounds

Programs

The graduate program in animal sciences involves faculty from the Departments of Animal Sciences and Nutrition of Cook College, the Department of Biological Sciences from the Faculty of Arts and Sciences—New Brunswick, and the Department of Anatomy at the University of Medicine and Dentistry of New Jersey—Robert Wood Johnson Medical School. In addition, researchers from local pharmaceutical companies serve as associate and adjunct members of the program. Major areas of research within the program include reproductive endocrinology and neuroendocrinology, nutrition of ruminant and nonruminant animals, and endocrine control of growth and metabolism. Domestic species currently utilized in research include the ovine, caprine, porcine, equine, bovine, and poultry. Other animal models include the rat, rabbit, guinea pig, and dog.

Applicants are expected to have an undergraduate major in animal sciences or a biological science. The Graduate Record Examination (general test and subject test in biology) must be taken. Prerequisites for admission include general chemistry, organic chemistry, and mathematics through calculus.

The master's program requirements include at least 12 credits of course work, more than 6 credits of research (30 credits total), and the successful completion of a research thesis.

The Ph.D. degree requires 72 credits, including at least 24 credits of course work (to include physiology and biochemistry) and 40 credits of research. Students must also pass a comprehensive examination, and successfully complete a research dissertation. There are no language or residency requirements.

Graduate Courses

16:067:501. CURRENT PRINCIPLES IN ANIMAL SCIENCES (3)

Sukhdeo et al. Offered fall 1997 and in subsequent alternate years. Current research and new technologies in the animal sciences. Topics include use of animals in research, management and feeding of domestic animals, nutrition, control of pathogens, animal immunology, physiology, biotechnology, and animal welfare.

16:067:502. PHYSIOLOGY OF REPRODUCTION (3)

Advis. Prerequisites: Organic chemistry, vertebrate physiology. Offered fall 1997 and in subsequent alternate years.

Reproductive physiology of the higher vertebrates. Topics include the estrous, menstrual, and ovulation cycles, pregnancy, and parturition and lactation. Emphasis on growth areas in the field of reproductive physiology research.

16:067:507. RUMINANT NUTRITION (4)

Wohlt. Lec. 3 hrs., lab. 3 hrs. Prerequisite: An introductory course in biochemistry or nutrition. Offered fall 1997 and in subsequent alternate years. Nutritional adequacy of feedstuffs as related to nutrient requirements and utilization, and metabolism in the ruminant animal for product development. Topics include experimental designs in ruminal nutrition, anatomy and physiology of the digestive tract, rumen fermentation, water lipid, carbohydrates and protein metabolism, appetite, palatability, and control of feed intake.

16:067:508. EQUINE EXERCISE PHYSIOLOGY (3)

McKeever. Prerequisites: An introductory course in physiology. Offered in the spring term. Physiological and environmental factors associated with exercise in the horse.

16:067:603,604. SPECIAL PROBLEMS IN ANIMAL SCIENCE (BA,BA)

16:067:611. TOPICS IN DOMESTIC ANIMAL NUTRITION (2)

Schoknecht. Offered fall 1998 and in subsequent alternate years.
Nutrient intake and metabolism and the partitioning of nutrients in pregnancy, lactation, and growth. Basic mechanisms and applications to production species.

16:067:612. RECENT ADVANCES IN ANIMAL REPRODUCTION (2)

Advis. Offered fall 1998 and in subsequent alternate years.
Survey and analysis of current literature pertaining to reproduction in domestic animals.

16:067:613. TOPICS IN ANIMAL GROWTH (2)

Offered spring 1998 and in subsequent alternate years.
Growth in farm animals considered from a mathematical, biochemical, nutritional, and endocrinologic basis.

16:067:614. CURRENT TOPICS IN METABOLIC REGULATION (2)

Jesse. Prerequisites: Biochemistry and a course in animal or poultry science.
Offered spring 1997 and in subsequent alternate years.
Consideration of metabolic regulation discussed in reference to domestic livestock from a biochemical and molecular biological viewpoint. Discussions based on presentations by the students and instructor using examples from the current literature.

16:067:615. TOPICS IN ANIMAL BEHAVIOR (2)

Sukhdeo. Offered spring 1997 and in subsequent alternate years.
Behavior of animals considered from endocrinological, evolutionary, and nutritional bases.

16:067:693,694. SEMINAR IN ANIMAL SCIENCE (1,1)

16:067:701,702. RESEARCH IN ANIMAL SCIENCE (BA,BA)

ANTHROPOLOGY 070

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Director of Graduate Program: Professor Susan M. Cachel,
Adams Building, Douglass Campus (732/932-9475)

Members of the Graduate Faculty

Myron J. Aronoff, Professor of Political Science, FAS-NB; Ph.D., Manchester
Political anthropology, complex societies; Israel, Middle East

Robert J. Blumenshine, Associate Professor of Anthropology, FAS-NB;
Ph.D., California (Berkeley)
Old world prehistory, zooarchaeology, hominid ecology and social organization; Africa

Susan M. Cachel, Associate Professor of Anthropology, FAS-NB; Ph.D., Chicago
Physical anthropology, primate evolution, morphology

Sheila C. Cosmidsky, Associate Professor of Sociology and Anthropology,
FAS-C; Ph.D., Brandeis

Cultural and medical anthropology, ethnic relations; Mesoamerica, Africa
Craig S. Feibel, Assistant Professor of Anthropology, FAS-NB; Ph.D., Utah
Environment and ecology in human evolution; rift valley sedimentation

Robin Fox, University Professor, FAS-NB; Ph.D., London
Kinship and marriage, evolution of behavior; North America,
Northwestern Europe

Peter J. Guarnaccia, Associate Professor of Human Ecology, CC;
Ph.D., Connecticut
Medical anthropology, nutritional anthropology, Hispanics in the U.S., cross-cultural psychiatry, anthropology and epidemiology; Mexico

John W. K. Harris, Chairperson and Professor of Anthropology, FAS-NB; Ph.D.,
California (Berkeley)
Paleoanthropology, old world prehistory, lithic analysis, method and theory; Africa

Dorothy L. Hodgson, Assistant Professor of Anthropology, FAS-NB; Ph.D.,
Michigan (Ann Arbor)

Gender, ethnicity, development, history, culture, and power; East Africa
Walton R. Johnson, Associate Professor of Africana Studies, FAS-NB;
Ph.D., London

Cultural anthropology, race relations, religion; Southern Africa
Daniel E. Lieberman, Assistant Professor of Anthropology, FAS-NB;
Ph.D., Harvard

Human evolution; craniofacial growth and development; bone biology

Uli H. Linke, Assistant Professor of Anthropology, FAS-NB; Ph.D.

California (Berkeley)
Cultural anthropology; body politics; gender and difference; memory, history,
and violence; European societies (Germany)

Scott L. H. Madry, Associate Director, Remote Sensing Center, CC; Ph.D., North
Carolina (Chapel Hill)

Remote sensing and GIS for regional settlement patterns and predictive models

Bonnie J. McCay, Professor of Anthropology and Ecology, CC; Ph.D., Columbia
Ecological and economic anthropology; fisheries, common property;
North Atlantic

M. Michael Moffatt, Professor of Anthropology, FAS-NB; Ph.D., Chicago
Cultural anthropology, caste, history, students; Southern India, United States

George E. B. Morren, Jr., Professor of Human Ecology, CC; Ph.D., Columbia
Human ecology, evolutionary theory, environment; Oceania, United States

William K. Powers, Professor of Anthropology, FAS-NB; Ph.D., Pennsylvania
Structural anthropology, religion, food, language, ethnomusicology; North
American Indians

Louisa Schein, Assistant Professor of Anthropology, FAS-NB; Ph.D.,
California (Berkeley)

Cultural politics, ethnicity, gender, transnational issues; China

Carmel Schrire, Professor of Anthropology, FAS-NB; Ph.D., Australian National
Prehistory, historical archaeology, human ecology, hunter-gatherers; Australia,
Southern Africa

Warren Shapiro, Professor of Anthropology, FAS-NB; Ph.D., Australian National
Social classification, symbols, history of anthropology; Australia, Lowland
South America

Nobuo Shimahara, Professor of Education, GSE; Ed.D., Boston
Japanese educational development, industrialization and culture

Janet Siskind, Associate Professor of Anthropology, FAS-N; Ph.D., Columbia
Economic anthropology, women, personality; Lowland South America, Africa

H. Dieter Steklis, Professor of Anthropology, FAS-NB; Ph.D., California (Berkeley)
Primateology, mountain gorilla conservation, biology of behavior; central-
East Africa

Heather Strange, Associate Professor of Anthropology, FAS-NB; Ph.D., New York
Cultural anthropology, culture and aging, women's studies, and gender issues;
Southeast Asia

Lionel Tiger, Charles Darwin Professor of Anthropology, FAS-NB; Ph.D., London
Political structures, sex roles, ethology, kibbutzim; Israel

Robert Trivers, Professor of Anthropology and Biological Sciences, FAS-NB;
Ph.D., Harvard

Principles underlying social evolution, evolutionary genetics

Andrew P. Vayda, Professor of Anthropology and Ecology, CC; Ph.D., Columbia
Human ecology, methodology and explanation, ecological and evolutionary theory;
Southeast Asia, New Guinea, Polynesia

Associate Members of the Graduate Faculty

Myra Bluebond-Langner, Professor of Anthropology, FAS-C; Ph.D., Illinois
Death, dying, bereavement, chronic illness; children and families

Anne-Marie Cantwell, Associate Professor of Anthropology, FAS-N;
Ph.D., New York

North American archaeology, prehistoric trade and ideology; complex societies

R. Brian Ferguson, Associate Professor of Anthropology, FAS-Newark,
Ph.D., Columbia

War, policing, contemporary "ethnic conflict," state-tribe interaction, historical
ecology; Lowland South America, Puerto Rico

Barbara E. Grandin, Assistant Professor of Human Ecology, CC; Ph.D., Stanford
Development resource management, agriculture, pastoralism; Africa

Chün-fang Yü, Professor of Religion, FAS-NB; Ph.D., Columbia
Culture and religion, Buddhism; China

Programs

Master of Arts students complete a written comprehensive examination after 30 credits or write a 6-credit master's thesis, with an oral examination, after 24 credits of course work. Students who have completed a master's degree may, with permission, proceed toward the Ph.D. degree. The Master of Philosophy degree is available to doctoral candidates.

All incoming graduate students must enroll in the Proseminars in Anthropology (16:070:501,502). Students in the human evolutionary studies track must take a course in basic statistics for research (01:960:401) or the equivalent, and enroll in Evolutionary Theory and Processes (16:070:508). All second-year students are expected to present a formal, scholarly paper during a day-long retreat.

In addition to the above requirements, Ph.D. students are required to take a course in research design or methods. Students must prepare written statements and comprehensive bibliographies in three areas of research. After completing 48 credits toward the Ph.D. degree, students undergo an oral examination on their dissertation proposal. When completed, the dissertation is evaluated in an oral dissertation defense.

While there is no formal fieldwork requirement, most students find fieldwork necessary for a doctoral degree. Students are urged to complete the Ph.D. degree within five years. There are no specific language requirements, but students are expected to acquire such languages as will be necessary for the successful completion of their work, including, for example, contact languages and others they may need for fieldwork and library research. There is no residency requirement.

Selected courses may be taken in other programs, such as geological sciences, history, political science, psychology, sociology, urban planning, ecology, nutrition, and computer science.

Graduate Courses

16:070:501. PROSEMINAR IN ANTHROPOLOGY I (3)
Presentations in areas of current faculty research.

16:070:502. PROSEMINAR IN ANTHROPOLOGY II (3)
A basic overview of the central concepts, theories, resources, and methods fundamental to cultural anthropology, human ecology, physical anthropology, and archaeology.

16:070:503. SOCIAL/CULTURAL ANTHROPOLOGY (3)
Social anthropology past and present; kinds of explanation, ethno-science, methods and fieldwork, new directions, process, transaction and symbolic interaction, modern role theory, and networks.

16:070:504. SOCIAL ORGANIZATION (3)
Examination of problems in social structure and organization with special reference to descent and alliance theory, kinship semantics and formal analysis, and evolution of social systems.

16:070:505. HISTORY OF ANTHROPOLOGICAL THEORY (3)
Origin and development of anthropology; surveying the central ideas of major figures from the seventeenth century to the present.

16:070:506. RESEARCH METHODS IN SOCIAL/CULTURAL ANTHROPOLOGY (3)
Survey and critical evaluation of methods in current anthropology, using original research as data.

16:070:508. EVOLUTIONARY THEORY AND PROCESSES (3)
Natural selection, adaptation, evolutionary genetics, speciation, extinction, adaptive radiation, and macroevolution with special emphasis on human and nonhuman primate evolution.

16:070:509. KINSHIP IN NATURE AND CULTURE (3)
Examination of the anthropological orthodoxy that kinship systems are a property of culture and hence of human society; systematic examination of the role of kinship in the lives of other species, particularly the higher primates. The adaptational significance of human innovations.

16:070:510. SOCIAL IMPLICATIONS OF GENDER DIFFERENCES (3)
A consideration of the results of the interaction between the biological fact of gender differences and the varieties of cultural response to and interpretation of these differences.

16:070:511. ANTHROPOLOGY OF GENDER (3)
Uses recent ethnographic and ethnological studies of women to appraise such anthropological assumptions as the homogeneity of simple societies, the harmony and stability of large or small societies, the primacy of the family, and the validity of ethnographic data.

16:070:512. COGNITIVE ANTHROPOLOGY (3)
Theoretical and methodological issues in the study of culture and cognition.

16:070:513. LANGUAGE DEVELOPMENT (3)
Animal communication; theories of the origin of language; biological basis of language. Cross-cultural comparison of language development in children and language universals.

16:070:514. LANGUAGE IN CULTURE AND SOCIETY (3)
Cultural implications of language and its use. Relations between language and culture, language and cognition, language and social group.

16:070:516. SEXUALITY IN A CROSS-CULTURAL PERSPECTIVE (3)
Ethnographic issues in study of sexuality; major approaches; construction of sexuality, eroticism, and gender in wide range of cultures; relation of erotic culture to wider social order, history.

16:070:517. PSYCHOLOGICAL ANTHROPOLOGY (3)
The study of interrelations among personality and culture and social structure. Emphasis on the comparative perspective.

16:070:518. CORPORATE AND PERSONAL VIOLENCE (3)
Analysis of aggression and violence as features of individual and group behavior. Biological, evolutionary, sociological, and philosophical approaches.

16:070:519. POLITICAL ORGANIZATION (3)
Explorations of political organization of human societies at all stages of sociocultural development, beginning with hunter-gatherers and concluding with modern industrial state systems.

16:070:520. ANALYSIS OF STATE SYSTEMS (3)
The anthropological approach to the analysis of nation-states with special reference to boundary mechanisms, value systems, and the political control of everyday activities.

16:070:521. ANTHROPOLOGY OF INDUSTRIAL SOCIETY (3)
Effects of the industrial system on kinship behavior, socialization of the young, the use of time, ethnicity and kinship interests, and "alienation." Limited, focused research project by the student.

16:070:522. ANTHROPOLOGY OF RELIGION (3)
Religion in the known cultures of the world, with special attention to ritual and myth. Detailed examination of particular ethnographic sources. The link between religious universals and theories of human nature.

16:070:523. CULTURE AND AGING (3)
Human aging in life course perspective. Focus on cross-cultural and intracultural diversity.

16:070:524,525. WORLD ETHNOGRAPHIC AREAS I,II (3,3)
Study of selected ethnographic areas such as Africa, Southeast Asia, India, or North America; cross-cultural analysis within an area. General theoretical and methodological issues as well as those unique to the particular area.

16:070:527. (F) THE ETHNOLOGY OF INEQUALITY: RACE, CLASS, AND ETHNICITY (3)
Siskind
Survey of anthropological literature on the relationships among race, class, and ethnicity. Ethnographic methods and the comparative approach to the study of hegemony, resistance, and conflict among groups defined as "racial" or "ethnic."

16:070:528. EXPLANATION IN ANTHROPOLOGY (3)
Vayda
Analysis of modes of explanation used in anthropological studies, with consideration of such issues as holism versus individualism; essentialism versus nominalism; action explanations and other explanations; generalization and particularism; and the problem of other cultures and other periods.

16:070:530. PROBLEMS IN SOCIAL ANTHROPOLOGY (3)
For graduate students wishing to pursue advanced work supplementary to that provided in formal courses. Program of reading and conferences arranged by professor in charge.

16:070:531. PROBLEMS IN COMPARATIVE ANALYSIS (3)

For graduate students wishing to pursue advanced work in areas not provided for in formal courses. Conferences, reading, and empirical work arranged in consultation with the professor in charge.

16:070:532. PROBLEMS IN ETHNOGRAPHY (3)

For graduate students wishing to pursue advanced work in areas not provided for in formal courses. Conferences, reading, and empirical work arranged in consultation with the professor in charge.

16:070:543. ECOLOGICAL ANTHROPOLOGY (3)

The ecological approach in anthropology. Consideration of theory, method, and data analysis in ecological studies.

16:070:544. HUMAN ECOLOGY AND MODERN PROBLEMS (3)

Methods for the analysis of current socioeconomic, health, and environmental problems involving interactions between people and their environment.

16:070:545. ANTHROPOLOGY OF DEVELOPMENT (3)

Economic development and social change in third-world and advanced industrial societies. Theories of social change applied to areas such as education, urban planning, and social welfare.

16:070:546. MEDICAL ANTHROPOLOGY (3)

Examination of sociocultural factors influencing health and illness, and the impact of social and cultural change on disease patterns and health-care systems. Includes ethnographic studies of systems of illness causation, prevention, diagnosis, and treatment.

16:070:547. PARTICIPATORY PLANNING IN APPLIED ANTHROPOLOGY (3)

Role of applied anthropologist in facilitating broad public participation in development projects and other kinds of change initiatives; ethics and professional practice.

16:070:550. ECONOMIC ANTHROPOLOGY (3)

Survey of theories and methods in economic anthropology.

16:070:551. MARITIME ANTHROPOLOGY (3)

Prerequisite: Course in anthropological theory.

An advanced course in sociocultural, economic, and ecological anthropology focused on the study of fishing and other maritime communities and problems concerning human relationships to natural resources.

16:070:552. SEMINAR IN ECOLOGICAL ANTHROPOLOGY (3)

Interrelations of ecological and socioeconomic changes as an interdisciplinary problem area.

16:070:553. PROBLEMS IN HUMAN ECOLOGY I (3)

For graduate students wishing to pursue advanced work in areas not provided for in formal courses. Conferences, reading, and laboratory work arranged in consultation with the professor in charge.

16:070:554. PROBLEMS IN HUMAN ECOLOGY II (3)

For graduate students wishing to pursue advanced work in areas not provided for in formal courses. Conferences, reading, and laboratory work arranged in consultation with the professor in charge.

16:070:558. EVOLUTION OF THE HOMINIDAE (3)

The fossil Old World higher primates; the Miocene fossil apes; problems of when, where, and why hominids first appeared; the australopithecines of Plio/Pleistocene Africa; early genus *Homo*; *Homo erectus*; Neanderthals; the appearance of anatomically modern man; Paleolithic cultures.

16:070:559. EVOLUTION OF BEHAVIOR (3)

Consideration of human and primate behavior from an evolutionary perspective. Topics include aggression, territorial behavior, sexuality and mating systems, socialization, and sex roles in primate society.

16:070:560. NATURAL SELECTION AND SOCIAL THEORY (3)

Recent papers on key topics in social evolution such as female choice, symmetry, parasites, virulence, kinship, homosexuality, reciprocal altruism, and self-deception. Special emphasis on human data.

16:070:563. THE BIOLOGY OF SOCIAL BONDS (3)

The dynamics of basic social bonds, such as the mother-child bond, the mating bond, the bond between older and younger males, and the sibling bond, analyzed in terms of their evolution and of their significance for micro and macro social structures.

16:070:564. PROBLEMS IN THE BIOLOGY OF SOCIAL RELATIONS (3)

The place of biology in the social sciences, relevance of the comparative sociology of animal societies; the phylogeny of behavior; special problems of aggression, territory, sexual and parental relationships, and language.

16:070:566. HUMAN OSTEOLOGY (3)

Lec. 2 hrs., lab 1 hr.

An examination of primate morphology with special emphasis on the evolution of human morphological adaptations.

16:070:567. HUMAN VARIATION (3)

Variation in body size, shape. Structural morphology, pigmentation, and biochemistry among living humans; climatic adaptation, disease, and human evolution; population origins through migration or local continuity through evolutionary time.

16:070:568. PRIMATE ECOLOGY AND SOCIAL BEHAVIOR (3)

The behavior of the nonhuman primates, emphasizing the relationship between ecology and social organization; the structure of social groups; and the development of behavior.

16:070:570. HOMINID TAXONOMY AND SYSTEMATICS (3)

Implications of the existence of sympatric species; limits to similarity imposed by the coexistence of competing species; controversies surrounding the establishment of taxa; phylo-genetic reconstructions.

16:070:571. PRIMATE EVOLUTION AND RADIATIONS (3)

Exploration of primate history in terms of evolutionary radiations. Emphasis on entrance to and radiation within new adaptive zones and the change of these zones through time, using morphological and paleoecological information.

16:070:572. BIOLOGY OF HUMAN BEHAVIOR (3)

Current uses and philosophical-historical bases of biological explanations of human behavior in social sciences. Role of animal behavior, cross-cultural, and genetic-neuro-hormonal data in the analysis of human social behavior.

16:070:573. PROBLEMS IN BIOLOGICAL ANTHROPOLOGY (3)

For graduate students wishing to pursue advanced work in areas not provided for in formal courses. Conferences, reading, and laboratory work arranged in consultation with the professor in charge.

16:070:578. OLD WORLD PREHISTORY (3)

Key data and current interpretive models concerning the archaeology of hominid adaptations from earliest times through the Neolithic in the Old World.

16:070:579. NEW WORLD PREHISTORY (3)

Key data and current interpretive models concerning the form, stability, and change of cultures throughout the pre-Columbian New World.

16:070:580. RESEARCH METHODS AND THEORY IN ARCHAEOLOGY (3)

Conceptual basis and assumptions used in the formulation of research designs and the interpretation of research results; examination of fieldwork problems and techniques, with emphasis on the problems of observation, use of documentary sources, surveying and excavation, and use of quantitative data.

16:070:581. HISTORICAL DEVELOPMENT OF ARCHAEOLOGY (3)
Origins of classical and Near Eastern archaeology in Greek and Roman philosophy, and developments from the revival of classical learning in the Renaissance. Development of prehistoric archaeology and New World archaeology as a subfield of general anthropology.

16:070:582. PALEOECOLOGY AND ARCHAEOLOGY (3)
Methods of environmental reconstruction. Emphasis on the evolution of subsistence economies, with special attention to the origins of animal and plant domestication.

16:070:583. ORIGINS OF AGRICULTURE (3)
Archaeological, zoological, botanical, geographical, and ethnographic data relating to ancient and modern hunter-gatherers and farmers are used to compare and contrast their demography, material culture, and economy, so that the origins of settled life can be seen.

16:070:584. THE BUILT ENVIRONMENT (3)
Prerequisite: One year of graduate work in anthropology.
Anthropological principles applied to the planning process in contemporary society. Emphasis on political, environmental, technological, and biological planned change.

16:070:585,586. PROBLEMS IN ARCHAEOLOGY (3,3)
For graduate students wishing to pursue advanced work in areas not provided for in formal courses. Conferences, reading, and laboratory work arranged in consultation with the professor in charge.

16:070:587. FIELD STUDY IN ARCHAEOLOGY (3)
Minimum of six to ten weeks at field location. Course may be repeated with permission of program director.
Supervised participation in fieldwork with instruction in excavation methods and practices. Personnel and field project location vary from year to year.
Fees: tuition, transportation to site, room, and board.

16:070:602. SEMINAR IN SOCIAL THEORY (3)
Prerequisites: 18 credits in graduate social science courses or permission of instructor.
The intellectual history and philosophy of social science; exploration of the origins of the social and behavioral sciences in the western humanistic tradition.

16:070:626. VISUAL ANTHROPOLOGY (3)
Study, use, and production of anthropological and ethnographic photographs, films, and videos for research and communication; study of human behavior through visual media.

16:070:701,702. RESEARCH IN ANTHROPOLOGY (BA,BA)

ART HISTORY 082

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Certificate Program Offered: Certificate in Museum Studies
Director of Graduate Program: Professor Catherine Puglisi,
212 Voorhees Hall, College Avenue Campus (732/932-7819)

Members of the Graduate Faculty

Matthew Baigell, Professor of Art History, FAS-NB; Ph.D., Pennsylvania
American art
Olga Berendsen, Associate Professor Emerita of Art History, FAS-NB;
Ph.D., New York
Baroque
Martin Eidelberg, Professor of Art History, FAS-NB; Ph.D., Princeton
Baroque and rococo; modern decorative arts
Rona Goffen, Professor of Art History, FAS-NB; Ph.D., Columbia
Italian Renaissance
Archer St. Clair Harvey, Associate Professor of Art History, FAS-NB;
Ph.D., Princeton
Early Christian and Byzantine

Angela Howard, Associate Professor of Art History, FAS-NB; Ph.D., New York
East Asian
John F. Kenfield III, Associate Professor of Art History, FAS-NB; Ph.D., Princeton
Greek and Roman
Tod A. Marder, Professor of Art History, FAS-NB; Ph.D., Columbia
Renaissance; baroque
Joan M. Marter, Professor of Art History, FAS-NB; Ph.D., Delaware
Modern art; twentieth-century art; gender studies; museum studies
Sarah E. Blake McHam, Professor of Art History, FAS-NB; Ph.D., New York
Italian Renaissance
Elizabeth Parker McLachlan, Associate Professor of Art History, FAS-NB; Ph.D.,
Courtauld Institute (London)
Medieval
Catherine R. Puglisi, Associate Professor of Art History, FAS-NB;
Ph.D., New York
Baroque
Jocelyn P. Small, Professor of Art History and Director, United States Center,
Lexicon Iconographicum Mythologiae Classicae; Ph.D., Princeton
Classical art and archaeology; iconography; Etruscology
James Smalls, Assistant Professor of Art History, FAS-NB; Ph.D., California
(Los Angeles)
Modern; African-American art
Jack J. Spector, Professor of Art History, FAS-NB; Ph.D., Columbia
Modern art and theory of criticism

Associate Members of the Graduate Faculty

Sarah Brett-Smith, Associate Professor of Art History, FAS-NB; Ph.D., Yale
African
Phillip D. Cate, Director of the Zimmerli Museum; M.A., Arizona State
History of the print; French nineteenth-century graphics
Mariët Westermann, Assistant Professor of Art History; Ph.D., NYU
Northern Renaissance and baroque

Programs

The faculty in art history offers degree programs leading to the M.A. and Ph.D. degrees in the major fields of Western art, sub-Saharan African art, and East Asian art. The faculty also offers a program leading to a certificate in museum studies. Both degree programs are designed to provide a well-rounded and comprehensive knowledge of the major historical periods. The Ph.D. program, in addition, allows for specialization in one of the major fields.

Applicants should have a minimum of eight art history courses as prerequisite for admission. Promising students who have taken fewer courses may be admitted but must make up deficiencies before beginning the graduate curriculum.

Requirements for the Ph.D. include fourteen courses (42 credits), reading knowledge of two languages, of which one must be German (one proficiency examination must be taken by the second term of study), the qualifying examination in one of the major art historical periods, and acceptance of the dissertation. After completion of eight courses, the student's work is reviewed to determine if he or she will be allowed to continue for the Ph.D.

The M.A. program is designed for those who do not plan to pursue the Ph.D., and for those pursuing the certificate in museum studies. Requirements include ten courses (30 credits), one foreign language, and a master's essay.

There are no residence requirements for either degree program. Students who have earned an M.A. degree elsewhere are welcome to apply for admission to the Ph.D. program. The curriculum is flexible and allows students to explore interests in such areas as African-American studies, African studies, American studies, Asian studies, classics, archaeology, film studies, gender studies, medieval studies, renaissance studies, and theory and criticism.

Further information on program requirements (e.g., the ratio of 500- to 600-level courses, timing sequences between M.A. examination and submission of master's paper) can be found in the booklet *The Graduate Program in Art History*, which can be obtained from the art history graduate office in Voorhees Hall.

Graduate Courses

16:082:503,504. INDIVIDUAL STUDIES IN ART HISTORY (BA,BA)

16:082:506. (S) APPROACHES TO ART HISTORY (3)

Spector

The history of art history and explanation of the basic methodologies (iconography, connoisseurship). Recent challenges from outside the field—political, psychological, semiotic.

16:082:509. AFRICAN ART AND ARCHITECTURE (3)

Brett-Smith

Survey of the art history of West Africa. Examines the different theoretical and practical models that have been used to look at African art history, their origins in the “discovery” of African art, and their relationship to multiculturalism and current attempts to study the “other.”

16:082:511. (F) ARCHAIC GREEK ART (3)

Kenfield

Examination of the origins and early development of Greek architecture, sculpture, and painting.

16:082:514. (S) HELLENISTIC PAINTING AND SCULPTURE (3)

Kenfield

Examination of the development of Hellenistic sculpture and painting from its origins in the late fifth century B.C.

16:082:515. (F) ETRUSCAN ART (3)

Small

Focuses on the development of an independent culture within a world increasingly dominated by Greece and Rome.

16:082:517. (S) ANCIENT MOSAICS (3)

Kenfield

Examination of mosaic painting from its origins through the early Byzantine period.

16:082:521. (F) ART OF LATE ANTIQUITY (3)

Harvey

Art and architecture of the mediterranean world, third to seventh centuries. Emphasis on religious and political contexts and theories of stylistic and iconographic development.

16:082:522. (F) MEDIEVAL MANUSCRIPTS (3)

McLachlan

Introduction to codicology and manuscript production, development of ornament, etc., followed by specialization in a specific stylistic period or genre such as Psalters or Bibles.

16:082:524. (S) CHRISTIAN ICONOGRAPHY (3)

Harvey

The origin and development of Christian imagery. Emphasis on methods of iconographical research.

16:082:525. (F) THE MEDIEVAL TREASURY (3)

McLachlan

Investigation of the materials, techniques, forms, and functions of medieval liturgical and secular treasures: precious metals, enamels, ivory, and textiles included.

16:082:528. MODERN ARCHITECTURE (3)

Major architects and theorists in Europe and the Americas from the eighteenth century to the present. Emphasis on reading of theoretical texts and analysis of the most important architects and buildings from Laugier to postmodernism.

16:082:529. DESIGN OF CITIES (3)

History of urban design in Europe and the Americas from the seventeenth century to the present, with emphasis on major cities, their principal planning episodes, and urban planning theory and practice in cultural and social perspective.

16:082:530. ARCHITECTURE AND THE CITY (3)

The relationship between architecture and urban design in select case studies of European and American cities. Topics include: modern Paris, Pombaline Lisbon, colonial Rio de Janeiro, Brasilia and the modernist utopia.

16:082:531. ITALIAN GOTHIC SCULPTURE (3)

McHam

Sculpture in Italy focusing on major artists, such as Nicola and Giovanni Pisano, Andrea Pisano, Jacopo della Quercia, and Ghiberti.

16:082:532. (S) ITALIAN PAINTING IN THE AGE OF DANTE (3)

Goffen

Style, patronage, and iconography in painting from 1250–1400, emphasizing the work of such masters as Giotto, Duccio, Simone Martini, and the Lorenzetti.

16:082:533. (S) ITALIAN FIFTEENTH-CENTURY SCULPTURE (3)

McHam

Major Italian fifteenth-century sculptors in Florence such as Donatello, Desiderio, and Verrocchio are discussed in comparison with sculptors active in other centers like Milan, Venice, and Rome.

16:082:534. (S) VENETIAN PAINTING (3)

Goffen,McHam

Painting in Venice and the Venetian empire between the fourteenth and sixteenth centuries, focusing on Giovanni Bellini, Titian, Tintoretto, and Veronese.

16:082:535. (F) CENTRAL ITALIAN SIXTEENTH-CENTURY

PAINTING (3)

Goffen,McHam

Painting in Florence and Rome from 1480 to the end of the sixteenth century; the High Renaissance (Leonardo, Michelangelo, and Raphael); Mannerism, and Counter-Reformation painting.

16:082:536. (S) RENAISSANCE ARCHITECTURE (3)

Marder

Modern architecture in Italy from 1400 to 1600, including issues of form, symbol, meaning, and intention. The influence of engineering, urban planning, military architecture, garden design, and theory as well as practice are addressed.

16:082:537. (F) EARLY BAROQUE PAINTING IN ITALY (3)

Puglisi

Painting in Rome ca. 1600, focusing on the stylistic innovations and legacy of the Carracci and Caravaggio in the context of contemporary artistic trends, patronage, and theory.

16:082:538. (S) BERNINI (3)

Marder,Puglisi

A consideration of Bernini's career as the universal artistic genius of the Roman baroque. Sculpture, architecture, and painting and their contexts considered.

16:082:539. (F) VELAZQUEZ AND BAROQUE PAINTING IN SPAIN (3)

Puglisi

Major achievements of the seventeenth-century painter and his impact on Spanish baroque painting.

16:082:540. (S) ENGLISH ARCHITECTURE (3)

Marder

The arrival and development of classical architecture in England from 1500 to 1780. Emphasis on individual styles, urban schemes, and cultural contexts.

16:082:541. (F) SEVENTEENTH-CENTURY NORTHERN EUROPEAN

PAINTING (3)

Eidelberg

A study of major stylistic and thematic currents of the baroque as interpreted in the Netherlands, Flanders, and France.

- 16:082:542. (S) ITALIAN SIXTEENTH-CENTURY SCULPTURE (3)
McHam
Major emphasis is on Michelangelo; his influence on other sixteenth-century sculptors like Bandinelli, Cellini, and Giambologna, and the reaction against his dominating style.
- 16:082:543. DUTCH GENRE PAINTING IN THE SEVENTEENTH CENTURY (3)
Westermann
Recent interpretations of the themes and pictorial "realism" of Dutch seventeenth-century genre painting and its antecedents. Artists include Frans Hals, Gerard Dou, Gerard Terborch, Johannes Vermeer, and Jan Steen.
- 16:082:544. (S) RUBENS (3)
An in-depth study of the Flemish master's works and their impact on European baroque art in terms of style and iconography.
- 16:082:546. (S) REMBRANDT (3)
Westermann
An in-depth study of the Dutch master's works, the evolution of his students' art, and their relation to Northern tradition.
- 16:082:547. (F) BAROQUE ARCHITECTURE (3)
Marder
Emphasizing seventeenth-century Rome, the great architects Bernini, Borromini, and Pietra da Cortona are discussed in depth. Issues of urbanism, the contributions of the Piedmontesi architects, and eighteenth-century architecture are examined.
- 16:082:548. (S) PRINTS AND PRINTMAKERS (3)
Westermann
History of printmaking emphasizing the processes and major artists involved.
- 16:082:550. (S) NORTHERN BAROQUE AND ROCOCO SCULPTURE (3)
Consideration of Netherlandish, French, English, and German sculpture from 1600 to 1775. Emphasis on the leading masters of each school and the types of sculptural commissions.
- 16:082:551. (S) ROMANTIC ART (3)
Spector
Nature, sources, and influences of nineteenth-century French romanticism (Gros, Gericault, Delacroix, Ingres), with some consideration of literature (Hugo, Gautier, Baudelaire).
- 16:082:552. (F) DAWN OF ABSTRACTION (3)
Spector
Analysis of the theories of critics and the practices of painters and sculptors in Europe from 1900 to 1920 in order to understand why and how abstraction emerged and evolved.
- 16:082:553. (F) SURREALISM (3)
Spector
The history of surrealist painting and writing as antimodernist avant-garde concerned with psychological and political questions.
- 16:082:554. NINETEENTH-CENTURY AMERICAN LANDSCAPE PAINTING (3)
Baigell
Consideration of various movements including the Hudson River School, luminism, American Barbizon, and impressionist painting as well as landscapes of the west.
- 16:082:555. (F) NINETEENTH-CENTURY REALISM (3)
Spector, Smalls
Emphasis on social and political themes in French art (Courbet, Manet) and literature (Balzac, Flaubert, Zola).
- 16:082:556. (F) AMERICAN ART, 1900-1960 (3)
Baigell
Consideration of various movements including the ashcan school, early modernism, precisionism, regionalism, social realism, and abstract expressionism.
- 16:082:557. (F) FRENCH EIGHTEENTH-CENTURY PAINTING (3)
Eidelberg
A study of rococo, neoclassicism, and early romanticism from the reign of Louis XIV to Napoleon. Focus on the emergence of modern subject matter.
- 16:082:559. (F) PICASSO (3)
Spector
Covers the full range of Picasso's artistic creations and also his writings, political involvement, and personality.
- 16:082:561. (F) POST-IMPRESSIONISM (3)
Developments between impressionism and fauvism mainly in France (Cezanne, Gauguin, Van Gogh, Seurat). Discussions will include nabis symbolism and art nouveau.
- 16:082:563. (F) MUSEUM TRAINING I (E3)
The history, philosophy, organizational structures, and operations of the museum as a sociocultural institution.
- 16:082:568. HISTORY OF MODERN DECORATIVE ARTS (3)
Eidelberg
Survey of both design and crafts of all media from 1850 to the present, from historicism, art nouveau, art deco to post-modernism; focus on the relation of design to the fine arts.
- 16:082:571. (F) GERMAN EXPRESSIONISM (3)
Marter, Spector
German expressionist art in the context of nineteenth- and twentieth-century European modernism. Literary, philosophical, and psychological aspects considered.
- 16:082:574. (S) FUTURISM (3)
Marter
The impact of futurist art and theory in Italy, France, Russia, Germany, and Great Britain. Futurist manifestos and their importance to modernism.
- 16:082:577. (F) MODERN SCULPTURE (3)
Marter
Major developments in European and American sculpture from 1880 to 1960. Beginning with Auguste Rodin and his impact on early modernists, and including sculpture produced in France, Germany, Italy, and the United States.
- 16:082:580. (S) CUBISM AND GEOMETRIC ABSTRACTION (3)
Marter
Origins of cubism, and links to cultural trends and scientific developments of the period. In addition to analytical and synthetic cubism, Russian constructivism, de Stijl, bauhaus art, and international constructivism are examined.
- 16:082:581. ITALIAN BAROQUE SCULPTURE (3)
Puglisi
Major sculptors and trends in seventeenth-century Italian sculpture.
- 16:082:582. SEMINAR, EAST ASIAN BIBLIOGRAPHY AND METHODS (3)
Howard. Required of students majoring in Asian art.
Important sources for researching Chinese art.
- 16:082:583. TOPICS IN EAST ASIAN ART HISTORY (3)
Howard
Criteria of style and iconography for genuine Buddhist sculpture. Sculpture executed in different media (gilt bronze, stone, wood, and lacquer) and at different times.
- 16:082:595,596. MUSEUM INTERNSHIP I, II (E3,E3)
Must complete both courses to receive credit. Prerequisites: 16:082:563 and permission of program director.
Internships tailored to the individual's special interest areas.
- 16:082:597,598. TEACHING APPRENTICESHIP (N1.5,N1.5)

- 16:082:599. MUSEUM INTERNSHIP III (E3)
Prerequisites: Completion of 16:082:563 and permission of instructor.
Internship tailored to the individual's special interest areas.
- 16:082:601,602. SPECIAL TOPICS IN ART HISTORY (3,3)
- 16:082:607. (F) MASTER DRAWINGS (3)
Eidelberg
Seminar on the history of drawings, from the Renaissance to modern times, with emphasis on studio traditions and modern connoisseurship.
- 16:082:612. (S) PROBLEMS IN ANCIENT ART (EARLY GREEK ARCHITECTURAL SCULPTURE) (3)
Kenfield
Seminar on the problems of the origins of the early Greek architectural orders and the kind of sculpture used to decorate those orders.
- 16:082:615. (F) LYSIPPOS AND THE BEGINNINGS OF HELLENISTIC SCULPTURE (3)
Kenfield
Seminar on the careers of Lysippos and the members of his school and their paramount importance to the development of Hellenistic sculpture.
- 16:082:620. (S) PROBLEMS IN EARLY CHRISTIAN AND BYZANTINE ART (3)
Harvey
Seminar focusing on a specific medium such as ivory carving, a specific problem such as cultural context, or a specific period such as the Macedonian Renaissance.
- 16:082:622. (S) PROBLEMS IN MEDIEVAL ART (3)
McLachlan
Seminar with specialized focus on varied topics such as cycles on carved doors, reliquaries, or in monumental painting.
- 16:082:624. (F) DONATELLO (3)
McHam
Seminar on Donatello's career: his formation, his influence on his contemporaries such as Masaccio, Desiderio, and altar artists like Verrocchio and Michelangelo.
- 16:082:630. (S) PROBLEMS IN ITALIAN RENAISSANCE PAINTING (3)
Goffen
Seminar on various topics in Italian painting from 1400 to 1500 such as patronage, gender studies, iconography, work of an individual artist, and cultural context.
- 16:082:632. (S) PROBLEMS IN EARLY ITALIAN PAINTING (3)
Goffen
Seminar on various topics such as the relation of art and literature, Mendicant spirituality, public and private patronage, specialized study of such masters as Giotto, the Lorenzetti, and Paolo da Venezia.
- 16:082:634. (S) THE HIGH RENAISSANCE (3)
Goffen
Seminar on various topics in Italian art from 1480 to 1600 such as cultural context, patronage, specialized study of one artist's career, the Mannerist crisis, and art theory in painting and sculpture.
- 16:082:635. (F) PROBLEMS IN LATER RENAISSANCE ART (3)
McHam
Topics in Italian painting, 1500 to 1600, involving patronage, gender studies, iconography, works of an individual artist, and/or cultural context.
- 16:082:636. (S) TITIAN (3)
Goffen
Titian's career considered in the context of sixteenth-century society, focusing on his stylistic and thematic innovations in sacred and secular art, notably his depiction of women.
- 16:082:638. BAROQUE SEPULCHRAL ART (3)
Seminar on funerary imagery of the seventeenth century as expressed in temporary catafalques and permanent tomb monuments. Consideration of biography, allegory, and European traditions.
- 16:082:640. PROBLEMS IN NORTHERN BAROQUE ART (3)
Seminar emphasizing either specific centers of art production or iconographic issues.
- 16:082:641. (S) PROBLEMS IN BAROQUE ART OF ITALY AND SPAIN (3)
Marder, Puglisi
Seminar on topics related to the leading artists of the period. Matters of style, iconography, religious and political contexts, patronage, and cultural milieu considered.
- 16:082:643. (F) PROBLEMS IN EIGHTEENTH-CENTURY ART (3)
Eidelberg
Topics related to leading artists of the period, with a primary focus on French art: genre painting and exoticism, the use of drawings, patronage.
- 16:082:646. (S) SEVENTEENTH-CENTURY PATRONS AND PATRONAGE (3)
Seminar examining the evolving roles of collectors and art dealers, the social context of art collecting, and its impact on artists.
- 16:082:650. (S) NORTHERN ROMANTICISM (3)
Seminar on specialized topics.
- 16:082:653. (F) PROBLEMS IN NINETEENTH-CENTURY PAINTING (3)
Spector
Seminar on special topics in nineteenth-century painting: one or more major figures, landscape, art and literature, art criticism.
- 16:082:654. (S) NINETEENTH-CENTURY FRENCH GRAPHICS (3)
Cate
Seminar based on the Zimmerli Art Museum's nineteenth-century graphics arts collection.
- 16:082:655. (F) PROBLEMS IN TWENTIETH-CENTURY ART (3)
Marter
Seminar on special topics in painting and/or sculpture.
- 16:082:656. (S) PROBLEMS IN AMERICAN ART (3)
Baigell
Aspects of nineteenth-century American art.
- 16:082:657. (F) PROBLEMS IN MODERN ART (3)
Spector
Seminar on special topics in twentieth-century painting: surrealism, the psychology of art, theories of criticism (psychoanalytic, feminist, semiotic).
- 16:082:659. (S) AMERICAN GENRE PAINTING (3)
Baigell
Seminar examining selected problems in genre painting.
- 16:082:660. (S) PROBLEMS IN MODERN AMERICAN ART (3)
Seminar on specialized topics.
- 16:082:697,698. EXHIBITION SEMINAR (3,3)
Seminar on research problems and on relevant aspects of the exhibition's ongoing development. An exhibition seminar is normally available at least once a year.
- 16:082:699. NONTHESIS STUDY (1)
- 16:082:701,702. RESEARCH IN ART HISTORY (BA,BA)
- 16:082:705. RESEARCH PROPOSAL IN ART HISTORY (6)
Prerequisite: Permission of instructor.
Preparation of dissertation proposal. Students must have completed all course work and have scheduled their qualifying examination.

ARTS, VISUAL AND THEATER

(See the separate catalog of Rutgers' Mason Gross School of the Arts for information on M.F.A. programs in visual and theater arts.)

ASIAN STUDIES 098

Program Offered: Certificate in Asian Studies

Director of Certificate Program: Professor Ching-I Tu, 330 Scott Hall, College Avenue Campus (732/932-7605)

Participating Faculty

The following members of the graduate faculty, identified more fully under the subject headings indicated, are among those in charge of the curricular arrangements for a certificate program in Asian studies as part of a wider advanced-degree program:

M. Adas, History
S. Boocock, Sociology
B. Boxer, Geography
N.L. Chou, Communication, Information, and Library Studies
N. Cornyetz, Comparative Literature
V. Dayal, Linguistics
M. Dutta, Economics
I.N. Gang, Economics
M. Gasster, History
P. Golden, History
A. Howard, Art History
D. Ko, History
P. Li, Comparative Literature
M.M. Moffatt, Anthropology
D. Roden, History
K. Sato, Economics
P. Schalow, Comparative Literature
L. Schein, Anthropology
N. Shimahara, Anthropology
H. Strange, Anthropology
S. Tangri, Economics
Ching-I Tu, Comparative Literature
A.P. Vayda, Anthropology
J.A. Walker, Comparative Literature
S.F. Walker, Comparative Literature
R. Weber, Philosophy
R.W. Wilson, Political Science
O. Wou, History
C.F. Yu, Anthropology

Certificate Program

Students with a special interest in any aspect of East, Southeast, or South Asian civilization may under certain conditions pursue, in the course of their regular program of studies toward an advanced degree, a special concentration in Asian studies. Those who fulfill the requirements may be awarded a Certificate in Asian Studies upon completion of their degree. The special requirements for the certificate, some of which may be used at the same time to satisfy the student's own graduate degree requirements, are as follows:

1. Successful completion with a minimum grade-point average of 3.0 in a minimum of two term courses on Asia within the chosen discipline and in a minimum of two term courses on Asia in one or more cognate fields (12 credits in total). At least two of these courses must be at the graduate level.
2. Reading proficiency in an Asian language.
3. Satisfactory completion of a research project in the field of Asian studies.
4. Either a master's thesis or an expanded seminar paper on a topic related to Asia.

Only students already admitted to a degree program in the Graduate School–New Brunswick may participate in the certificate program. Courses in Asian Studies are offered by the participating faculty and additional faculty through their departments and graduate degree programs. Further information is available from the director of the certificate program in Asian studies.

BIOCHEMISTRY 115

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Robert Krug, Center for Advanced Biotechnology and Medicine, Busch Campus (732/235-4100)

Associate Director of Graduate Program: Professor N. Ronald Morris, UMDNJ-RWJMS, Busch Campus (732/235-4081)

Members of the Graduate Faculty

Cory Abate-Shen, Associate Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS/CABM; Ph.D., Cornell Medical College
Gene regulation in the developing mammalian nervous system
Stephen Anderson, Associate Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., Harvard
Proteases and protease inhibitors; protein folding; molecular recognition
Edward Arnold, Professor of Chemistry, CABM; Ph.D., Cornell
Protein and virus structure; AIDS; drug and vaccine design
Gad Avigad, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Hebrew
Carbohydrate metabolism; enzymology and glycoconjugates
Jean S. Baum, Associate Professor of Chemistry, FAS-NB; Ph.D., California (Berkeley)
Structural studies of proteins by nuclear magnetic resonance techniques
Helen M. Berman, Professor of Chemistry, FAS-NB; Ph.D., Pittsburgh
Crystallographic and molecular modeling studies of biological molecules
Leonard Borack, Associate Professor of Zoology, FAS-N; Ph.D., New York
Biochemical genetics of *Drosophila*
Kenneth J. Breslauer, Professor of Chemistry, FAS-NB; Ph.D., Yale
Drug-DNA interactions; DNA lesions and mutagenesis/repair; DNA conformational heterogeneity
Steven J. Brill, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., SUNY (Stony Brook)
Mechanism and regulation of eukaryotic DNA replication
Barbara Brodsky, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Harvard
Structure and binding of triple-helix peptides as models for collagen and the macrophage scavenger receptor
Harry D. Brown, Professor of Biochemistry, CC; Ph.D., Columbia
Energetics of enzymic reactions; calorimetry; AChE carcinogens
George M. Carman, Professor of Food Science, CC; Ph.D., Massachusetts
Enzymology of phospholipid metabolism
Kiran K. Chada, Assistant Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Oxford
Developmental gene expression using transgenic mice
Theodore Chase, Jr., Associate Professor of Biochemistry, CC; Ph.D., California (Berkeley)
Enzymology and molecular biology of plants, especially with reference to flavor compounds
Kuang-Yu Chen, Professor of Chemistry, FAS-NB; Ph.D., Yale
Biochemistry and function of polyamines and hypusine; gene regulation in cell aging and tumor differentiation
Suzie Chen, Assistant Professor of Chemical Biology and Pharmacognosy, CP; Ph.D., Albert Einstein
Interactions of SV40 and cellular targets in transformation and growth culture, and molecular mechanisms of commitment to cellular control
Khew-Voon Chin, Assistant Professor of Medicine and Pharmacology, CINJ/UMDNJ-RWJMS; Ph.D., Rutgers
Drug resistance in cancers; regulation of gene expression
David T. Denhardt, Professor of Cellular and Molecular Biology, FAS-NB; Ph.D., California Institute of Technology
Regulation of mammalian gene expression, cell proliferation, and metastasis
Monica A. Driscoll, Associate Professor of Molecular Biology and Biochemistry, CABM; Ph.D., Harvard
Molecular genetics of neuronal differentiation and abnormal death
Richard H. Ebricht, Professor of Chemistry, WIM/FAS-NB; Ph.D., Harvard
Regulation of gene expression; protein-DNA interaction; protein engineering
Isaac Edery, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB, CABM; Ph.D., McGill
Molecular and cellular mechanisms underlying biological clocks
Eric F. Eikenberry, Associate Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Massachusetts Institute of Technology
Macromolecular structure; X-ray diffraction; collagen
Julie M. Fagan, Associate Professor of Animal Sciences, CC; Ph.D., Arizona
Proteases and their inhibitors in health and disease
Abram Gabriel, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB; M.D., Johns Hopkins
Mechanisms of retrotransposon replication
Marc Gartenberg, Assistant Professor of Pharmacology, UMDNJ-RWJMS; Ph.D., Yale
Chromosomal DNA structure and organization; transcriptional silencing

Millie Georgiadis, Assistant Professor of Chemistry, WIM/FAS-NB; Ph.D., California (Los Angeles)
X-ray crystallographic studies of enzyme-nucleic acid complexes

Richard A. Harvey, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Utah
Antibiotic binding to surgical prostheses

Sarah E. Hitchcock-DeGregori, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Case Western Reserve
Biochemistry and molecular biology of contractile proteins

Masayori Inouye, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Osaka
Membrane biogenesis; regulation of synthesis of outer membrane proteins

Sumiko Inouye, Associate Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Nagoya
Mycobacteria and bacterial reverse transcriptases

Kenneth D. Irvine, Assistant Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Stanford
Cell signaling and growth control during *Drosophila* development

Stephan S. Isied, Professor of Chemistry, FAS-NB; Ph.D., Stanford
Modification of electron transfer proteins

Frank Jordan, Professor of Chemistry, FAS-N; Ph.D., Pennsylvania
Mechanism of thiamin-dependent enzymes and of serine proteases

Peter C. Kahn, Associate Professor of Biochemistry, CC; Ph.D., Columbia
Multisubunit proteins; circular dichroism; agent orange

Frederick C. Kauffman, Professor of Pharmacology, CP; Ph.D., Illinois
Biochemical aspects of toxicology

Avedis Khachadurian, Professor of Medicine, UMDNJ-RWJMS; M.D., American University of Beirut
Cholesterol and lipoprotein metabolism; hyperlipidemias

Megerditch Kiledjian, Assistant Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Pennsylvania
RNA-protein interactions in the regulation of eukaryotic gene expression

Terri Goss Kinzy, Assistant Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Case Western Reserve
Eukaryotic translation elongation and regulation of gene expression

Daniel Klessig, Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Harvard
Gene regulation and signal transduction in plant defense

Marilyn Kozak, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Johns Hopkins
Mechanism of protein synthesis in eukaryotic cells

Robert M. Krug, Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., Rockefeller
Splicing and nucleocytoplasmic transport of eukaryotic mRNAs

Eric Lam, Associate Professor of Plant Science, CMB/CC; Ph.D., California (Berkeley)
Light regulation of gene expression

Debra Laskin, Professor of Pharmacology and Toxicology, CP; Ph.D., Medical College of Virginia
Immunology; inflammation; cytokines and nitric oxide

Jeffrey D. Laskin, Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., SUNY (Buffalo)
Carcinogenesis and differentiation in cell culture, nitric oxide

John Lenard, Professor of Physiology, UMDNJ-RWJMS; Ph.D., Cornell
Transcription, replication, and fusion of RNA viruses, calmodulin; kinases

Ronald M. Levy, Professor of Chemistry, FAS-NB; Ph.D., Harvard
Dynamics of macromolecules; computer simulation of proteins

Alice Y.-C. Liu, Professor of Biological Sciences, FAS-NB; Ph.D., Mount Sinai
Heat shock (stress) response; cell aging

Leroy Liu, Professor of Pharmacology, UMDNJ-RWJMS; Ph.D., California (Berkeley)
Cancer biology, cancer pharmacology, DNA conformation dynamics

Kiran Madura, Assistant Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Rochester
Mechanism and significance of ubiquitin-dependent degradation of g-alpha

Pal Maliga, Professor of Biology, WIM/FAS-NB; Ph.D., Hungary
Genetics and molecular biology of plastids; RNA editing

Paul Manowitz, Professor of Psychiatry and Neurology, UMDNJ-RWJMS; Ph.D., Brandeis
Biochemistry of mental illness

Fumio Matsumura, Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., Nagoya
Molecular biology of microfilaments and cell division

Richard Mendelsohn, Professor of Chemistry, FAS-N; Ph.D., Massachusetts Institute of Technology
Biophysical studies of membrane structure

Joachim W. Messing, University Professor of Molecular Biology, WIM/FAS-NB; Ph.D., Munich
Plant molecular biology

Gaetano T. Montelione, Associate Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., Cornell
Protein NMR spectroscopy, molecular recognition, rational drug design

N. Ronald Morris, Professor of Pharmacology, UMDNJ-RWJMS; M.D., Yale
Molecular biology of microtubules and mitosis

Lenore Neugeborn, Assistant Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Columbia
Control of gene expression in yeast

Robert A. Niederman, Professor of Molecular Biology and Biochemistry, FAS-NB; D.V.M., Ph.D., Illinois
Structure, function, and assembly of photosynthetic membranes

David N. Norris, Assistant Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Harvard
Effect of chromatin structure on transcription and recombination in yeast

Wilma Olson, Mary I. Bunting Professor of Chemistry, FAS-NB; Ph.D., Stanford
Relation of structure, conformation and function in nucleic acids

Richard Padgett, Associate Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., North Carolina (Chapel Hill)
Dorsal-ventral pattern formation and TGF- β receptors in *Drosophila*

Stuart Peltz, Assistant Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Wisconsin (Madison)
Eukaryote gene expression

Isaac Peng, Assistant Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Temple
Incorporation of actin into the microfilaments of the myofibril

Sidney Pestka, Professor of Molecular Genetics and Microbiology; M.D., Pennsylvania
Natural interferons: genes, receptors

George Pieczenik, Associate Professor of Biochemistry, CC; Ph.D., New York
Evolutionary paradigms for molecular information

Regina Pietruszko, Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., London
Human aldehyde dehydrogenase structure and function

Claudio Pikielny, Assistant Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Brandeis
Molecular genetics of olfaction in *Drosophila*

John Pintar, Associate Professor of Neuroscience, UMDNJ-RWJMS; Ph.D., Oregon
Molecular analysis of gene expression during development

Ronald D. Poretz, Professor of Biochemistry, CC; Ph.D., SUNY (Buffalo)
Inherited susceptibility to neurotoxicants and intracellular targeting of pharmaceuticals

Carl A. Price, Professor of Biology, WIM/FAS-NB; Ph.D., Harvard
Molecular biology of plastids

Arnold Rabson, Associate Professor of Microbiology and Molecular Genetics, UMDNJ-RWJMS; M.D., Brown
Molecular biology of human retroviruses; regulation of gene expression in lymphocytes

Tariq Rana, Assistant Professor of Pharmacology, UMDNJ-RWJMS; Ph.D., California (Davis)
RNA-protein interactions; regulation of HIV-1 gene expression; drug design; artificial proteolysis

Danny F. Reinberg, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Albert Einstein
Mechanisms that control the regulation of gene expression in higher eukaryotes

Monica Roth, Associate Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Albert Einstein
Genetics and biochemistry of murine leukemia virus

Carl P. Schaffner, Professor of Biology, WIM/FAS-NB; Ph.D., Illinois
Antibiotic chemistry and biology; prostatic cholesterologenesis

Aaron Shatkin, Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; University Professor of Molecular Biology, Rutgers; Director of the Center for Advanced Biotechnology and Medicine, Ph.D., Rockefeller
Eukaryotic gene expression; viral cytopathogenesis and host range restriction

Michael M. Shen, Assistant Professor of Pediatrics, UMDNJ-RWJMS; Ph.D., Cambridge
Growth factor signaling during mouse embryogenesis

Navin K. Sinha, Associate Professor of Biology, WIM/FAS-NB; Ph.D., Minnesota
Accuracy of DNA replication; chemical carcinogenesis

William Sofer, Associate Professor of Microbiology, WIM/FAS-NB; Ph.D., Miami
Predicting protein folding via genetic algorithms

Ruth Steward, Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Switzerland
Nuclear migration, RNA localization, and patterning in *Drosophila*

Ann Stock, Assistant Professor of Biochemistry, UMDNJ-RWJMS/CABM; Ph.D., California (Berkeley)
Structure and function of signal transduction proteins

Kevin S. Sweder, Assistant Professor of Chemical Biology, CP; Ph.D., California Institute of Technology
Mechanisms of DNA repair; transcription-coupled repair; translesion synthesis

Mark Takahashi, Associate Professor of Physiology, UMDNJ-RWJMS; Ph.D., Wisconsin
Cytokine signal transduction pathways; apoptosis in epithelial cells

T.J. Thomas, Assistant Professor of Medicine, UMDNJ-RWJMS; Ph.D., Indian Institute of Science
Regulation of ornithine decarboxylase in autoimmune diseases

Lynn D. Vales, Assistant Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Albert Einstein College of Medicine
Regulation of adenovirus gene expression

Theodorus van Es, Professor of Biochemistry, CC; Ph.D., Witwatersrand
Carbohydrate chemistry; nonimmunogenic enzymes

Andrew K. Vershon, Associate Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Massachusetts Institute of Technology
Structure/function of yeast transcriptional regulatory proteins

Nancy Walworth, Assistant Professor of Pharmacology, UMDNJ-RWJMS; Ph.D., Yale
Regulation of cell cycle progression in eukaryotic cells

William W. Ward, Associate Professor of Biochemistry, CC; Ph.D., Johns Hopkins
Bioluminescence mechanisms; protein and peptide biochemistry

Bruce P. Wasserman, Professor of Food Science, CC; Ph.D., Massachusetts
Biopolymer synthesis in plants; plasma membrane structure and function

Eileen White, Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., SUNY (Stony Brook)
Programmed cell death

Donald Winkelmann, Associate Professor of Pathology, UMDNJ-RWJMS; Ph.D., Wisconsin (Madison)
Macromolecular structure and assembly mechanisms of muscular contraction

Chung S. Yang, Professor of Chemical Biology and Pharmacognosy, CP; Ph.D., Cornell
Cytochrome P-450 regulation and active site mechanisms; molecular mechanisms of esophageal carcinogenesis

Peter D. Yurchenko, Associate Professor of Pathology and Laboratory Medicine, UMDNJ-RWJMS; M.D., Ph.D., Albert Einstein College of Medicine
Molecular basis of basement membrane structure and function; receptor-mediated cell-matrix interactions

Barbara A. Zilinskas, Professor of Plant Biochemistry, CC; Ph.D., Illinois
Photosynthetic light reactions; plant molecular biology

Programs

The joint graduate program in biochemistry at Rutgers, The State University of New Jersey, and the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School provides high quality graduate training in biochemistry. The most appropriate preparation for graduate study is an undergraduate concentration in biochemistry or in either biology (particularly molecular biology, cell biology, or microbiology) or chemistry (particularly organic chemistry or physical chemistry) with a minor in the other discipline. Applicants are also expected to have studied mathematics through calculus, and to have completed one year of physics, and analytical and physical chemistry, although those who lack one or two of these prerequisites may complete them (without graduate credit) after admission to graduate school. Applicants are also required to take the general and subject tests of the Graduate Record Examination.*

The program is interdepartmental and interinstitutional with a wide variety of research areas in biochemistry and molecular biology that include regulation of DNA replication and transcription, virus gene expression, gene expression in development and differentiation, tumor biology, molecular genetics, structural biochemistry, plant molecular biology, signal transduction and molecular targeting, cell cycle control, membrane biochemistry, protein chemistry, muscle biochemistry, and enzymology. Faculty members are drawn from the Departments of Molecular Biology and Biochemistry, Chemistry, Biological Sciences, and Applied Microbiology and Plant Physiology, the Waksman Institute of Microbiology, and the AgBiotech Center at Rutgers; and the Departments of Biochemistry, Neuroscience and Cell Biology, Pathology, Physiology, Pharmacology, and Microbiology and Molecular Genetics at UMDNJ; and from the Center for Advanced Biotechnology and Medicine, a joint center of Rutgers and UMDNJ.

The Ph.D. program has been updated to address the recent remarkable developments in molecular biology and biochemistry. It requires a minimum of 30 credits of course work and 42 credits of advanced research. Ph.D. students take a common first-year core

curriculum as described under the molecular biosciences heading within this chapter. The course requirements for the Ph.D. include biochemistry (16:115:501, 3 credits); biochemistry (molecular biology) (16:115:502, 3 credits); molecular biophysics (16:160:537, 3 credits); advanced cell biology (16:695:601, 3 credits); laboratory rotation (16:695:615, 616, 6 credits); biochemistry seminar (16:115:613, 614, 2 credits); and electives (6 credits). The above requirements can readily be coordinated with the requirements of the first-year core curriculum for the consolidated programs in molecular biosciences. The Ph.D. program also requires a minimum of one year of full-time research in residence.

Joint Ph.D. degrees are available in this program. See the Degree Programs Available chapter.

Graduate Courses

16:115:501. (F) BIOCHEMISTRY (3)

Winkelmann, Wong. Prerequisite: One year organic chemistry.
Corequisite: 16:115:502.

Modern concepts of protein biochemistry and metabolism for first-year Ph.D. students.

16:115:502. (F) BIOCHEMISTRY (MOLECULAR BIOLOGY) (3)

Reinberg, Wong. Prerequisite: One year organic chemistry.
Corequisite: 16:115:501.

Modern concepts of nucleic acid biochemistry and metabolism for first-year Ph.D. students.

16:115:508. (S) PROTEINS AND ENZYMES (3)

Chase. Prerequisite: 16:115:501 or equivalent.

Assay and purification of enzymes and other proteins. Analysis and significance of primary, secondary, and tertiary structure of proteins. Chemical modification and kinetics as tools in understanding structure-function relationships and mechanisms. Mechanisms of selected enzymes.

16:115:510. (S) ENZYMES: KINETICS AND MECHANISMS (3)

Chase, Harvey, Pietruszko

Methods for evaluating steady and presteady state parameters of enzyme-catalyzed reactions. The contribution of enzyme kinetics to our understanding of the catalytic process critically evaluated.

16:115:511, 512. (F) MOLECULAR BIOLOGY AND BIOCHEMISTRY (3,3)

Prerequisite: One year organic chemistry. These courses recommended for students outside the program in biochemistry.

First term: structure and function of proteins, catalysis of biochemical reactions, intermediary metabolism, oxidative phosphorylation, photosynthesis, properties of membranes, signal transduction. Second term: nucleic acid structure, gene regulation, DNA replication, RNA splicing, translation, mobile genetic elements, introduction to animal cells and their viruses, recombinant DNA approaches.

16:115:533. (F) PHYSICAL BIOCHEMISTRY (3)

Kahn. Prerequisites: Biochemistry, physical chemistry.

Principles of the physical chemistry of macromolecules of biochemical importance. Specific aspects of thermodynamics related to biopolymers. Spectroscopic techniques including optical rotary dispersion, circular dichroism, ultraviolet and visible spectroscopy, X-ray diffraction, and nuclear magnetic resonance. See also 16:160:537.

16:115:552. BIOCHEMICAL SEPARATIONS (3)

Prerequisite: 01:115:313 or 11:115:313; or 11:115:413.

Basic theory and practice of separating biological molecules. Methods include chromatography, centrifugation, electrophoresis, ultrafiltration, and general methods of extraction and purification of proteins, nucleic acids, carbohydrates, and other biological molecules.

16:115:554. (S) GENE REGULATION IN THE BRAIN (2)

Abate-Shen

Survey of recent literature regarding the regulation of gene expression in the nervous system. Emphasis on the molecular mechanisms involved in gene regulation during neuronal development.

* Admission is handled by the consolidated graduate programs in molecular biosciences. For further information, refer to the molecular biosciences heading within this chapter.

16:115:605,606. ADVANCED STUDIES IN BIOCHEMISTRY (BA,BA)
Independent library and laboratory research into special aspects of biochemistry arranged under the supervision of faculty members in any of the participating groups.

16:115:613,614. SEMINAR IN BIOCHEMISTRY (1,1)

16:115:616. SPECIAL TOPICS IN BIOCHEMISTRY (BA)
Faculty members occasionally offer a special course on a new or developing topic in biochemistry.

16:115:701,702. RESEARCH IN BIOCHEMISTRY (BA,BA)

BIOMEDICAL ENGINEERING 125

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Stanley M. Dunn,
112 Biomedical Engineering Building, Busch Campus
(732/445-3706 or 732/445-4462)

Codirector of Graduate Program: Professor Michael G. Dunn,
Medical Education Building 4, Room 424, UMDNJ-RWJMS
(732/235-7972)

Members of the Graduate Faculty

Metin Akay, Visiting Professor of Biomedical Engineering, CE; Ph.D., Rutgers
Stochastic modeling, detection, estimation, and processing of biomedical signals

Harold Alexander, *Director, Department of Bioengineering, Hospital for Joint Diseases; Ph.D., New York*
Biomechanics; biomaterials; orthopedic implant design

Helen M. Buettner, Associate Professor of Chemical and Biomedical Engineering, CE; Ph.D., Pennsylvania
Chemical and biochemical engineering; nerve regeneration

William Craelius, Associate Professor of Biomedical Engineering, CE; Ph.D., Northwestern
Cardiac and neural electrophysiology

Gary M. Drzewiecki, Associate Professor of Biomedical Engineering, CE; Ph.D., Pennsylvania
Circulatory system dynamics; noninvasive hemodynamics; chaos and fractals

Michael G. Dunn, Associate Professor of Surgery, UMDNJ-RWJMS; Ph.D., Rutgers
Tissue engineering for tendons/ligaments, resorbable biomaterials, wound healing, biomaterials

Stanley M. Dunn, Associate Professor of Biomedical Engineering, CE; Ph.D., Maryland; Ph.D., Amsterdam
Computer vision; image and processing; pattern recognition

Norman H. Edelman, Professor of Medicine, UMDNJ-RWJMS, and Adjunct Professor of Biomedical Engineering, CE; M.D., New York
Control of breathing; brain blood flow

Eric F. Eikenberry, Associate Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Massachusetts Institute of Technology
Macromolecular structure; X-ray diffraction; collagen

Sandra J. England, Associate Professor of Pediatrics, UMDNJ-RWJMS; Ph.D., Dartmouth
Respiratory control and mechanics in the neonate

Herbert M. Geller, Professor of Pharmacology, UMDNJ-RWJMS; Ph.D., Case Western Reserve
Cellular mechanisms of neurotransmission

Abdullah N. Guzelsu, Associate Professor of Biomechanics, UMDNJ-SOM; Ph.D., Princeton
Biomechanics; bone; electromechanical properties of tissues

Joseph Kedem, Associate Professor of Physiology and Biophysics, UMDNJ-RWJMS; Ph.D., Hebrew University
Quantitative relation between cardiac function and metabolism

Jochim B. Kohn, Associate Professor of Chemistry, FAS-NB; Ph.D., Weizmann Institute of Science
Degradable materials for medical uses

John B. Kostis, Professor and Chairperson of Medicine, UMDNJ-RWJMS, and Adjunct Professor of Biomedical Engineering, CE; M.D., Athens
Cardiovascular diseases and hypertension

Eileen Kowler, Professor of Psychology, FAS-NB; Ph.D., Maryland
Eye movements and visual information processing

Irwin Krasna, Professor of Surgery, UMDNJ-RWJMS; M.D., Chicago Medical School
Intestinal blood flow; splenic transplants; cancer growth

Noshir A. Langrana, Professor of Mechanical and Aerospace Engineering, CE; Ph.D., Cornell
Spinal mechanics; fracture fixation; knee joint; kinematics

Jerome Y. Lettvin, New Jersey Professor of Neuroengineering Emeritus, CE; M.D., Illinois
Neurophysiology of visual perception and experimental epistimology

John K.-J. Li, Professor of Biomedical Engineering, CE; Ph.D., Pennsylvania
Cardiovascular dynamics; biomedical instrumentation

James Mackenzie, Professor of Surgery, UMDNJ-RWJMS, and Adjunct Professor of Biomedical Engineering, CE; M.D., Michigan
Modified nucleosides for detection of cancer

Richard Mammone, Associate Professor of Electrical Engineering, CE; Ph.D., CUNY
Image restoration; speech recognition; medical imaging

Evangelia Micheli-Tzanakou, Professor and Chairperson of Biomedical Engineering, CE; Ph.D., Syracuse
Visual pattern recognition; neural networks; digital signal processing

Donald A. Molony, Professor Emeritus of Biomedical Engineering, CE; M.S., Rutgers
Computer applications; heart assist systems; instrumentation

Judith A. Neubauer, Associate Professor of Medicine, UMDNJ-RWJMS; Ph.D., Rutgers
Central respiratory control

Dorene A. O'Hara, Assistant Professor of Anesthesia, UMDNJ-RWJMS; M.D., Harvard
Computer-controlled delivery of drugs; computer modeling of drug kinetics

Thomas V. Papatthomas, Professor of Biomedical Engineering, CE; Ph.D., Columbia
Motion, depth, and texture perception; computer graphics; image processing

John R. Parsons, Associate Professor of Orthopedics, UMDNJ-NJMS; Ph.D., Pennsylvania
Biomechanics; biomaterials; orthopedic implant design

Mark R. Plummer, Assistant Professor of Biological Sciences, FAS-NB; Ph.D., Rutgers
Signal transmission; nervous transmission

E. Diane Rekow, Professor and Chairperson, Department of Orthodontics, UMDNJ-NJDS; Ph.D., D.D.S., Minnesota
Machinable ceramics

Alvin J. Salkind, Professor/Chief, Surgery/Bioengineering, UMDNJ-RWJMS, and Professor of Biomedical Engineering, CE; D.Ch.E., Polytechnic Institute of New York
Physiological sensors and stimulators; pacemakers; catheters

John Semmlow, Professor of Biomedical Engineering, CE, and Professor of Surgery, UMDNJ-RWJMS; Ph.D., Illinois
Biocontrol; noninvasive medical instrumentation

George K. Shoane, Professor of Biomedical Engineering, CE; Ph.D., California (Berkeley)
Visual control models; early visual processing, machine vision applications

Samuel Sideman, Distinguished Visiting Professor of Biomedical Engineering, CE; D.Sc., Technion-Israel Institute of Technology
Transport phenomena; modeling cardiovascular systems

Frederick H. Silver, Professor of Pathology, UMDNJ-RWJMS; Ph.D., Massachusetts Institute of Technology
Biomaterials; connective tissue structure and mechanics

Robert Trelstad, Chairperson and Professor of Pathology, UMDNJ-RWJMS; M.D., Harvard
Tissue injury and repair

Yehuda Vardi, *Professor of Statistics, FAS-NB; Ph.D., Cornell*
Positron emission tomography; operations research; applied probability and industrial statistics

Tritala K. Vaidyanathan, *Professor of Prosthodontics and Biomaterials, UMDNJ-NJDS; Ph.D., Polytechnic Institute of New York*
Dental biomaterials (ceramics, polymers, metals); corrosion microscopy

Harvey R. Weiss, Professor of Physiology, UMDNJ-RWJMS; Ph.D., Duke
Circulatory and cardiac physiology

Walter Welkowitz, Professor Emeritus of Biomedical Engineering, CE; Ph.D., Illinois
Cardiovascular research; heart assist systems

Joseph Wilder, Research Professor of Electrical and Computer Engineering, CE; Ph.D., Pennsylvania
Human visual perception

Mark C. Zimmerman, *Principal Scientist/Group Leader, Johnson & Johnson; Ph.D., Rutgers*
Orthopedic biomaterials and biomechanics, acoustic microscopy

Associate Members of the Graduate Faculty

Robert E. Brolin, Associate Professor of Surgery, UMDNJ-RWJMS; M.D., Michigan
Intestinal ischemic disease and morbid obesity

Kenneth J. Ciuffreda, Professor of Vision Sciences, SUNY (College of Optometry); Ph.D., California (Berkeley)
Clinical and research aspects of visual function and oculomotor control

Robert G. Fisher, Professor of Neurosurgery, UMDNJ-RWJMS; M.D., Pennsylvania
Increased intracranial pressure; spine mechanics; C.N.S. circulation

Ralph S. Greco, Professor of Surgery, UMDNJ-RWJMS; M.D., Yale
Biocompatibility of implants and prostheses

Mel L. Kantor, Associate Professor of Oral Pathology, Biology, and Diagnostic
Sciences, UMDNJ-NJDS, and Clinical Associate Professor of Radiology,
UMDNJ-NJMS; D.D.S., North Carolina
Observer performance, diagnostic efficacy, and visual psychophysics in radiology

Sanford L. Klein, Chairperson and Professor of Anesthesia, UMDNJ-RWJMS;
M.D., Albany Medical Center, D.D.S., New York
Neuroelectrophysiology applied to anesthesiology

Suzanne H. Maxian, Department of Surgery, Pennsylvania College of Medicine;
Ph.D., Rutgers-UMDNJ
Biomechanics and biomaterials; research of novel hard tissues

Robert M. Olson, Clinical Assistant Professor of Surgery, UMDNJ-RWJMS;
M.D., Pennsylvania
Wound healing; burns; collagen; synthetic skin; epithelialization

Steve Petrucelli, Assistant Professor of Biomedical Engineering, CE; Ph.D., Rutgers
Design of microcomputer base; analytical instrumentation

Daniel M. Shindler, Associate Professor of Medicine, UMDNJ-RWJMS;
M.D., Seville
Echocardiographic image processing

Charles Steiner, Professor Emeritus of Osteopathic Sciences, UMDNJ-SOM; D.O.,
Philadelphia College of Osteopathic Medicine
Osteopathic medicine

George S. Tzanakos, Visiting Associate Professor of Biomedical Engineering, CE;
Ph.D., Syracuse
Positron emission tomography (PET): R&D of new PET scanners and detectors,
image reconstruction

Adjunct Members of the Graduate Faculty

David L. Christiansen, Assistant Professor of Pathology, UMDNJ-RWJMS;
Ph.D., Rutgers/UMDNJ-RWJMS
Biometric materials, bioceramics; extracellular matrix mineralization

Mikio Ohno, Assistant Professor of Pathology, UMDNJ-RWJMS; Ph.D., Oklahoma
Extracellular matrices; collagen and laminin or cell interactions

Heikki Uustal, Staff Physiatrist, J.F.K. Johnson Rehabilitation Institute;
M.D., Vermont
Prosthetics and orthotics; amputees

Programs

The academic, research, and training activities of the graduate program in biomedical engineering are carried out collaboratively by the faculties of the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School and the College of Engineering of Rutgers, The State University of New Jersey, located on the Busch campus in Piscataway, New Jersey.

The biomedical engineering faculty has established research programs in cardiovascular systems analysis; automated diagnostic devices; bioinstrumentation, including biotelemetry and implants; cardiac assist devices; medical applications of pattern recognition; medical imaging; neural network applications to biomedical engineering; neurological control; neuromuscular modeling; biomechanics; and biomaterials. Research areas in the medical school also include electroneurophysiology, neural information processing and modeling, hypertension, respiratory controls, computer assisted diagnosis, nuclear magnetic resonance, positron emission tomography, the study of binocular oculomotor balance, and the study of artificial implant materials.

Minimum requirements for the M.S. degree include 10 credits in a core of courses in physiology, 17 credits in a core of courses in biomedical engineering, 9 credits in elective courses, 6 credits of research, and an M.S. thesis. Minimum requirements for a Ph.D. degree are 48 credits with satisfactory grades in approved courses and 24 credits for an acceptable research thesis. There is no foreign language requirement. The residence requirement depends on the area of specialization.

Students who have been accepted to both the Graduate School-New Brunswick and the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School and who satisfy the requirements of both institutions are eligible to pursue an M.D./Ph.D. curriculum.

The qualifying examination normally consists of four written examinations. All students take examinations in both physiology and in the research area of their thesis. Depending on specific concentration within the program, students take examinations

in either (1) systems analysis and computer applications, and instrumentation or (2) biomaterials and biomechanics. An oral examination, in the appropriate area of specialization, is administered by the student's thesis committee. Candidates are required to present seminars, which are attended by all members of the thesis committee, in order to allow the committee to evaluate research progress.

The program in biomedical engineering has been selected to participate in the Graduate Professional Opportunities Program, which provides fellowships for women and minority students.

Graduate Courses

16:125:503,504. THEORY AND DESIGN OF BIOMEDICAL INSTRUMENTS (3,3)
Semmlow

The principles of instrument-type transducer design, with illustrations of resistance, inductance, capacitance, piezoelectric, magnetostrictive, and force-balance-type transducers. Examples stress instruments for medical applications.

16:125:505. (F) BIOPOLYMERS (3)

Silver. Prerequisite: Elementary biochemistry. Recommended: Physical chemistry. The relationship between macromolecular structure, maintenance of tissue shape, and mechanical integrity, particularly in mammalian connective tissues. Emphasis on structural mechanisms related to viscoelastic behavior of collagen and matrix components as well as the rubber-like behavior of elastin. Laboratory demonstrations emphasize the relationship of structure and physical properties of structural biomaterials.

16:125:506. (S) ARTIFICIAL IMPLANTABLE MATERIALS (3)

Silver. Prerequisite: Bachelor's degree in engineering or permission of instructors. The evaluation of biocompatibility. Specific biomaterials-tissue interactions. Toxicology of implanted materials. Surface phenomenon and membranes. Implantable electrodes and power sources. Implantable metals, alloys, polymers, and ceramics. Lubrication and wear of implants. Total hip and knee prostheses. Connective tissue replacement.

16:125:507. (F) WAVE PHENOMENA IN BIOMEDICAL SYSTEMS (3)

Wave propagation in electrical, mechanical, thermal, and chemical systems; the common parameters of distributed systems; blood flow in arteries; chemical diffusion in organs; and nerve action potential transmission.

16:125:508. (S) PATHOBIOLOGY (3)

Silver. Prerequisites: 01 or 11:115:301 or equivalent, and permission of instructor. Cellular and tissue reaction to injuries resulting from ischemia, physical forces, and exposure to chemicals including synthetic and natural polymers. Inflammation, immune reactions, regeneration, and repair. Transplantation of natural and synthetic materials as well as reactions to implanted materials.

16:125:509. MEDICAL DEVICE DEVELOPMENT (3)

Development of medical devices that employ primarily polymeric materials in their construction. Materials selection, feasibility studies, prototype fabrication, functionality testing, prototype final selection, biocompatibility considerations, efficacy testing, sterilization validation, FDA regulatory approaches, writing of IDE, SID(K) and PMAs, device production and record keeping.

16:125:510. (S) ENGINEERING HEMODYNAMICS (3)

Drzewiecki
Application of engineering techniques to the study of blood flow. Topics include the analysis of physiologically relevant models of the left ventricle, aorta, and peripheral vascular system in normal and diseased states. The analysis is applied to the design of circulatory assist devices and cardiovascular instrumentation.

- 16:125:512. (S) DIGITAL PROCESSING OF MEDICAL IMAGES (3)
Dunn. Prerequisite: 16:332:543.
Image restoration and enhancement techniques, convex projections, pseudo inverse, back projection, simplex methods, least mean square error, constrained solutions, nonlinearities. Applications include X-ray, ultrasound, NMR, and optical medical imaging systems.
- 16:125:513. (S) VISUAL RESEARCH AND INSTRUMENTATION (3)
Shoane. Prerequisite: 14:332:345 or equivalent.
Control system analysis of human visual systems and survey of instrumentation used. Topics include anatomy of the visual system; triad: accommodation, vergence, and pupil; saccadic and pursuit eye movements.
- 16:125:515. (F) ELECTROCHEMICAL ASPECTS OF IMPLANTS AND DEVICES (3)
Salkind, Guzelsu. Prerequisites: 16:125:503, 504, and 507.
Applications of bioelectrochemical engineering to areas of biomedical engineering, including membrane properties, propagation of biological wave potentials, corrosion of implanted materials, and nerve and organ stimulation.
- 16:125:516. (S) VISUAL PATTERN RECOGNITION (3)
Micheli-Tzanakou. Prerequisites: 01:119:356 and 01:640:244, or equivalent.
Patterns are the means by which living organisms and "thinking" machines sense, interpret, classify, and act on information extracted from their surroundings. Recognition in the visual system within the context of information processing in living organisms and computers. Computer vision compared to biological vision.
- 16:125:517. (F) CIRCULATORY DYNAMICS (3)
Li
The circulatory system with emphasis on invasive and noninvasive measuring techniques. Topics include measurement of blood pressure and flow in arteries and veins, muscle mechanics, models of the heart, microcirculation, the closed cardiovascular system, and cardiac assist devices.
- 16:125:518. (S) COMPUTER APPLICATIONS IN BIOMEDICAL ENGINEERING (3)
Eikenberry, Papatomas
Digital and other computer techniques applied to the problems of biomedicine. The acquisition of data and its processing with small computers. Modeling of biological and other systems.
- 16:125:519. (F) BIOLOGICAL MATERIALS (3)
Guzelsu. Prerequisite: Bachelor's degree in engineering.
Mechanical and electromechanical properties of biological tissues. Bone, tendon, cartilage, and soft tissues. Composite and mixture modeling. Experimental and theoretical determination of strain energy function. Bionimetics.
- 16:125:520. (S) NEUROELECTRIC SYSTEMS (3)
Micheli-Tzanakou. Prerequisites: 16:332:505 and general physiology.
Introduction to function and models of the nervous system; generator and action potentials; conduction in nerve fibers and across synaptic junctions; analysis of sensory and neuromuscular systems; EEG and EKG waveforms.
- 16:125:523. (F) BIOMEDICAL INSTRUMENTATION LABORATORY (3)
Li. Prerequisites: 16:125:503, 504.
Practical design of biomedical transducers, electrodes, amplifiers. Operation and performance evaluation of biomedical instruments. Recording, filtering, processing, and analysis of physiological signals.
- 16:125:525. (F) BIOLOGICAL CONTROL SYSTEMS (3)
Shoane. Prerequisite: 01:119:356 or equivalent.
Application of control theory to the analysis of physiological systems. Topics include: pharmacokinetics, cardiovascular system, pulmonary system, stability analysis using Nyquist and root locus, LMS adaptive algorithm, renal concentrating mechanism, membrane potential, and ionic channels. Computer simulation exercises parallel each lecture topic.
- 16:125:526. BRAIN DYNAMICS (3)
Micheli-Tzanakou. Prerequisite: 16:125:520 or equivalent.
Combined analysis procedures of EEG and evoked potentials may provide information on signal neural events provided that the experiments are adequately designed. Presents the conceptual development of resonance phenomena in biophysical sciences and considers the system at the moment of stimulation for estimating and prediction of its response. Stereodynamics, simultaneously recorded multichannel EEG data, and evoked potentials from substructures of the brain.
- 16:125:528. (S) MOLECULAR SYSTEMS ENGINEERING (3)
Craelius. Prerequisite: Mammalian physiology and cell physiology.
Interfacing of biomolecules and biological tissues with useful devices. Principles of recording and analysis of molecular signals discussed. Modeling of molecular electronic systems using simulation software.
- 16:125:530. NONLINEAR BIODYNAMICS, CHAOS, AND FRACTALS (3)
Drzewiecki
Introduction to nonlinear dynamics and chaos, phase plots, strange attractors, deterministic/random fractals, fractal dimension. Applications in cardiopulmonary science and neurosciences.
- 16:125:531. (S) ELECTROMAGNETIC COMPATIBILITY (3)
Craelius
Medical applications of electromagnetic (EM) energy; principles of reducing EM emission and noise susceptibility of devices in the 25–1000 MHz band; test and measurements of EM fields for regulatory compliance.
- 16:125:532. CYTOMECHANICS (3)
Craelius. Prerequisite: Undergraduate degree in engineering.
Mechanical properties and measurements of cells; stress-strain relationships in cells, organelles, and biomatrices, including methods of mechanical measurements.
- 16:125:533. DESIGN OF MICROPROCESSOR BASED MEDICAL INSTRUMENTATION (3)
Petrucci. Prerequisites: 16:125:504 and 14:332:374, or equivalent.
Signal processing, display, and control components of medical instrumentation systems. Topics include bus and communication protocols, microprocessor interface design, signal conditioning and acquisition circuitry, and data display interfaces.
- 16:125:540. (S) INTRODUCTION TO LIMB PROSTHETICS I (3)
Basics of prosthetic practice, ethics, health economics, and professionalism; neuropathology and orthopathology.
- 16:125:541. (F) BIOMECHANICAL MEASUREMENTS (3)
Craelius, Dunn
Techniques for measuring biomechanical properties of limbs, organs, and tissues, as well as prosthetic devices, both at rest and during ambulation. Topics include experimental and statistical methods, clinical research study design, mechanical properties and behavior of tissues, use of transducers, and major imaging modalities.
- 16:125:542. (S) PROSTHETICS FOR THE UPPER LIMB (4)
Craelius, Uustal
Material selection and mechanical-electrical design criteria for the upper-limb amputee. Design and fabrication of operational prostheses, starting from measurements of amputee subjects, and finishing with operational testing.
- 16:125:543. (F) PROSTHETICS FOR THE LOWER LIMB I (4)
Uustal, Craelius
Material selection and mechanical design criteria for the transtibial amputee. Design and fabrication of operational prostheses, starting from measurements of amputee subjects, and finishing with operational testing. Bodily responses to amputation; casting; components; initial fitting; gait evaluation and training; pre- and post-operative care.

16:125:544. (S) PROSTHETICS FOR THE LOWER LIMB II (4)

Uustal, Craelius

Material selection and mechanical design criteria for the transfemoral amputee. Design and fabrication of operational prostheses, starting from measurements of amputee subjects, and finishing with operational testing. Bodily responses to amputation; casting; components; initial fitting; gait evaluation and training; pre- and post-operative care.

16:125:562. DIGITAL RADIOLOGY (3)

Dunn

Models of image formation, part and process segmentation and recognition. Specialized models of living organisms. Structural and statistical models of form; reasoning and interpretation models of functions. Medical diagnosis. Artificial intelligence and computational biology.

16:125:601,602. SEMINAR IN BIOMEDICAL ENGINEERING I,II (1,1)

For first-year graduate students.

Current topics in biomedical engineering.

16:125:603,604. SEMINAR IN BIOMEDICAL ENGINEERING III,IV (1,1)

For advanced graduate students.

Current topics in biomedical engineering discussed by invited speakers and in prepared presentations by students.

16:125:610. ADVANCED TOPICS IN COMPUTERS IN BIOMEDICAL ENGINEERING (3)

Dunn. Prerequisites: 16:125:518 and permission of instructor.

Advanced study of computer applications in biomedical engineering. Possible topics include: computerized axial tomography (CAT), positron emission tomography (PET), magnetic resonance imaging (MRI), use of artificial intelligence (AI) in medical diagnosis, learning systems, digital and sampled data implementations, large scale systems, filtering, and image reconstruction. Topics vary from year to year.

16:125:612. ADVANCED TOPICS IN ENGINEERING

HEMODYNAMICS (3)

Prerequisite: 16:125:510.

Emphasis on assisted circulation and artificial hearts, noninvasive indice of cardiac disorders and their measurement, and models of coronary circulation.

16:125:615. ADVANCED TOPICS IN BRAIN RESEARCH (3)

Papathomas. Prerequisites: 16:125:520 and permission of instructor.

Advanced study of current research areas of brain research. Topics include information processing in the brain, pattern recognition in different sensory modalities, advanced techniques of diagnosing different system disorders, and data recording and techniques of analysis. Topics vary from year to year depending on student interest and faculty availability.

16:125:620. NEURAL NETWORKS AND NEUROCOMPUTING (3)

Micheli-Tzanakou. Prerequisites: Advanced standing and permission of instructor.

Classical theories such as the Perceptron, LMS algorithm, the Boltzmann machine, Hopfield nets, back propagation, associative neurons, as well as adaptive algorithms, such as the ALOPEX algorithms, are examined in detail. Different applications and current literature on the subject are examined and discussed.

16:125:621,622. SPECIAL PROBLEMS IN BIOMEDICAL ENGINEERING (BA,BA)

16:125:699. NONTHESIS STUDY (1)

16:125:701,702. RESEARCH IN BIOMEDICAL ENGINEERING (BA,BA)

See also courses listed under Electrical Engineering, as well as the following course: 16:650:528 Biomechanical Systems (3).

BIORESOURCE ENGINEERING 127

Degree Program Offered: Master of Science

Director of Graduate Program: Professor Gene A. Giacomelli,
Bioresource Engineering Building, Cook Campus (732/932-9753)

Members of the Graduate Faculty

Robert M. Cowan, Assistant Professor of Environmental Science, CC;
Ph.D., SUNY (Buffalo)

Biological treatment (kinetics, process engineering, modeling); bioremediation, industrial and hazardous waste treatment

Gene A. Giacomelli, Professor of Bioresource Engineering, CC; Ph.D., Rutgers
Greenhouse environmental control and crop production systems

Kan-Ichi Hayakawa, Professor of Food Science, CC; Ph.D., Rutgers
Heat and mass transfer in foods; heat sterilization of food

Uta Krogmann, Assistant Professor of Environmental Science, CC; Ph.D.,
Hamburg-Harburg

Waste analysis, recycling, waste minimization, anaerobic digestion, composting

Peter P. Ling, Assistant Research Professor of Bioresource Engineering, CC; Ph.D.,
Texas A&M

Computer vision for intelligent machines

David R. Mears, Professor of Bioresource Engineering, CC; Ph.D., Rutgers
Energy alternatives for agriculture; engineering greenhouse systems: solar and
waste heat; mechanization

George H. Nieswand, Professor of Environmental Systems Analysis, CC;
Ph.D., Rutgers

Environmental systems analysis; water resource management; land use planning

William J. Roberts, Director of Center for Controlled Environment Agriculture and
Extension Specialist in Bioresource Engineering, CC; M.S., Rutgers

Energy alternatives for agriculture; greenhouse heating systems: solar and waste
heat; structures; protected cultivation

Kuan-Chong Ting, Chairperson and Professor of Bioresource Engineering, CC;
Ph.D., Illinois

Environmental control and automation for protected cultivation; systems analysis;
robotics in food processing

Barbara J. Turpin, Assistant Professor of Environmental Science, CC;
Ph.D., Oregon Graduate Institute

Air pollution instrumentation, sampling and analysis of atmospheric particles

Robert R. Wolfe, Professor of Bioresource Engineering, CC; Ph.D., Purdue
Food quality inspection; applied machine vision; unit operations

Associate Member of the Graduate Faculty

Craig A. Storlie, Extension Specialist in Bioresource Engineering, CC; Ph.D.,
Nebraska (Lincoln)

Irrigation management; greenhouse technology; computers; modeling

Adjunct Members of the Graduate Faculty

Andrew J. Higgins, Vice President for Engineering, Applied Waste Water
Tech., Inc.; Ph.D., Rutgers

Wastewater process engineering; solid waste recycling and utilization;
hazardous waste

Tadashi Takakura, Professor of Agricultural Engineering, University of Tokyo;
Ph.D., Tokyo

Environmental control engineering

Programs

Bioresource engineering is concerned with the application of engineering and technology to the production, processing, and handling of food and natural fiber. It deals with the basic research and practical biological and engineering applications in such fields as conservation of natural resources, irrigation and drainage, quality of surface and ground water, land use planning, processing and storage techniques, fundamental studies of the engineering properties of biological materials, the effects of biological waste disposal systems on the environment, the design and development of machines and buildings, and the automation in greenhouse crop production systems and the food industry. There are no language or residency requirements.

Graduate Courses

16:127:507. (F) ENVIRONMENTAL SYSTEMS ANALYSIS (3)

Ting, Nieswand

The philosophy of the systems approach. The modeling of systems. Quantitative methods in environmental systems analysis. The application of the systems approach and techniques of systems analysis to environmental problems.

16:127:508. (S) INSTRUMENTS IN BIORESOURCE ENGINEERING (3)
Ling, Wolfe

General measurement systems, error analysis, transducer and signal conditioning. Digital data acquisition and control systems.

16:127:611,612. SEMINAR IN BIORESOURCE ENGINEERING (1,1)

16:127:697,698. SPECIAL PROBLEMS IN BIORESOURCE ENGINEERING I,II (BA,BA)

Directed studies on special problems that involve unique applications of bioresource engineering.

16:127:699. NONTHESIS STUDY (1)

16:127:701,702. RESEARCH IN BIORESOURCE ENGINEERING (BA,BA)

BIOTECHNOLOGY 126

Program Offered: Core Curriculum in Biotechnology

Directors of Interdisciplinary Core Curriculum: Professor Henrik Pedersen, Department of Chemical and Biochemical Engineering, Busch Campus, (732/445-2568, 5514); Professor Aaron J. Shatkin, Center for Advanced Biotechnology and Medicine, Busch Campus, (732/235-5300)

Participating Faculty

The following members of the graduate faculty, identified more fully under the subject headings indicated, are among those in charge of the curricular arrangements for a core curriculum in biotechnology as part of a wider advanced-degree program:

Cory Abate-Shen, Physiology and Neurobiology

Stephen Anderson, Biochemistry

Edward Arnold, Chemistry

Helen Berman, Chemistry

Ira Black, Physiology and Neurobiology

Kenneth J. Breslauer, Chemistry

Helen M. Buettner, Chemical and Biochemical Engineering

William Craelius, Biomedical Engineering

Stanley Dunn, Biomedical Engineering

Richard H. Ebright, Chemistry and Molecular Genetics

Herbert Geller, Pharmacology

Celine Gelinas, Microbiology and Molecular Genetics

Masayori Inouye, Biochemistry

Daniel F. Klessig, Microbiology and Molecular Genetics

Joachim Kohn, Chemistry

David Kosson, *Chemical and Biochemical Engineering*

Casimir Kulikowski, Computer Science

Debra Laskin, Toxicology

Michael J. Leibowitz, Microbiology and Molecular Genetics

Peter Lobel, Pharmacology

Joachim Messing, Microbiology and Molecular Genetics

Prabhas Moghe, Chemical and Biochemical Engineering

Gaetano T. Montelione, Biochemistry

Fernando Muzzio, Chemical and Biochemical Engineering

Henrik Pedersen, Chemical and Biochemical Engineering

Sidney Pestka, Microbiology and Molecular Genetics

Arnold Rabson, Microbiology and Molecular Genetics

David J. Riley, Physiology and Neurobiology

Aaron J. Shatkin, Microbiology and Molecular Genetics

Ann M. Stock, Biochemistry

Eileen White, Microbiology and Molecular Genetics

Kathryn Uhrich, Chemistry

Gerben J. Zylstra, Microbiology and Molecular Genetics

Core Curriculum Program

The goal of the biotechnology core curriculum is to provide predoctoral students with an integrated, interdisciplinary education in biotechnology. Students apply to the core curriculum after they have been admitted as full-time students in any one of the biological, physical, or mathematical science doctoral programs in the Graduate School–New Brunswick. Upon graduation, students within the core curriculum receive a Ph.D. in their primary field (e.g., microbiology, biochemistry, chemical engineering) with

specialization in biotechnology. Because of the interdisciplinary nature of the subject matter, specific course guidelines, laboratory rotations, and seminars have been established to ensure that students are not only well-educated within one primary discipline, but also acquire the cross-disciplinary skills needed to translate basic science discoveries into technological developments.

The course structure is flexible. However, formal course requirements include a minimum of 6 credit hours in molecular and cellular biology, 3 credit hours in biophysical chemistry, and 3 credit hours in engineering or computer science. All students are required to complete 2 laboratory rotations (one of which is in an industrial laboratory) and to enroll in 16:126:603, 604 Topics in Advanced Biotechnology during each term of enrollment. The laboratory rotation allows students a broader exposure to the methods of biotechnology and the faculty of the core curriculum. The topics course provides students with an in-depth exposure to new developments in biotechnology and serves to unify the students and faculty. Students also work closely with a faculty mentor on a dissertation topic. The emphases of the research training are in the areas of protein production, bioseparations, tissue engineering, drug design and delivery, and biomolecular engineering. Students in the core curriculum are expected to have a science background that includes 1 year of college mathematics, 1 year of biology, 3 years of chemistry (general, organic, physical), and 1 year of physics.

Graduate Courses

16:126:603,604. TOPICS IN ADVANCED BIOTECHNOLOGY (1,1)

Oral presentations and discussions of the current literature in biotechnology.

CELL AND DEVELOPMENTAL BIOLOGY 148

Degree Programs Offered: Master of Science, Doctor of Philosophy

Director of Graduate Program: Professor Alice Y.-C. Liu, Nelson Biology Laboratories, Busch Campus (732/445-3430)

Members of the Graduate Faculty

Cory Abate-Shen, Associate Professor of Neuroscience and Cell Biology

UMDNJ-RWJMS/CABM; Ph.D., Cornell Medical College

Molecular processes that control gene expression during mammalian neuronal development

Kurt F. Amsler, Assistant Professor of Physiology, UMDNJ-RWJMS;

Ph.D., Tennessee

Polarized expression of receptor tyrosine kinases in regulation of epithelial cell behavior

Brian J. Aneskievich, Assistant Professor of Surgery, UMDNJ-RWJMS;

Ph.D., SUNY (Stony Brook)

Regulation of keratinocyte gene expression by retinoids and fatty acids

Bruce S. Babiarz, Associate Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Cincinnati

Early mammalian development, implantation; mammalian developmental genetics

Salvatore J. Caradonna, Associate Professor and Chairperson of the Department of

Molecular Biology, UMDNJ-SOM; Ph.D., SUNY (Buffalo)

Molecular biology of human DNA repair; interactions with cell cycle control elements

Kiran K. Chada, Associate Professor of Biochemistry, UMDNJ-RWJMS;

Ph.D., Oxford

Developmental gene expression in transgenic mice

Suzie Chen, Assistant Professor of Chemical Biology and Pharmacognosy, CP;

Ph.D., Albert Einstein College of Medicine

Transgenic mice predisposed to melanoma development; molecular mechanism of adipocyte differentiation; *uu*-inducible genes

Lori Covey, Assistant Professor of Cell Biology, Developmental Biology, and

Neurobiology, FAS-NB; Ph.D., Columbia

Switch recombination in human B lymphocytes in response to T-cell factors

Bill D. Davis, Associate Professor of Cell Biology, Developmental Biology,

and Neurobiology, FAS-NB; Ph.D., Purdue

Robin L. Davis, Associate Professor of Cell Biology, Developmental Biology,

and Neurobiology, FAS-NB; Ph.D., Stanford

Regeneration and electrophysiology of peripheral auditory neurons

David T. Denhardt, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., California Institute of Technology
Mammalian molecular cell biology; systems physiology of TIMP and OPN; gene regulation and cancer

Emmet A. Dennis, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Connecticut
Parasitology, schistosome pathology

M. David Egger, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Yale
Neurophysiology; neuroanatomy; neurogenetics

Francine B. Essien, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Albert Einstein College of Medicine
Developmental biology; genetics

Allahverdi Farmanfarman, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Stanford
Molecular aspects of membrane transport

Dunne Fong, Associate Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Princeton
Cell differentiation; proteinases and cancer invasion

Abram Gabriel, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB/CABM; M.D., Johns Hopkins
Mechanisms of eukaryotic retrotransposition

Herbert M. Geller, Professor of Pharmacology and Neurology, UMDNJ-RWJMS; Ph.D., Case Western Reserve
Developmental and cellular neurobiology

Bijan K. Ghosh, Professor of Physiology and Biophysics, UMDNJ-RWJMS; D.Sc., Calcutta
Development of subcellular organelles

Nathan H. Hart, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Harvard
Sperm egg interactions; egg activation; role of cytoskeleton in early embryogenesis

Robert Herman, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Rutgers
Immunity to protozoan parasitic infection

Sarah Hitchcock-DeGregori, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Case Western Reserve
Structure-function relationships in contractile proteins

Arnold G. Hyndman, Professor of Biological Sciences, FAS-NB; Ph.D., California (Los Angeles)
Developmental neurobiology; neurotoxicology

Masayori Inouye, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Osaka
Gene regulation; signal transduction; protein folding; adaptation to stresses

Kenneth Irvine, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB/WIM; Ph.D., Stanford
Cell communication, patterning, and morphogenesis

Megerditch Kiledjian, Assistant Professor of Cell Biology, Developmental Biology, and Neurobiology; Ph.D., Pennsylvania
RNA-protein interactions in the eukaryotic gene expression

Daniel F. Klessig, Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Harvard
Signal transduction in plant-pathogen interaction

George M. Krauthamer, Professor of Anatomy, UMDNJ-RWJMS; Ph.D., New York
Neurophysiology; neuroanatomy

Jerome A. Langer, Associate Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Yale
Cloning and analysis of the cell surface receptors for alpha interferon; mechanism of action of interferons; protein recognition; receptors

Debra L. Laskin, Professor of Pharmacology and Toxicology, CP; Ph.D., Medical College of Virginia
Immunology; inflammation; toxicology; cytokinesis

Hsin-Yi Lee, Professor of Biological Sciences, FAS-C; Ph.D., Minnesota
Developmental biology; tissue culture

John Lenard, Professor of Physiology and Biophysics, UMDNJ-RWJMS; Ph.D., Cornell
Enveloped virus fusion; transcription and replication of negative-stranded RNA viruses

Alice Y.-C. Liu, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Mount Sinai
Signal transduction mechanism of the heat shock response: heat shock gene expression and cell aging

Peter Lobel, Associate Professor of Pharmacology, UMDNJ-RWJMS/CABM; Ph.D., Columbia
Protein targeting, mannose 6-phosphate receptors, cancer prognostic indicators

Robert E. Loveland, Associate Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Harvard
Marine biology; invertebrate zoology; mathematical modeling

Richard A. Lutz, Professor of Marine and Coastal Sciences, CC; Ph.D., Maine
Biology of deep-sea hydrothermal vents; molluscan ecology

Gordon J. Macdonald, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Rutgers
Biology of reproduction; endocrinology

Sasha Malamed, Professor of Anatomy, UMDNJ-RWJMS; Ph.D., Columbia
Nervous and neurotrophic regulations of ovarian follicle formation

Charles Martin, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Florida State
Genetic control of membrane assembly

Fumio Matsumura, Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., Nagoya
Molecular and cell biology of cytokinesis

Michael McCormack, Professor of Pathology, UMDNJ-SOM; Ph.D., Minnesota
Human genetics; behavioral genetics; biochemical genetics; genetic counseling

Terry R. McGuire, Associate Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Illinois
Behavioral and neurogenetics; biometrical genetics

Kim S. McKim, Assistant Professor of Microbiology and Genetics, CC/WIM; Ph.D., British Columbia
Regulation of meiotic recombination; homologous chromosome pairing; DNA repair

Randall D. McKinnon, Assistant Professor of Surgery, UMDNJ-RWJMS; Ph.D., McMaster
Growth factors regulating CNS myelination; oligodendrocyte development

N. Ronald Morris, Professor of Pharmacology, UMDNJ-RWJMS; M.D., Yale
Molecular biology of mitosis

William R. Moyle, Professor of Obstetrics and Gynecology, UMDNJ-RWJMS; Ph.D., Harvard
Molecular biology of hormone action; structure and function of protein hormones and their receptors

Robert G. Nagele, Associate Professor of Molecular Biology, UMDNJ-SOM; Ph.D., Rutgers
Chromatin organization in the cell nucleus

Lenore Neugeboren, Assistant Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Columbia
Genetic and molecular mechanisms governing gene regulation in yeast

Richard S. Nowakowski, Associate Professor of Anatomy, UMDNJ-RWJMS; Ph.D., Harvard
Cell proliferation and migration during the early development of central nervous system

Julian J. O'Rear, Assistant Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Wisconsin (Madison)
Basement membrane structure and function; encapsidation of retrovirus RNA

Richard W. Padgett, Assistant Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., North Carolina
Molecular genetics of development in *Drosophila* and *C. elegans*

Howard C. Passmore, Jr., Professor of Microbiology and Genetics, FAS-NB; Ph.D., Michigan
Mammalian genetics

Isaac Peng, Assistant Professor of Neuroscience, UMDNJ-RWJMS; Ph.D., Temple
Actin and the cytoskeleton

John Pintar, Associate Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Oregon
Role of growth factors during embryogenesis and neuroendocrine development

Mark R. Plummer, Associate Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Stanford
Pharmacology and kinetic studies of neuronal calcium channels and synaptic plasticity

Jamshid Rabii, Associate Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., California (San Francisco)
Neuroendocrinology; dynamics of brain-pituitary axis

Yacov Ron, Associate Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Weizmann Institute of Science
Gene therapy approaches for treatment of autoimmune diseases; development of T and B cells

Michael M. Shen, Assistant Professor of Pediatrics, UMDNJ-RWJMS; CABM; CINJ; Ph.D., Cambridge
Growth factor signaling in vertebrate development

Robert Trelstad, Chairperson and Professor of Pathology, UMDNJ-RWJMS; M.D., Harvard
Morphogenesis; patterning mechanisms; medical informatics

Richard E. Triemer, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., North Carolina
Cellular and evolutionary biology of protists

Aurea C. Vasconcelos, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Chicago
Cell biology; plant molecular biology; carbohydrate metabolism in plants

Andrew K. Vershon, Associate Professor of Molecular Biology and Biochemistry, WIM/FAS-NB; Ph.D., Massachusetts Institute of Technology
Regulation of transcription in the yeast *S. cerevisiae*

Robert C. Vrijenhoek, Professor of Marine and Coastal Sciences; Director of the Center for Theoretical and Applied Genetics, CC; Ph.D., Connecticut
Molecular evolution; phylogeny; population genetics; conservation biology

William G. Wadsworth, Assistant Professor of Pathology, UMDNJ-RWJMS/CABM; Ph.D., Missouri (Columbia)
Extracellular matrix and the guidance of cell migrations in *C. elegans*

W. Steven Ward, Assistant Professor of Surgery, UMDNJ-RWJMS; Ph.D., Vanderbilt
Mammalian DNA organization and molecular biology of prostate cancer

Eileen White, Professor of Molecular Biology and Biochemistry, FAS-NB/CABM; Ph.D., SUNY (Stony Brook)
Regulation of programmed cell death (apoptosis) by viral oncogenes and tumor suppressor genes

Frank J. Wilson, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Pittsburgh
Functions of motility-related proteins in muscle and nonmuscle systems

Donald A. Winkelmann, Associate Professor of Pathology, UMDNJ-RWJMS; Ph.D., Wisconsin (Madison)
Macromolecular structure and assembly; molecular motor dynamics

Mengqing Xiang, Assistant Professor of Pediatrics, UMDNJ-RWJMS; Ph.D., Texas
Molecular mechanisms of neurosensory development

Chung S. Yang, Professor of Pharmacognosy, CP; Ph.D., Cornell
Mechanisms of drug metabolism and toxicity; molecular changes in carcinogenesis and their inhibition by dietary constituents

Wise Young, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Iowa; M.D., Stanford
Spinal cord nerve regeneration

Peter D. Yurchenco, Associate Professor of Pathology, UMDNJ-RWJMS; M.D., Ph.D., Albert Einstein College of Medicine
Basement membrane assembly and structure; biochemistry cell biology and molecular genetic approaches

James Q. Zheng, Assistant Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Tsinghua
Molecular/cellular mechanisms underlying the formation of neuronal circuitry

Associate Members of the Graduate Faculty

Rocco V. Carsia, Associate Professor of Cell Biology, UMDNJ-SOM; Ph.D., Rutgers
Adrenocortical cell physiology

Julie M. Fagan, Associate Professor of Animal Sciences, CC; Ph.D., Arizona
Mechanisms of protein breakdown in mammalian cells; muscle growth; molecular, cellular, and immunological studies of proteinases and their inhibitors in health and in disease

Paul D. Foglesong, Assistant Professor of Biology, CCAS; Ph.D., SUNY (Stony Brook)
DNA topoisomerases in normal and neoplastic human cells

Dennis J. Joslyn, Professor of Zoology, FAS-C; Ph.D., Illinois
Insect cytogenetics

Leonard Sciorra, Professor of Obstetrics/Gynecology and Reproductive Sciences, UMDNJ-RWJMS; Ph.D., Hahnemann
Human cytogenetics; fluorescent in situ hybridization; chromosome structure

Kathleen M. Scott, Associate Professor of Biological Sciences, FAS-NB; Ph.D., Yale
Mammalogy; vertebrate paleontology; functional morphology

David Seiden, Associate Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Temple
Skeletal and cardiac muscle; electron microscopy

Programs

The graduate program in cell and developmental biology is part of a large, diverse, and highly interactive community of biological scientists at Rutgers and the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School. The graduate program currently has approximately 77 faculty members from a number of departments in the two universities. Faculty research spans the fields of molecular, cellular, and developmental biology, drawing upon diverse experimental systems to study developmental, human, and molecular genetics; signal transduction and regulation of gene expression; developmental biology; regulation, structure, and function of the cytoskeleton; parasitology; cellular and molecular endocrinology; ultrastructural and molecular analysis of mammalian cells; and neurobiology.

Applicants are expected to have had one year each of undergraduate mathematics, chemistry, and physics in addition to two years of biology-related courses, although those who lack some of these prerequisites may complete them (without graduate credit) after admission to the program. Undergraduate concentrations in biology or other life-science related fields and research experience are desirable although not necessary. The graduate program in cell and developmental biology offers advanced studies leading to the M.S. and Ph.D. degrees. Classroom instruction combines a core of courses in biochemistry and molecular biology, molecular genetics, cell biology, and developmental biology, with speciality area courses selected on the basis of area of specialization. Other graduate level course offerings at Rutgers and UMDNJ-RWJMS are

available to students providing training opportunities in related areas such as neurobiology, immunology, biostatistics, computer science, and systems physiology. The major goal of the program is to provide a challenging and rewarding environment in which students can develop individual research and teaching skills to the fullest. *

While requirements for the Ph.D. students may vary with the area of specialization, all students are expected to complete a set of core courses during their first two years in the program that includes biochemistry, molecular genetics, cell biology, developmental biology, and laboratory rotation. For advanced graduate students, the program offers a number of special topic courses in cell and developmental biology. The minimum requirement for the Ph.D. degree is 72 credits, of which at least 36 credits must be devoted to course work. A student becomes a candidate for the Ph.D. degree after passing a qualifying examination, which consists of a written comprehensive examination in cell and developmental biology, and oral presentation and defense of a research proposal before a graduate faculty committee. A minimum of one academic year in residence is required. The program has no foreign language requirement.

Programs for the master's degree may be undertaken either with or without a research thesis. The requirement for the degree without thesis is 30 credits of course work. This includes a minimum of 1 credit of Advanced Problems in Cell and Developmental Biology (16:148:509,510) and the acceptance of the student's library or research project by a committee of three program faculty members. The requirements for the M.S. degree with thesis are a minimum of 24 course credits, 6 credits of research, and the satisfactory completion and defense of the thesis. All students must maintain a cumulative grade-point average of 3.0 or better to remain in the program.

Teaching assistantships are available for first-year and advanced graduate students. The program also offers fellowships to outstanding applicants. Joint Ph.D. degrees are available in this program. Further information about these may be found in the Degree Programs Available chapter.

Graduate Courses

16:148:503. (F) CELLULAR AND MOLECULAR ENDOCRINOLOGY (3)
Moyle. Prerequisite: General biochemistry.

Transduction at the molecular level. Use of newer research techniques emphasized.

16:148:504. (S) DEVELOPMENTAL BIOLOGY (3)
Moyle

Mechanisms responsible for the morphogenetic changes that occur during development of selected vertebrates and invertebrates. The role of intercellular communication in development, including mechanisms of action of receptors and cell adhesion proteins needed for this process.

16:148:507. (F) IMMUNITY TO ANIMAL PARASITES (3)
Herman

Various aspects of natural and acquired humoral and cellular immune mechanisms operative in humans and other hosts against protozoan and helminth parasites. The effects of immunosuppression, antigenic variation, and stage-specific immunity in experimental parasitic infections.

16:148:509,510. ADVANCED PROBLEMS IN BIOLOGY (BA,BA)
Required for nonthesis master's degrees. May also be used for independent study.
Prerequisite: Permission of graduate director.
Meets the needs of individual students.

16:148:514. (F) MOLECULAR BIOLOGY OF CELLS (3)
Liu. Prerequisites: 01:119:380 and 01:119:460, or equivalents. Corequisite: Graduate course in biochemistry.

Fundamentals of the molecular organization and functions of cells.

* Admission to the doctoral program is handled by the consolidated graduate programs in molecular biosciences. For further information, refer to the molecular biosciences heading within this chapter.

16:148:517. CELLULAR AND MOLECULAR MECHANISMS OF DISEASE (3)

Theories on the cellular and molecular mechanisms which underlie the development and progression of human diseases discussed. General topics include cell injury, inflammation, regeneration and repair, neoplasia, immune protection and immune disorders, environmental disorders, vascular diseases, connective tissue disorders.

16:148:530. (S) HUMAN GENETICS (3)

Passmore. Prerequisite: Basic molecular genetics. Recommended: Biochemistry and physiology.

Examination of molecular and chromosomal bases for human inherited diseases. Molecular approaches to gene identification, including position cloning and linkage analysis. Role of mutations, evaluation of repetitive sequences in the human genome.

16:148:534. (S) CYTOGENETIC ANALYSIS (4)

Sciorra
Covers the field of eucaryotic chromosome analysis from the standpoint of development and application of various techniques to the elucidation of chromosome structure, organization, and function. Examples taken largely from mammalian and human material. Some emphasis on human molecular cytogenetics and the phenotypic manifestations of chromosomal aberrations.

16:148:547,548. CURRENT TOPICS IN ENDOCRINOLOGY (1,1)

Liu. Prerequisite: Permission of instructor. Course may be repeated for credit. Biochemical, physiological, and biological aspects of important current topics of endocrine research as reflected in recent journal articles. Topics vary from term to term to reflect the state of endocrine research.

16:148:550. (S) ADVANCED DEVELOPMENTAL BIOLOGY (3)

Stewart. Prerequisite: 16:148:514 or equivalent; or permission of the instructor. Suggested: genetics. Also open to advanced undergraduates. Molecular mechanisms of cell type differentiation and body part specification. Cell-cell interaction, signal transduction during development, morphogenetic gradients, pattern formation, focusing on three experimental organisms: the nematode *C. elegans*, *Drosophila*, and the mouse. Genetic experimental approaches will be emphasized.

16:148:555. (F) CELL BIOLOGY AND HISTOLOGY (4)

F. Wilson. Lec. 3 hrs., lab. 3 hrs. Prerequisite: Permission of instructor. A study of microscopic structure of cells, tissues, and organs as seen in the light and electron microscopes. Emphasis on the correlation of structure and function.

16:148:565. (F) GROSS AND DEVELOPMENTAL ANATOMY (7)

Seiden, et al. Lec. 4 hrs., lab. 8 hrs. Prerequisite: Permission of instructor. A study of the macroscopic structure of the human body by dissection and other methods with reference to functional mechanisms and changes during development and clinical correlations.

16:148:581. (F) IMMUNOGENETICS (3)

Passmore. Prerequisites: Immunology, genetics, or permission of instructor. An examination of the genetic control of antibody structure, immune response, graft rejection, and cell surface antigens. The use of immunology as a tool in genetic research.

16:148:591. (F) IMMUNOLOGY: CELLULAR AND MOLECULAR (3)

Covey. Prerequisite: Basic immunology. Development of humoral and cell mediated immune systems.

16:148:598. SEMINAR IN CELL AND DEVELOPMENTAL BIOLOGY (1)

Student, staff, and guest lectures on current topics in cell and developmental biology. Student presentation required.

16:148:600 THROUGH 605. SELECTED TOPICS IN CELL AND DEVELOPMENTAL BIOLOGY (1 EACH)

Prerequisites: 16:148:514, 550. Advanced study of rapidly emerging areas in cell and developmental biology.

16:148:610,611. LABORATORY ROTATION (1.5 EACH)
Laboratory research for incoming students.

16:148:652. CURRENT CELL BIOLOGY (3)

Moyle
Analyses of progress in all areas of cell biology.

16:148:701,702. RESEARCH IN BIOLOGY (BA,BA)

CELLULAR AND MOLECULAR PHARMACOLOGY (see Pharmacology, Cellular and Molecular 718)

CERAMIC SCIENCE AND ENGINEERING 150

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor W. Roger Cannon, CCR,
129 Engineering Building, Busch Campus (732/445-4718)

Members of the Graduate Faculty

W. Roger Cannon, Professor of Ceramics, CE; Ph.D., Stanford
Strengthening of ceramics; high temperature creep; colloidal chemistry; powder processing
Frederic Cosandey, Professor of Ceramics, CE; Ph.D., Carnegie Mellon
Electron microscopy; metal-matrix composites, interfacial phenomena
Stephen C. Danforth, Professor of Ceramics, CE; Ph.D., Brown
Ceramic processing, rapid prototyping, injection molding, Si₃N₄, nano-sized powders, mechanical properties, ceramic composites
Stephen H. Garofalini, Professor of Ceramics, CE; Ph.D., Stanford
Surface physics; structure and properties of glass surfaces; diffusion in glasses; thin films and coatings
Victor A. Greenhut, Corning-Saint Gobain Malcolm G. McLaren Professor of Ceramics Engineering, CE; Ph.D., Rutgers
Structure-property relations; bonding and joining ceramics; glass to metals; failure analysis; calcination and firing of clays
Richard A. Haber, Associate Professor of Ceramic Engineering, CE; Ph.D., Rutgers
Particulate ceramic composite; slip casting
James A. Harrington, Professor of Ceramic Science and Engineering, CE; Ph.D., Northwestern
Infrared waveguides for laser surgery
James D. Idol, Professor of Ceramics/Packaging Science and Engineering, CE; Ph.D., Purdue
Permeation characteristics and physical properties of barrier packaging materials; catalytic processes, especially oxidation
Bernard H. Kear, New Jersey Professor of Materials Science and Technology, CE; D.Sc., Birmingham
Synthesis, characterization, and properties of complex inorganic materials
Armen G. Khachaturyan, New Jersey Professor of Materials Science and Technology, CE; Ph.D., Kiev Institute
Theory of phase transformation in metal alloys and ceramics
Lisa C. Klein, Professor of Ceramics, CE; Ph.D., Massachusetts Institute of Technology
Sol-gel processing of coatings and monoliths; silicate and phosphate glasses; viscosity and transformation kinetics
Richard L. Lehman, Professor of Ceramics, CE; Ph.D., Rutgers
Waveguide materials; raw materials and batch formulation; nuclear waste management; ceramic fiber composites
Jing Li, Associate Professor of Chemistry, FAS-NB; Ph.D., Cornell
Synthesis and characterization of inorganic solid compounds
M. John Matthewson, Associate Professor of Ceramic Engineering, CE; Ph.D., Cambridge
Mechanical properties of optical materials
William Mayo, Associate Professor of Ceramics, CE; Ph.D., Rutgers
Physical metallurgy; phase transformation; alloy development
Ronald A. McCauley, Associate Professor of Ceramics, CE; Ph.D., Pennsylvania State
Corrosion of ceramics; phase equilibria; thermal analysis methods; luminescence; crystal chemistry, microscopy
Dale E. Niesz, Professor and Chairperson of the Department of Ceramics and Director of the Center for Ceramic Research, CE; Ph.D., Ohio State
Powder processing; sintering and fabrication; materials thermodynamics

Richard E. Riman, Associate Professor of Ceramic Science and Engineering, CE; Ph.D., Massachusetts Institute of Technology
Synthesis, intelligent process modeling and control

Ahmad Safari, Professor of Ceramics, CE; Ph.D., Pennsylvania State University
Preparation, characterization of electroceramic materials for dielectric, piezoelectric, and ferroelectric applications; ferroelectric and superconductor ceramics and thin films

Mahmoud R. Shahriari, Associate Research Professor of Ceramic Science and Engineering, CE; Ph.D., Catholic University
Optical glasses, fiber optic sensors, IR glasses

Daniel J. Shanefield, Professor of Ceramics, CE; Ph.D., Rutgers
Ceramic packaging for electronics; thin film electronics; organic chemical additives for ceramic processing

George H. Sigel, Jr., Professor of Ceramics, CE; Director of the Fiber Optics Materials Research Program; Ph.D., Georgetown
Optical materials; infrared transmitting materials; radiation resistant materials; optical sensors

Thomas Tsakalakos, Professor of Ceramics, CE; Ph.D., Northwestern
Physical metallurgy; modulated structure materials; multilayered thin film technology

John T. Wenzel, Professor of Chemistry, CE; Ph.D., Chicago
Laser glasses; fiberization; sol-gel glasses

Associate Member of the Graduate Faculty

Edward M. Phillips, Professor of Packaging Science and Engineering, CE; Ph.D., Pittsburgh
Transport properties of packaging materials and packaging systems

Adjunct Members of the Graduate Faculty

John J. Friel, Ph.D., Pennsylvania
Sterology; structure property relationships; image analysis; X-ray analysis

Robert A. Laudise, Ph.D., Massachusetts Institute of Technology
Synthesis and properties of electronic materials; physical chemistry of high-pressure reactions and crystal growth

Programs

Programs in ceramic science leading to the M.S. and Ph.D. degrees may be arranged with the thesis work emphasizing the fundamental aspects of ceramic material behavior. Programs in ceramic engineering leading to the M.S. and Ph.D. degrees may be arranged with thesis work emphasizing the engineering and developmental aspects of the categories in ceramics. For students with full-time jobs in industry, programs without theses leading to the master's degree may also be arranged. A special curriculum for students interested in ceramics manufacturing will lead to a master's degree and may be taken either full time or part time. The curriculum includes business and industrial engineering courses.

Areas of specialization in ceramics include the following: fiber optics; structure and properties of glass; relation of microstructure and properties of ceramic materials; sintering mechanisms; rheology of slips; slip casting; preparation and properties of ceramic powders; dielectric materials, including ferroelectric, piezoelectric and ferromagnetic ceramics; sol-gel processing; thin films; high-temperature materials; strength, toughening, and impact resistance; ceramic-metal systems and composites.

The facilities of the program include approximately 25,000 square feet of well-equipped laboratories. Major pieces of analytical and processing equipment include: scanning electron microscopes; high-resolution TEM Raman microprobe; FTIR; Thermoanalyzer; induction coupled plasma (ICP); X-ray diffraction equipment; X-ray photoelectron spectroscopy; hot isostatic press; pressure caster; mechanical testing machines; and field emission SEM.

The focus of much of the research in ceramics is on the science and technology of synthesis of advanced ceramics materials. Processing ceramics from powders includes: synthesis and characterization of powders, green forming (slip casting, tape casting, rapid prototype methods, injection molding, and spray drying/powder compaction), and densification of powder preforms (sintering, hot pressing, hot isostatic pressing, and preceramic polymer pyrolysis). In addition ceramics are synthesized directly from sol-gels and used for coatings, filters, battery components, etc. Ceramics may be characterized mechanically, electrically, and thermally. Surfaces are studied using scanning tunneling microscopes and atomic force microscopes and simulated by computer modeling

using molecular dynamics. Ceramic composites are being studied to develop stronger, tougher ceramics. Dielectric ferroelectric, piezoelectric, and other active/functional materials are being developed for electronic substrates, capacitors, actuators, sensors, and smart/intelligent materials.

The fiber optic materials research program conducts research in the areas of synthesis of optical materials, fabrication and characterization of optical waveguides, and a wide variety of fiber device applications such as fiber lasers and amplifiers, optical sensors, infrared and ultraviolet transmitting fibers, and fibers for optical power delivery. Extensive experimental facilities are available, including laboratories for preparation of optical quality oxide and nonoxide glasses, chemical vapor deposition equipment, commercial drawing towers, numerous optical spectrometers and fiber optic analyzers, lasers, mechanical testing laboratories, and extensive optical and electro-optical characterization laboratories.

A prospective candidate for the degree of Doctor of Philosophy must spend not less than one academic year as a full-time student in residence. The residence requirement means that every student seeking the doctorate must make their principal commitment of time for one year to courses of study and research within the university.

Academic and research training in the area of packaging science and engineering is available in this program. For further information see the packaging science and engineering courses listed in this section and the program description to be found under the heading "Packaging Science and Engineering."

Graduate Courses

16:150:501. (F) ADVANCED POWDER PROCESSING I (3)

Riman. Prerequisite: 16:150:531.

Examination and comparison of classical and high technology ceramic processing systems using chemical thermodynamics and kinetics, understanding of the approaches for chemically synthesizing ceramic material, coprecipitation, sol-gel processing, hydrothermal synthesis, plasma and CVD.

16:150:502. (F) ADVANCED POWDER PROCESSING II (3)

Danforth

Microstructure development: powder, consolidation behavior, and sintering process, including thermodynamics vs. kinetics and solid state vs. liquid phase or reactive densification.

16:150:503. (F) THEORY OF SOLID-STATE MATERIALS (3)

Khachaturyan

The basic principles of classical mechanics and quantum mechanics, as well as the experimental basis for introduction of quantum postulates. Application of these concepts to various physical phenomena to develop an understanding of solid-state material behavior.

16:150:504. (F) STRUCTURAL DEFECTS IN SOLIDS (3)

Cosandey. Prerequisite: 16:150:551 or equivalent.

Atomistic aspects of defects in solids including point defects, dislocations and grain boundaries; nature of partial dislocations; grain boundary-dislocation interactions; grain boundary migration and segregation phenomena; nature of interfaces.

16:150:505. (F) ADVANCED GLASS I (3)

Wenzel

Advanced topics in glass science and engineering. Major emphasis on the structure and transport properties of oxide and selected nonoxide glasses. Detailed discussion of glass structure, structural modeling, and the relationship between structure and properties.

16:150:506. (S) ADVANCED GLASS II (3)

Sigel

Correlation of the fundamental optical properties of glasses to their structure and bonding. Intrinsic absorption and scattering, color, luminescence, photochromism, laser action, and nonlinear effects in glasses.

16:150:508. ADVANCED CERAMIC-METAL SYSTEMS (3)

Greenhut

The physical and chemical principles of interactions between metals and ceramic materials. Solid, liquid, and interfacial energies. The effect of microstructure in cermet bodies and its relationship to the exhibited properties. Practical systems such as oxide base cermets, carbides, and composite materials.

16:150:509. (F) ADVANCED ELECTRONIC CERAMICS (3)

Safari. Prerequisite: 14:154:421.

The electrical, optical, and magnetic properties of ceramic materials based on their electronic structure, defect chemistry, and transport processes.

16:150:510. (S) PHYSICAL PROPERTIES OF CRYSTALS (3)

Safari

Physical properties of crystals in tensor notation. What tensors are and how they are used. Common mathematical basis of tensor properties; thermodynamic relations among them.

16:150:511. THERMAL ANALYSIS OF CERAMIC MATERIALS (3)

McCauley. Course offered in alternate years.

Description of the equipment used for differential thermal analysis (DTA), differential scanning calorimetry (DSC), and thermal gravimetric analysis (TGA). Calibration techniques. Interpretation of results. Relationships between sample thermal properties, particle size, sample size, crucible materials, heating rates, and atmospheres.

16:150:512. (S) ADVANCED CERAMIC MICROSCOPY (3)

McCauley. Prerequisite: 14:150:407.

Use of optical microscopy for the study of ceramic microstructures. Advanced techniques including image analysis for studying both polished sections and thin sections. Techniques in photomicroscopy with application to a particular problem of interest to each student.

16:150:513. (F) MECHANICAL BEHAVIOR OF CERAMIC MATERIALS I (3)

Cannon

Mechanical behavior and properties of oxide and nonoxide ceramics, emphasizing fracture, microstructure, and environment. Differences in plastic behavior of ceramics related to creep, wear resistance, and hardness.

16:150:514. (S) MECHANICAL BEHAVIOR OF CERAMIC MATERIALS II (3)

Matthewson. Prerequisite: 16:150:513.

In-depth usage of advanced topics concerned with the mechanical properties of ceramic materials, including thin films, fibers, and stress effects on properties.

16:150:515. (F) PROPERTIES OF OPTICAL CERAMICS (3)

Prerequisites: 16:150:505, 506.

Waveguide propagation starting with Maxwell's equations, slab and cylindrical waveguides, active waveguides, fiber laser materials and configurations, infrared fiber waveguides, optical power delivery, fiber optic sensors.

16:150:516. (S) PROPERTIES OF NONCRYSTALLINE SOLIDS (3)

Garofalini. Prerequisite: 14:150:303.

Nature of the glass transition, structure of oxide glasses, physical and chemical properties, surface properties of glasses.

16:150:517. (F) ADVANCED REFRACTORIES (3)

McCauley

The role of the phase equilibria and microstructure in the corrosion of refractories. Stability and behavior in selected environments, including ferrous and nonferrous metals, glass, and advanced energy systems.

16:150:520. (S) X-RAY AND SPECTROGRAPHIC METHODS IN CERAMICS (3)

Greenhut

Principles, operation, and application: X-ray diffraction, X-ray fluorescence, analytical electron microscopy, microprobe analysis, high-temperature X-ray image and backscatter electron analysis, qualitative diffraction, and quantitative chemical and phase analysis.

16:150:521. (S) X-RAY AND SPECTROSCOPIC METHODS LABORATORY (1)

Greenhut. Corequisite: 16:150:520.

Qualitative and quantitative chemical and phase analysis by X-ray fluorescence and diffraction methods, automated diffractometry, microanalysis and image analysis, strain and particle size determination, and sample preparation techniques, including random sampling.

16:150:522. (F) SCANNING ELECTRON MICROSCOPY AND X-RAY MICROANALYSIS (3)

Greenhut

Principles, operation, and application of scanning electron microscopy and X-ray microanalysis: electron optics; instrumental and signal resolution; qualitative and quantitative chemical microanalysis; image processing; signal and metallic samples for ceramic, organic, and metallic samples.

16:150:523. (F) SCANNING ELECTRON MICROSCOPY AND X-RAY MICROANALYSIS LABORATORY (1)

Greenhut. Corequisite: 16:150:522.

Operation of the scanning electron microscope: secondary, backscatter, and specimen current images; elemental distribution by line scans and mapping and quantation by X-ray fluorescence; electronic image enhancement; stereoscopy; preparation of inorganic and organic samples.

16:150:524. (F) ADVANCED CERAMIC CHARACTERIZATION (3)

Cosandey. Prerequisites: 14:150:309, 359.

Instrumental techniques for characterization of ceramics and the study of processing and properties, including absorption and emission spectroscopy, FTIR and Raman spectroscopy, secondary ion mass spectrometry, XPS scanning Auger microscopy, neutron scattering.

16:150:525. (F) PROPERTIES OF CERAMIC SURFACES (3)

Garofalini

Surface structure of ceramic materials, absorption, surface diffusion, thin films.

16:150:526. (S) CRYSTAL CHEMISTRY OF CERAMIC MATERIALS (3)

McCauley

The relationship of structure to composition, temperature, and pressure. The importance of ionic radii, charge, and polarizability in determining structure. Study of families of compounds, compound formation, and phase transitions.

16:150:527. (F) THERMODYNAMICS OF CERAMIC SYSTEMS (3)

Matthewson

Emphasis on special thermodynamic considerations for ceramics: chemical thermodynamics, solution thermodynamics, and thermodynamics related to phase diagrams, surfaces, and point defects.

16:150:529. (F) COLLOIDAL CHEMISTRY OF CASTING SLIPS (3)

Riman

The fundamentals of colloidal chemistry as they apply to ceramic slips. Surfactants, wetting agents, and dispersants of all kinds for clay and nonclay. Rheology and rheometry as they apply to casting slips. The effect of particle size and distribution.

16:150:531. (F) DIFFUSION IN OXIDES (3)

Klein. Prerequisite: Differential equations.

Diffusion in solids. Solutions to Fick's first and second laws under important boundary conditions. Atomic models of diffusion, diffusion in ionic solids, diffusion in metals.

16:150:532. (S) KINETICS OF CERAMIC SYSTEMS (3)

Klein

Diffusion in solids. Solutions to Fick's first and second laws under important boundary conditions. Ionic diffusion. Diffusion applied to sintering. Solid-state reaction kinetics, nucleation, crystal growth, precipitation.

16:150:551. (F) PHYSICAL METALLURGY (3)

Crystal structure of metals and nature of bonding; free energy and phase diagrams; defect structure and relationship to mechanical properties; phase transformations and hardening mechanisms; recovery and recrystallization processes.

16:150:552. (S) PHASE TRANSFORMATIONS IN METAL AND ALLOYS (3)

Prerequisite: 16:150:551 or equivalent.

Thermodynamics and phase diagrams. Solid solutions. Ordered phases. Coherent, semicoherent, and incoherent precipitates. Diffusion-controlled and interface-controlled growth. Nucleation and growth theories. Overall transformation kinetics. Precipitation. Diffusionless transformations.

16:150:553. (F) MECHANICAL BEHAVIOR OF METALS (3)

Mayo. Prerequisite: 16:150:551.

The response of metals to applied forces from both the macroscopic and microscopic points of view. Crystal defect structures as they relate to plastic flow and the onset of fracture. Case studies of metal deformation and fracture, including fatigue, creep, environmentally assisted fracture, and wear.

16:150:561. (F) MATERIALS SCIENCE LABORATORY (3)

Mayo. Prerequisite: Previous computer experience.

Laboratory course in use of instrumentation in the modern analysis laboratory such as X-ray diffractometers, creep machines, torsional pendulum. Topics include computer controlled data acquisition, noise reduction, and curve fitting methods.

16:150:563. (F) ELEMENTARY X-RAY DIFFRACTION (4)

Principles of atomic arrangements; X-ray diffraction by real crystals and elucidation of structure-sensitive properties; identification of unknown substances, phase analysis, X-ray topographic methods, and special methods to characterize defect structures of materials.

16:150:564. (S) ADVANCED DIFFRACTION ANALYSIS (3)

Prerequisite: 16:150:563.

Application of Fourier transform and convolution methods to diffraction of amorphous and crystalline materials; elucidation of lattice defects and correlation to properties of materials, dynamical theory, and application in materials science.

16:150:566. (S) ELECTRON MICROSCOPY (3)

Cosandey

Nature of the electron microscope; techniques of specimen preparation; theory of electron diffraction; diffraction patterns; application to crystal structure; crystal morphology and defects in various engineering materials.

16:150:567. (S) ELECTRON MICROSCOPY LABORATORY (1)

Techniques of electron microscopy and application to structure and defect structure of materials.

16:150:568. (F) ADVANCED ELECTRON MICROSCOPY (3)

Cosandey. Prerequisites: 16:150:566, 567, or equivalent.

Principles and aspects of dynamical theory. Weak beam analysis. High-resolution imaging. Convergent beam diffraction. Scanning transmission and analytical microscopy. Description and application of specialized microscopy techniques to materials problems, including metals, ceramics, and polymers.

16:115:569. (F) QUANTITATIVE METALLOGRAPHY (3)

Tsakalagos

The theory and practice of stereological aspects of quantitative analysis of microstructures observed in alloy, ceramic, polymeric, histological, and other materials. Determination of three-dimensional properties of microstructures by means of measurements of two-dimensional sections, transmission, or scanning electron micrographs.

16:150:571,572. INTRODUCTION TO PACKAGING

ENGINEERING I,II (3,3)

Materials science, engineering, design, development and testing, packaging machinery, package production, distribution, marketing and resource utilization.

16:150:575. (F) PACKAGING—REGULATORY ASPECTS (3)

Prerequisites: 16:150:571,572.

State and federal regulation of packaging and labeling for consumer and environmental protection. Regulations for engineers and scientists to design and fabricate legal containers. Forecasting and aiding in the development of future trends in regulatory action.

16:150:576. (S) PACKAGING MACHINERY (3)

Prerequisites: 16:150:571,572.

Interrelationship between machinery and materials; package production lines; principles of machine design and selection and economics of choice of alternatives.

16:150:577,578. MATERIALS AND DESIGN IN PACKAGING (3,3)

Idol. Prerequisites: 16:150:571,572.

Package design problems from the point of view of the chemical, physical, and engineering behavior of the entire system. Emphasis on the properties of packaging materials and the relation of those properties to structure and performance.

16:150:581,582. SEMINAR IN PACKAGING (1,2)

Idol. Prerequisites: 16:150:571,572.

16:150:583,584. MATERIALS AND PACKAGE EVALUATION LABORATORY (3,3)

Lec. 1 hr., lab. 6 hrs. Prerequisites: 16:150:571,572.

The principles and practices used in the characterization and evaluation of the engineering properties of packaging materials and packages. Gas and vapor permeation of materials and packages; physical properties of materials and packages; package dynamics.

16:150:587,588. SPECIAL PROBLEMS IN PACKAGING (BA,BA)

Idol. Prerequisites: 16:150:571,572, and permission of instructor.

16:150:595. STRUCTURAL TRANSFORMATIONS IN SOLIDS I (3)

Tsakalagos. Prerequisites: 16:150:551,552.

Crystallography of phase transformations. Stability of homogeneous solutions. Static concentration wave theory. Decomposition in alloys. Spinodal decomposition. Elastic coherency strain. Morphology of single coherent inclusions. Applications: precipitation, ceramics, polymer blends.

16:150:596. ADVANCED TOPICS IN MATERIALS (3)

Khachaturyan. Pre- or corequisites: 16:150:551, 552 or equivalent.

Diffusional transformations in crystalline materials. Ordering. Symmetry and long-range order. Symmetry and thermodynamics. Non-stoichiometry and ordering in ceramic systems. Decomposition in ceramic and metal systems. Diffusional kinetics. Elementary atomic processes in diffusion. Diffusionless (displacive) transformations. Crystallography of crystal lattice rearrangement. Crystal lattice coherency. Habit plane and orientation relationships. Orientation relations. Shape Memory Effect. Ferroelectric and ferroelastic transitions. Striction. Transformation-induced strain and strain-accommodating structures. Applications to ferroelectric and ferroelastic systems and to metal alloys.

16:150:601,602. CERAMICS SEMINAR (1,1)

Cannon

Current areas of research studied and discussed.

16:150:603,604. (F,S) SPECIAL PROBLEMS IN MATERIALS SCIENCE (BA,BA)

16:150:701,702. RESEARCH IN CERAMICS (BA,BA)

CHEMICAL AND BIOCHEMICAL ENGINEERING 155

Degree Programs Offered: Master of Science, Doctor of Philosophy

Director of Graduate Program: Professor Helen M. Buettner,
C138 Engineering Building, Busch Campus (732/445-4950)

Members of the Graduate Faculty

Fred R. Bernath, Associate Professor of Chemical and Biochemical Engineering, CE;
Ph.D., Rutgers

Biomedical engineering; transport phenomena

Helen M. Buettner, Associate Professor of Chemical and Biochemical Engineering,
CE; Ph.D., Pennsylvania

Neurobiology; cell motility; biomedical engineering

Yee C. Chiew, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Pennsylvania
Statistical thermodynamics

Alkis Constantinides, Chair and Professor of Chemical and Biochemical
Engineering, CE; D.E.Sc., Columbia

Biochemical engineering; modeling of fermentation processes

Peter R. Couchman, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Virginia
Thermodynamics, transition, and equation of state behavior of single and
multicomponent systems, particularly polymers; surface phenomena

Burton Davidson, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Northwestern
Alternate fuels; control theory; safety systems engineering

Benjamin J. Glasser, Assistant Professor of Chemical and Biochemical Engineering,
CE; Ph.D., Princeton

Multiphase flows and reactors; granular materials and particulate suspensions;
nonlinear dynamics of transport processes

Masanori Hara, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Kyoto
Polymer physics; structure-property relationships of ion-containing polymers in
solid and solution

Marcus Karel, State of New Jersey Professor of Food Science Emeritus, CC; Ph.D.,
Massachusetts Institute of Technology

Food engineering; reaction kinetics; physical chemistry of foods

Joachim B. Kohn, Associate Professor of Chemistry, FAS-NB; Ph.D.,

Weizmann Institute of Science
Biotechnology; bioorganic chemistry; new methods for drug delivery

David S. Kosson, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Rutgers
Hazardous waste control

Prabhas V. Moghe, Assistant Professor of Chemical and Biochemical Engineering,
CE; Ph.D., Minnesota

Tissue engineering; cell-biomaterial interactions; receptor-mediated cellular
processes; mammalian cell culture design and analysis; artificial organs

Fernando Muzzio, Associate Professor of Chemical and Biochemical Engineering,
CE; Ph.D., Massachusetts (Amherst)

Mixing; chaos and randomness; transport phenomena

Brian A. Newman, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Bristol
Structure and morphology of electroactive polymers; X-ray diffraction studies of
polymers; high pressure polymer physics

Henrik Pedersen, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Yale
Biochemical engineering; reactor design; plant cell culture

Alvin J. Salkind, Professor of Surgery, UMDNJ-RWJMS; D.Ch.E., Polytechnic
Institute of New York

Electrochemical engineering; energy; metal recovery

Jerry I. Scheinbeim, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Pittsburgh
Structure-electrical properties of polymers; dielectric, piezoelectric, pyroelectric,
and ferroelectric properties of electroactive polymers

Metin Turkay, Assistant Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Carnegie Mellon
Process systems engineering; modeling, design, synthesis, and optimization
of process systems

Shaw S. Wang, Professor of Chemical and Biochemical Engineering, CE;

Ph.D., Rutgers
Biochemical engineering; food science and technology

Martin L. Yarmush, Visiting Professor of Chemical and Biochemical Engineering,
CE; Ph.D., Rockefeller

Applied immunology; bioprocesses; artificial organs and tissue engineering

Associate Members of the Graduate Faculty

Robert Cowan, Assistant Professor of Environmental Science, CC; Ph.D.,
SUNY (Buffalo)

Environmental engineering; bioremediation; bioregenerative life support

William Craelius, Associate Professor of Biomedical Engineering, CE;

Ph.D., Northwestern
Cardiac and neural electrophysiology

Panagiotis G. Georgopoulos, Associate Professor of Environmental and
Community Medicine, UMDNJ-RWJMS; Ph.D., California Institute
of Technology

Environmental chemical engineering; turbulent transport; reactive flows

Gaetano T. Montelione, Associate Professor of Molecular Biology and
Biochemistry, FAS-NB; Ph.D., Cornell

Nuclear magnetic resonance studies of proteins; protein molecular design;
mechanisms of protein folding

Richard E. Riman, Associate Professor of Ceramic Science and Engineering, CE;
Ph.D., Massachusetts Institute of Technology

Synthesis, processing, and characterization of electronic materials

K. Venkatasubramanian, Visiting Professor of Chemical and Biochemical
Engineering, CE; Ph.D., Rutgers

Applied molecular biology; biochemical process economics

Adjunct Member of the Graduate Faculty

Ingeborg D. Bossert, Assistant Research Professor of Chemical and Biochemical
Engineering, CE; Ph.D., Rutgers

Microbial processes in the environment: biodegradation and bioremediation

Programs

The graduate program in chemical and biochemical engineering is composed of several major elements: engineering science, applied chemistry, and biochemical engineering. Engineering science includes the transport processes, with special emphasis on mass transfer, thermodynamics, and applied mathematics. Applied chemistry encompasses surface chemistry, applied chemical kinetics, catalysis, synthesis, and properties of polymers, semipermeable membranes, and electrochemistry. Biochemical engineering deals with microbial and enzyme technology, fermentations, applied biochemical kinetics and catalysis, biological separations, and applied molecular biology.

The program emphasizes integration of instruction and application, placing great importance on individual student projects and expressions of creativity and originality in the application of fundamentals to solution of research and design problems. The use of basic and advanced chemical and biochemical engineering principles is stressed, together with development of practical applications relating to industrial processing, environmental quality improvement and regulation, and conceptual advances in the understanding of chemical and biochemical reaction processes. Research effort is applied to the advancement of basic scientific theories as well as applications.

Master's degree candidates may elect a thesis or nonthesis option. The thesis option consists of a minimum of 24 course credits and a total of 30 credits including a thesis on a research or design problem. In the nonthesis option, a candidate must complete 30 course credits as well as a critical essay in partial fulfillment of course requirements. The nonthesis option is especially suited to the student who has extensive research experience or full-time professional responsibilities in industry. The program for the Ph.D. normally consists of a minimum of 30 credits of course work and 24-42 credits of research beyond the B.S. degree. The total number of credits required is 72. The course work for the Ph.D. and M.S. degrees includes a sequence of five courses that form the core—chemical engineering analysis; advanced transport phenomena I and II; advanced chemical engineering thermodynamics; and kinetics, catalysis, and reactor design. The Master of Philosophy degree is available to doctoral candidates. The doctoral qualifying examination, given each year in two parts, stresses fundamentals of chemical engineering and advancements in the profession as reflected in the current graduate instructional program.

All students must give an oral presentation on their research or special area of interest before their program is complete. There is no language or residency requirement.

Faculty and students in the program are involved in a broad range of research areas. Research in biochemical engineering includes such topics as enzyme and microbial engineering, biomembrane transport theory, plant and insect cell culture, imaging and biosensing, mammalian cell culture, and biomedical engineering. Chemical environmental efforts involve the use of basic chemical engineering principles such as mass, momentum, and energy balances, reactor

theory, and system simulation to solve problems that relate to surface water and groundwater quality, advanced biological and physiochemical treatment systems, solid waste management, incineration, and hazardous substance evaluation and disposal. Pharmaceutical engineering research focuses on topics such as solids mixing, granular materials and particulate suspensions, powder processing, and crystallization. Alternate fuels research includes enhanced alcohol fermentation and electrochemical engineering with emphasis on battery failure analysis. Liquid-liquid extraction, supercritical extraction processes, and flow simulation in mixing processes are examples of mass transfer applications. Work in statistical thermodynamics is also available.

Graduate assistantships and fellowships are available for both first-year and advanced graduate students. Students participating in the research program on a sponsored basis receive a stipend for either a ten-month or a twelve-month period and have tuition remitted. Support is usually associated with sponsoring grants or contracts, and specific information on available projects should be requested from the graduate director. It is common for an exchange of information on assistantships or fellowships to take place during consideration of admission, with identification of student interests prior to entry to the program.

Graduate Courses

16:155:501. (F) ADVANCED TRANSPORT PHENOMENA I (3)

Muzzio. Prerequisite: Undergraduate transport phenomena.

Momentum transport processes in laminar and turbulent flow systems. Development and application of steady and unsteady boundary layer processes including growth, similitude principles, and separation. Potential flow theory coupled with viscous dissipation at boundaries. Momentum transport in fixed and fluid bed exchangers and reactors.

16:155:502. (S) ADVANCED TRANSPORT PHENOMENA II (3)

Moghe. Prerequisite: Permission of instructor.

Energy balances derived from first and second law approaches to open systems, with reaction. Conduction in fluids and solids, both steady and unsteady examples. Convection in laminar and turbulent flow systems. Interphase transport based on film concepts and boundary layer effects. Radiation. Heat exchanger and furnace design.

16:155:503. (F) MASS TRANSPORT PHENOMENA (3)

Pre- or corequisite: 16:155:501.

Principles of transport phenomena as applied to mass transfer. Diffusion and its treatment in stagnant and flowing media. Two phase systems, coupled reaction and mass transfer, and engineering practices in equipment design.

16:155:504. (S) MIXING: THEORY AND APPLICATIONS (3)

Muzzio. Prerequisite: Undergraduate fluid mechanics.

Theory of mixing processes in laminar and turbulent flows. Practical aspects of mixing processes (equipment selection, design, scale-up) used in industrial operations.

16:155:507. (F) ANALYTICAL METHODS IN CHEMICAL AND BIOCHEMICAL ENGINEERING (3)

Buettner. Prerequisites: Undergraduate differential and integral calculus and differential equations or permission of the graduate director.

Analytical solutions to deterministic mathematical models encountered in chemical and biochemical engineering, including environmental and safety systems. Emphasis is on purpose, philosophy, classification, development, and analytical solutions of models occurring in transport phenomena, thermochemical, and reactor systems.

16:155:508. (F) CHEMICAL ENGINEERING ANALYSIS (3)

Constantinides. Prerequisite: Undergraduate or graduate degree in chemical engineering or in the biological or physical sciences.

Mathematical modeling and simulation of chemical and biochemical systems; numerical methods. Solution of ordinary and partial differential equations. Statistical methods of linear and nonlinear regression analysis; optimization methods. Extensive use of digital computers.

16:155:511. (F) ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS (3)

Chiew. Prerequisite: Undergraduate or graduate degree in engineering or chemistry.

Basic principles of classical chemical thermodynamics. Chemical and physical equilibria and their relationships in simple and reactive systems. Estimation and correlation of thermodynamic functions, applications of thermodynamic principles to transport and rate processes. Irreversible and statistical thermodynamic topics also introduced.

16:155:512. ADVANCED CHEMICAL ENGINEERING MOLECULAR THERMODYNAMICS (3)

Chiew. Prerequisite: 16:155:511 or equivalent.

Statistical ensembles; ideal and non-ideal gases; liquids; distribution function theories; Ornstein-Zernike equation; computer simulation methods; perturbation theories; engineering semi-empirical equations of state; applications to chemical engineering systems.

116:155:514. (S) KINETICS, CATALYSIS, AND REACTOR DESIGN (3)

Wang. Prerequisites: 16:155:501 and 507, or equivalent.

Principles of applied chemical kinetics, reaction mechanisms and rate laws, and engineering design of reactor vessels. Applications to homogeneous and heterogeneous process reaction systems with internal, transphase, and external mass transfer. Noncatalytic gas-solid reaction and gas-liquid absorption with reaction. Micromixing and macromixing in reactor systems.

16:155:517. ADVANCED PROCESS CONTROL (3)

Davidson. Prerequisite: Process control or permission of instructor.

Review of analysis and design of feedback control systems. Advanced process control systems. Control systems for multi-variable processes. Process control systems, using computers and artificial intelligence techniques. Intelligent control laboratory.

16:155:518. (S) PROCESS SYSTEMS ENGINEERING (3)

Turkey. Prerequisite: Undergraduate engineering design.

Recent developments in process systems engineering, particularly in the area of process synthesis and design. Principles of process synthesis and design, energy integration in chemical processes/complexes, planning and scheduling of batch/continuous processes. Basic steps of problem solving and algorithm generation illustrated in several case studies.

16:155:531. (F) BIOCHEMICAL ENGINEERING (3)

Wang. Prerequisites: Degree or option in biochemical engineering, or 01 or 11:115:301 and 01:119:390, or equivalent.

Integration of the principles of chemical engineering, biochemistry, and microbiology. Development and application of biochemical engineering principles. Analysis of biochemical and microbial reactions.

16:155:532. (F) TOPICS IN BIOCHEMICAL ENGINEERING (3)

Pedersen. Prerequisite: 16:155:531.

An advanced course devoted to current topics of interest in biochemical and enzyme engineering. Topics include production, isolation, and purification of enzymes; downstream processing; design and analysis of bioreactors; bioprocess economics; modeling, optimization, and scale-up of biochemical systems. Content and format may vary from year to year.

16:155:533. (S) BIOSEPARATIONS (3)

Yarmush. Prerequisite: Permission of instructor.

Fundamental problems of separation processes important to the recovery of products from biological processes. Topics include membrane filtration centrifugation, chromatography, extraction, electrokinetic methods. Emphasis on protein separations.

- 16:155:534. (S) ENZYME ENGINEERING (3)
Pedersen. Prerequisite: Undergraduate or graduate degree in chemical or biochemical engineering or in the biological sciences.
Application of biochemical engineering principles to enzyme technology. Enzyme structure and function, biochemical and biophysical properties, enzyme stability, mathematical models for inactivation. Design and analysis of enzyme and fixed microbial cell reactors. Use of enzymes in industrial, environmental, and medical applications. Case studies of commercial enzyme processes.
- 16:155:551. (F) POLYMER SCIENCE AND ENGINEERING I (3)
Physical and chemical structure of polymers; morphology of polymer crystals; microscopic texture. Mechanical properties; influence of orientation; effects of temperature and environment; engineering applications.
- 16:155:552. POLYMER SCIENCE AND ENGINEERING II (3)
Prerequisite: 16:155:551.
Emphasis on a modern treatment of polymers, including statistical mechanics scaling concepts and polymer properties and characterization.
- 16:155:553. (F) POLYMER SCIENCE AND ENGINEERING LAB (1)
Fina. Pre- or corequisite: 16:155:551.
Basic structure-property relationships of polymeric materials in their liquid, glassy, and crystalline states including synthesis, molecular weight distribution, morphology, thermal and mechanical properties.
- 16:155:554. POLYMER PROCESSING (3)
Newman. Prerequisites: 16:635:155:551,552.
Extrusion, transfer, and compression molding; injection molding, thermoforming, and blow molding; thermoset, thermoplastics, and elastomers. Additives and fillers, coatings, laminates, mold designs, heat sealing, and orientation in films and fibers.
- 16:155:555. (F) POLYMER PHYSICS (3)
Prerequisites: 16:155:551,552.
Introduction to physics of high polymers and their properties in the solid state; discussion of dielectric, mechanical, and nuclear magnetic resonance phenomena and application to relaxation behavior; theories of rubber elasticity and viscoelasticity; yield and fracture behavior.
- 16:155:556. (S) POLYMER RHEOLOGY (3)
Prerequisites: 16:155:551,552.
Introduction to viscosity and rheological phenomena in high polymers; the relation of these to molecular parameters and their applications in polymer physics, polymer engineering, and polymer processing.
- 16:155:557. (S) ADVANCED POLYMER PHYSICS (3)
Prerequisites: 16:155:554,555.
Theory of thermoelastic behavior of rubbers, calculations of surface tension for single and multicomponent systems, Gibbs-DiMarzio theory of the glass transitions, effect of pressure on transitions, relaxations, viscoelastic behavior of homopolymer blends, diffusion, viscosity.
- 16:155:558. (F) VIBRATIONAL SPECTROSCOPY OF POLYMERS (3)
Fina. Prerequisite: 16:155:551,552.
Physical basis for infrared absorption and Raman scattering. Theory of molecular vibrations. Michelson interferometer with associated optical and computational techniques. Modeling of vibrational properties of chain molecules. Applications to synthetic and biological macromolecules.
- 16:155:559. (F) SCATTERING METHODS IN POLYMER SCIENCE (3)
Hara. Prerequisites: 16:155:551,552.
Basic scattering theory and its application in studying polymers in solution and solid state: static and dynamic light scattering, small-angle X-ray scattering, and small-angle neutron scattering.
- 16:155:561. (F) APPLIED SURFACE CHEMISTRY (3)
Prerequisite: Undergraduate or graduate degree in chemical engineering or in the biological or physical sciences.
Phenomena and processes relevant to chemical engineering characterized by large interfacial area relative to phase volume. Consideration of fundamental principles of surface chemistry and physics, such as interfacial tension and pressure. Study of the colloidal state and colloidal particles. Theories of the electrical double layer and stability of suspensions. Application of theory to important processes such as foaming, emulsification, detergency, adhesion, ore flotation, and rate processes controlled at a phase interface, including nucleation and crystallization.
- 16:155:562. (S) SYNTHESIS AND PROPERTIES OF SOLID POLYMERS (3)
Prerequisite: Undergraduate or graduate degree in chemical engineering or in the biological or physical sciences.
Advanced treatment of polymer processes and resultant polymer properties from the interrelated points of view of reaction engineering (including catalytic routes) and materials science (structure-property relationships) appropriate to the modern generation of engineering polymers.
- 16:155:563. (F) SEMIPERMEABLE MEMBRANES (3)
Prerequisite: Undergraduate or graduate degree in chemical engineering or in the biological or physical sciences.
The applied physicochemical principles that underlie the frontier applications of barrier diffusion.
- 16:155:572,573. ELECTROCHEMICAL ENGINEERING I,II (3,3)
Salkind. Prerequisite: Undergraduate or graduate degree in chemical engineering or chemistry.
An introduction to the principles and applications of electrochemical engineering properties of electrodes. Electrochemical engineering, energy conversion, and storage thermodynamics and design features in primary and secondary fuel cells, and in metallic corrosion, electroforming, and electrolysis.
- 16:155:574. (S) SOLVENT EXTRACTION ENGINEERING (3)
Prerequisite: Undergraduate or graduate degree in chemical engineering or chemistry.
Advanced treatment of solvent extraction operations including both practical design approaches and a systematic development based on the fundamental aspects of mass transfer, mass transfer with reaction, and dispersion modeling in various contractor configurations.
- 16:155:575. ELECTROCHEMICAL ENGINEERING TECHNIQUES (3)
Salkind. Lec. 2 hrs., lab. 3 hrs. Prerequisites: 16:155:572,573.
A lecture-laboratory course providing theoretical and practical experience in the techniques of studying charge-transfer and mass-transfer controlled reactions in corrosion, electroplating, battery energy conversion, the production of chemicals, and other electrochemical applications.
- 16:155:582. (S) FUNDAMENTALS OF CONTAMINANT MASS TRANSFER (3)
Kosson. Prerequisite: Undergraduate degree in chemical, biochemical, or environmental engineering, or permission of instructor.
Theory and mathematical modeling of thermodynamics, reaction, and diffusive and convective mass transfer for inorganic and organic contaminants in porous media, emphasizing behavior in sediments and saturated soils.
- 16:155:588. (F) SPECIAL PROBLEMS IN CHEMICAL ENVIRONMENTAL ENGINEERING (3)
Kosson. Prerequisites: 16:155:501,502, or equivalent.
Natural water bodies described by the techniques developed for chemical and biochemical reactor analysis. Physical transport, interfacial exchanges, and biochemical reactions. Examples drawn from reaeration processes, surface water temperature and energy balances, and stochastic variations in stream discharge.

16:155:601,602. CHEMICAL ENGINEERING GRADUATE SEMINAR (N1,N1)

Buettner
Graduate students are given an opportunity to make a formal presentation on their independent study and/or research. Outside speakers are also invited.

16:155:603,604. TOPICS IN ADVANCED BIOTECHNOLOGY (1,1)
Pedersen. Prerequisite: Permission of instructor.

Oral presentations and discussions of the current literature in biotechnology. Topics will be selected from: tissue, genetic, and protein engineering; growth control; receptor signaling; immunotechnology; neurotechnology; and others.

16:155:701,702. RESEARCH IN CHEMICAL AND BIOCHEMICAL ENGINEERING (BA,BA)

CHEMISTRY 160

Degree Programs Offered: Master of Science, Master of Science for Teachers, Doctor of Philosophy

Director of Graduate Program: Professor Roger A. Jones, Wright-Rieman Laboratories, Busch Campus (732/445-3223)

Vice Chairperson for Graduate Studies: Professor Martha A. Cotter, Wright-Rieman Laboratories, Busch Campus (732/445-2259)

Members of the Graduate Faculty

William H. Adams, Professor of Chemistry, FAS-NB; Ph.D., Chicago
Quantum theory of atoms and molecules

Stephen Anderson, Associate Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., Harvard

Proteases and protease inhibitors; protein folding; molecular recognition
Edward Arnold, Associate Professor of Chemistry, FAS-NB; Ph.D., Cornell

Crystallographic studies of human viruses and viral proteins
Jean S. Baum, Associate Professor of Chemistry, FAS-NB; Ph.D.,

California (Berkeley)
Structural studies of proteins by nuclear magnetic resonance techniques

Helen M. Berman, Professor of Chemistry, FAS-NB; Ph.D., Pittsburgh
X-ray crystallographic and molecular modeling studies of biological molecules

George R. Bird, Professor of Chemistry, FAS-NB; Ph.D., Harvard
Photovoltaic cells; chemical imaging systems; dye lasers

Robert S. Boikess, Professor of Chemistry, FAS-NB; Ph.D., Columbia
Chemical education

John G. Brennan, Associate Professor of Chemistry, FAS-NB; Ph.D., California (Berkeley)

Solid-state inorganic chemistry; thin films; nanoclusters
Kenneth J. Breslauer, Professor of Chemistry, FAS-NB; Ph.D., Yale

Biopolymer structures and drug-nucleic acid interactions
Kuang-Yu Chen, Professor of Chemistry, FAS-NB; Ph.D., Yale

Biophysical and biological chemistry; polyamines in cancer and aging
Martha A. Cotter, Professor of Chemistry, FAS-NB; Ph.D., Georgetown

Theoretical studies of liquid crystals and micellar systems
Richard H. Ebright, Professor of Chemistry, WIM/FAS-NB; Ph.D., Harvard

Protein-DNA interaction; protein engineering; regulation of gene expression
Eric L. Garfunkel, Professor of Chemistry, FAS-NB; Ph.D., California (Berkeley)

Surface science; thin-film growth; molecular adsorption on surfaces
Millie M. Georgiadis, Assistant Professor of Chemistry, WIM/FAS-NB;

Ph.D., California (Los Angeles)
X-ray crystallographic studies of retroviral enzymes

Alan S. Goldman, Associate Professor of Chemistry, FAS-NB; Ph.D., Columbia
Organometallic reaction mechanisms, photochemistry, and catalysis

Lionel Goodman, Professor of Chemistry, FAS-NB; Ph.D., Iowa State
Laser spectroscopy with emphasis on multiphoton processes

Martha Greenblatt, Professor of Chemistry, FAS-NB; Ph.D., Polytechnic Institute of New York

Solid-state inorganic chemistry; crystal growth
Gene S. Hall, Associate Professor of Chemistry, FAS-NB; Ph.D., Virginia

Polytechnic Institute
Applied analytical chemistry; trace analysis

Gregory F. Herzog, Professor of Chemistry, FAS-NB; Ph.D., Columbia
Origin and evolution of meteorites; cosmogenic radioisotopes

Jane Hinch, Associate Professor of Chemistry, FAS-NB; Ph.D., Cambridge
Molecular beam-surface interactions and diffractive techniques

Stephan S. Isied, Professor of Chemistry, FAS-NB; Ph.D., Stanford
Bioinorganic chemistry; long-range intramolecular electron transfer

Roger A. Jones, Chairperson of Department and Professor of Chemistry, FAS-NB; Ph.D., Alberta

Nucleic acid synthesis and structural analysis; ligand-nucleic acid interactions

Spencer A. Knapp, Professor of Chemistry, FAS-NB; Ph.D., Cornell
Total synthesis of natural products; new synthetic methods
Joachim B. Kohn, Professor of Chemistry, FAS-NB; Ph.D., Weizmann Institute

of Science
Biotechnology; bioorganic chemistry; new methods for drug delivery

John Krenos, Associate Professor of Chemistry, FAS-NB; Ph.D., Yale
Chemical physics, particularly molecular beam chemistry

Karsten Krogh-Jespersen, Professor of Chemistry, FAS-NB; Ph.D., New York
Computational studies of molecular electronic structure; excited electronic states

Jeehiun Katherine Lee, Assistant Professor of Chemistry, FAS-NB; Ph.D., Harvard
Biological and organic reactivity, recognition, and catalysis; computational

chemistry; mass spectrometry
Ronald M. Levy, Professor of Chemistry, FAS-NB; Ph.D., Harvard

Biophysical chemistry; chemical physics; dynamics of macromolecules
Frederick H. Long, Assistant Professor of Chemistry, FAS-NB; Ph.D., Columbia

Optical spectroscopy of condensed matter
Theodore E. Madey, Professor of Physics and Chemistry, FAS-NB; Ph.D.,

Notre Dame
Structure and reactivity of surfaces and ultrathin films

Gerald S. Manning, Professor of Chemistry, FAS-NB; Ph.D., California (San Diego)

Theory of polyelectrolytes; ionic effects on biopolymers
Gaetano T. Montelione, Associate Professor of Molecular Biology and

Biochemistry, FAS-NB; Ph.D., Cornell
Nuclear magnetic resonance studies of proteins; protein molecular design

Robert A. Moss, Professor of Chemistry, FAS-NB; Ph.D., Chicago
Organic chemistry in aggregates; chemistry of reactive intermediates

Wilma Olson, Professor of Chemistry, FAS-NB; Ph.D., Stanford
Theoretical studies of nucleic acid structure and properties

Joseph A. Potenza, University Professor of Chemistry, FAS-NB; Ph.D., Harvard
Molecular structure; X-ray diffraction; magnetic resonance

Laurence Romsted, Professor of Chemistry, FAS-NB; Ph.D., Indiana
Micellar organic chemistry; organic reaction mechanisms

Heinz D. Roth, Professor of Chemistry, FAS-NB; Ph.D., Cologne
Chemistry of reactive intermediates

Ronald R. Sauers, Professor of Chemistry, FAS-NB; Ph.D., Illinois
Organic photochemistry; molecular modeling

Harvey J. Schugar, Professor of Chemistry, FAS-NB; Ph.D., Columbia
Inorganic and bioinorganic chemistry; long-range electron transfer

Stanley Stein, Adjunct Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., CUNY

Methods in analytical biochemistry
John W. Taylor, Associate Professor of Chemistry, FAS-NB; Ph.D., Chicago

Synthesis of bioactive peptides and peptide mimetics; protein engineering
Irwin Tobias, Professor of Chemistry, FAS-NB; Ph.D., Princeton

Interaction of radiation with molecules; tertiary structure of biopolymers
Sidney Toby, Professor of Chemistry, FAS-NB; Ph.D., McGill

Chemical kinetics; photochemistry; chemiluminescence
Kathryn E. Uhrich, Assistant Professor of Chemistry, FAS-NB; Ph.D., Cornell

Polymer synthesis; novel polymer architectures; biomedical polymers
Alexander M. Yacynych, Associate Professor of Chemistry, FAS-NB,

Ph.D., Cincinnati
Electrochemistry; chemically modified electrodes; biosensors

Associate Members of the Graduate Faculty

Georgia A. Arbuckle, Associate Professor of Chemistry, FAS-C; Ph.D., Pennsylvania

Synthesis/properties of conducting polymers; quartz crystal microbalance study of electroactive surfaces

Jing Li, Associate Professor of Chemistry, FAS-C; Ph.D., Cornell
Experimental and theoretical studies of solid-state inorganic materials

Richard D. Ludescher, Associate Professor of Food Science, CC; Ph.D., Oregon
Protein structure, dynamics, and function; optical spectroscopy

Programs

The program has a large and diverse faculty with strength in biophysical, bioinorganic, bioorganic, and biological chemistry, solid-state and surface chemistry, and theoretical chemistry, as well as in the traditional subdisciplines of analytical, inorganic, organic, and physical chemistry. Chemistry faculty members are engaged in a variety of interdisciplinary research efforts, in collaboration with researchers in other departments and institutes at Rutgers and at the Robert Wood Johnson Medical School. Interdisciplinary research in the areas of surface science, solid-state materials research, and molecular biophysics and biochemistry has increased substantially over the past several years due primarily to the establishment and growth of several advanced technology centers on the Rutgers-New Brunswick campuses: the Center for Advanced Biotechnology

and Medicine, the Center for Advanced Food Technology, the Center for Ceramics Research, the Fiber Optics Research Center, and the Laboratory for Surface Modification.

Faculty and graduate student research is supported by in-house shop facilities (machine, electronics, and glassblowing), a comprehensive chemistry library, and a full range of state-of-the-art chemical instrumentation. Instruments of particular note include 400, 500, and 600 MHz NMR spectrometers with 2-D and 3-D capabilities, 200 MHz NMR spectrometers with solid-state capabilities, computer interfaced single-crystal and powder X-ray diffractometers, a nanosecond laser flash photolysis system, ultrahigh vacuum surface analysis systems, and extensive laser and calorimetric instrumentation. Departmental computer and molecular graphics facilities include more than 35 workstations, 150 terminals and desktop computers, color laser printers, and plotters with associated hardware to facilitate network connectivity and access to the Internet.

The program for the master's degree requires a minimum of 30 credits and includes either a critical essay or a thesis on some research problem. The program for the Ph.D. degree requires a thesis and an appropriate combination of course work and research credits. The Master of Philosophy degree is available to doctoral candidates.

A Ph.D. candidate must complete a minimum of 15 credits of course work, including 9 credits in his or her principal subfield of study (analytical, biological, inorganic, organic, or physical chemistry) and 6 credits chosen from among core courses in other subfields. The Ph.D. qualifying examination consists of a series of written cumulative examinations and, in most subfields, the oral presentation and defense of a research proposal. There is no language requirement.

A Ph.D. candidate must spend not less than one academic year as a full-time student in residence. This residence requirement may be waived in cases of outstanding professional accomplishment and experience.

Most graduate courses are scheduled in the late afternoon and early evening hours. This provides an opportunity for students who are unable to attend classes during the day because of employment restrictions to pursue an M.S. degree.

Teaching assistantships and fellowships are available for both first-year and advanced graduate students; virtually all full-time doctoral students receive financial support. Teaching assistants spend no more than six contact hours per week on their duties and normally take 6 to 10 credits of graduate courses or research each term. Fellowships normally do not entail special duties, and those who hold them can devote their time to course work and to research related to their Ph.D. dissertation. Further information on these and other matters may be found in The Graduate Program in Chemistry, a brochure available from the department.

Graduate Courses

16:160:501. (F) CHEMISTRY OF HETEROCYCLIC COMPOUNDS (3)

Prerequisites: 01:160:307,308, or equivalent.
Covers p-deficient (pyridine type) and p-excessive (pyrrole type) heterocyclic compounds. Emphasis on synthesis, reactivity, rearrangements, utility (in general organic synthesis), and biological activity.

16:160:503. (S) MODERN SYNTHETIC ORGANIC CHEMISTRY (3)

Prerequisite: 16:160:511.
A survey of preparative methods in organic chemistry and their application to the synthesis of complex molecules.

16:160:504. (S) RECENT ADVANCES IN ORGANIC CHEMISTRY (3)

Prerequisite: 16:160:511.
Selected newer topics discussed at an advanced level.

16:160:509. ORGANIC CHEMISTRY OF HIGH POLYMERS (3)

Prerequisites: 01:160:307,308 and 327,328, or equivalent.
Introduction to the synthesis and reactions of macromolecules, free-radical polymerization, stereospecific polymerization, and stepwise polymerization.

16:160:510. INTRODUCTION TO MOLECULAR MODELING (3)

Prerequisites: 01:160:307,308, 323,324; or equivalent.
Introduction to the use of computer-assisted molecular modeling techniques for the study of chemical problems; lectures on theoretical principles; instruction in use of modern modeling programs; computer projects involving solution of chemical problems.

16:160:511,512,513. ADVANCED ORGANIC CHEMISTRY I,II,III (3,3,3)

Prerequisites: 01:160:307,308, or equivalent.
Advanced survey of organic chemistry; molecular orbital theory, orbital symmetry correlations, structure and stereochemistry of organic molecules, chemistry of reactive intermediates, structure-reactivity relationships, molecular rearrangements.

16:160:515. (F) INTERPRETATION OF ORGANIC SPECTRA (3)

Prerequisites: 01:160:307,308, or equivalent.
The use of nuclear magnetic resonance, mass spectrometry, infrared and ultraviolet spectroscopy for the identification of organic compounds and the elucidation of organic reaction mechanisms.

16:160:518. (S) BIOORGANIC MECHANISMS (3)

Prerequisites: 01:160:307,308 and 327,328, or equivalent; 16:160:511.
Catalysis of organic reactions that are model systems for enzymatic processes. Emphasis on mechanisms of enzyme-catalyzed reactions.

16:160:520. (F) MATHEMATICAL METHODS OF CHEMISTRY (3)

Selected aspects of infinite series, vectors and matrices, functions of a complex variable, differential equations, and integral transforms as they are used in chemistry.

16:160:521. (F) ATOMIC AND MOLECULAR STRUCTURE (3)

Prerequisites: 01:160:327,328, or equivalent.
Introduction to the ideas of quantum chemistry and their application to the structure and properties of atoms and molecules.

16:160:522. STATISTICAL MECHANICS (3)

Prerequisites: 01:160:327,328, or equivalent.
The basic concepts and methods of equilibrium statistical mechanics. Applications to systems and phenomena of chemical interest, including ideal and real gases, chemical equilibria, phase transitions, classical liquids, polymer solutions.

16:160:524. (F) MATERIALS AND MECHANISMS OF MODERN PHOTOGRAPHIC PROCESSES (3)

Prerequisite: Bachelor's degree in chemistry, physics, or chemical engineering.
Chemical imaging systems from a molecular point of view. Conventional silver halide processes and organic imaging systems.

16:160:525. (S) CHEMICAL THERMODYNAMICS (3)

Prerequisites: 01:160:327,328, or equivalent.
Principles of classical and statistical thermodynamics and their application to the study of homogeneous and heterogeneous equilibria.

16:160:526. PHYSICAL CHEMISTRY OF SOLUTIONS (3)

Prerequisite: 16:160:525.
Thermodynamics and statistical thermodynamic properties of solutions; Brownian motion and diffusion; Debye-Huckel theory of electrolytes.

16:160:527,528. PHYSICAL CHEMISTRY OF HIGH POLYMERS (3,3)

Prerequisites: 01:160:327,328, or equivalent.
Introduction to the physical chemistry of macromolecules aimed at understanding relations between molecular structure and physical properties of high polymers.

16:160:529. MOLECULAR SPECTROSCOPY (3)

Prerequisite: 16:160:521. Pre- or corequisite: 16:160:532.
Principles of electronic and vibrational spectroscopy of polyatomic molecules. Emphasis on the quantum-mechanical basis of the spectra and the ways in which spectra yield information about molecular properties.

- 16:160:530. INTRODUCTION TO RADIO AND NUCLEAR CHEMISTRY (3)
Prerequisites: 01:160:327,328, or equivalent.
Fundamentals of the nuclear atom; radioactivity and decay processes; detection of radiation; the chemical uses of radioactivity; nuclear chemistry; hot-atom chemistry; Mossbauer effect; design of experiments.
- 16:160:531. PHOTOCHEMISTRY (3)
Prerequisites: 01:160:307,308 and 327,328, or equivalent.
The absorption of light; the formation of electronically excited states and their subsequent chemical reactions; fluorescence, phosphorescence, and quantum yields; applications of photochemistry to organic systems.
- 16:160:532. QUANTUM MECHANICS (3)
Prerequisites: 16:160:520, 521.
Introduction to the principles of quantum mechanics with emphasis on operator approaches and the angular momentum problem. Approximate methods and application to simple examples.
- 16:160:533. CHEMICAL APPLICATIONS OF GROUP THEORY (3)
Prerequisite: 16:160:521 or equivalent.
Aspects and consequences of molecular symmetry; point groups and character tables; group theory and quantum mechanics; symmetry aspects of the electronic structure in organic and inorganic molecules; selection rules for electronic and vibrational spectroscopy; ligand field theory.
- 16:160:534. (S) CHEMICAL KINETICS (3)
Prerequisites: 01:160:327,328, or equivalent.
Chemical reaction rates, theories of molecular transformations, and the elucidation of reaction mechanisms.
- 16:160:535,536. CRYSTAL AND MOLECULAR STRUCTURE I,II (3,3)
Prerequisites: 01:160:327,328, or equivalent. See also 16:635:564.
The symmetry of crystals; point and space groups. Determination of crystal structure by X-ray diffraction. Analysis of X-ray photographic and diffractometer data and its processing.
- 16:160:537. BIOPHYSICAL CHEMISTRY I (3)
Olson. Prerequisites: 01:160:327,328, or equivalent.
Introduction to the physical chemistry of proteins, nucleic acids, and their complexes. Forces that determine biopolymer structure. Principles of protein and nucleic acid structure. Transitions and interactions of biopolymers.
- 16:160:538. BIOPHYSICAL CHEMISTRY II (3)
Olson. Prerequisite: 16:160:537 or equivalent.
Introduction to biophysical techniques used in the study of structure and function. Theoretical methods of macromolecular analysis. Methods of macromolecular engineering and design.
- 16:160:539. PROTEIN ENGINEERING AND DESIGN (3)
Ebright. Prerequisites: 01:160:307, 308, and 11:115:403,404, or equivalent, or permission of instructor; 16:160:537 strongly recommended.
Protein structure. Protein structure-function relationships. Protein engineering methods. Protein engineering to modify the properties of existing useful proteins (e.g., ligand recognition, catalysis, allostery, stability). Protein engineering to create new useful proteins. Catalytic antibodies. Semi-synthetic proteins. Denovo protein design.
- 16:160:540. SINGLE-CRYSTAL X-RAY ANALYSIS LABORATORY (1)
Potenza, Berman, Ginell. Prerequisite: 16:160:535. Corequisite: 16:160:536.
Laboratory course to accompany 16:160:536. Characterization of crystals and introduction to diffractometry.
- 16:160:541,542. SPECIAL TOPICS IN PHYSICAL CHEMISTRY (3,3)
Prerequisites: 01:160:327,328, or equivalent.
Advanced topics of current interest.
- 16:160:543,544. SPECIAL TOPICS IN BIOLOGICAL CHEMISTRY (1-3 BA,1-3 BA)
Prerequisites: 16:160:537,538, or equivalent.
Advanced topics of current interest.
- 16:160:546. CHEMICAL SEPARATIONS (3)
Prerequisite: 01:160:348 or equivalent.
The principles of chemical separations by various chromatographic techniques.
- 16:160:548. SPECIAL ANALYTICAL METHODS (3)
Prerequisite: 01:160:348 or equivalent.
Advanced topics in analytical chemistry.
- 16:160:549. ELECTROANALYTICAL CHEMISTRY (3)
Prerequisite: 01:160:348 or equivalent.
The application of electrochemical principles and techniques, including modern polarographic methods, voltammetry, potentiometry, and chronopotentiometry.
- 16:160:551. ANALYTICAL SPECTROSCOPY (3)
Prerequisite: 01:160:348 or equivalent.
Theory of spectroscopy and spectrophotometry, including the analytical applications of spectrochemical methods.
- 16:160:565. ENERGETICS AND STRUCTURES IN INORGANIC CHEMISTRY (3)
Prerequisite: 01:160:371 or equivalent.
Relation of molecular structure and bonding to thermochemical properties.
- 16:160:571. (F) ADVANCED INORGANIC CHEMISTRY (3)
Prerequisite: 01:160:371 or equivalent.
A survey of bonding, electronic-structural, and magnetic properties of transition metal complexes, followed by a survey of the kinetics and mechanisms by which such materials undergo substitution, isomerization, and redox reactions.
- 16:160:575. (S) PRINCIPLES OF ORGANOMETALLIC CHEMISTRY (3)
Prerequisites: 01:160:307,308, 371, or equivalent.
A detailed survey of the mechanisms of organometallic reactions.
- 16:160:576. BIOINORGANIC CHEMISTRY (3)
Prerequisite: 01:160:371 or equivalent.
Spectroscopic, chemical, and other properties of metal-containing biological systems such as hemoglobin, vitamin B₁₂, and carboxypeptidase.
- 16:160:577. (S) SOLID-STATE CHEMISTRY (3)
Prerequisites: 01:160:371, 421, or equivalent.
Relation between crystal structure, bonding and physical properties of solids, imperfections in solids; nonstoichiometric compounds; electronic and magnetic properties of various types of solids; transformation in solids; solid-state reactions; crystal growth; solid-state electrochemistry.
- 16:160:579. SPECIAL TOPICS IN INORGANIC CHEMISTRY (3)
Prerequisite: 01:160:371 or equivalent.
Advanced topics of current interest.
- 16:160:601,602. INDEPENDENT STUDIES IN CHEMISTRY (BA,BA)
Individualized instruction supervised by a faculty member.
- 16:160:605,606. LABORATORY ROTATION IN CHEMISTRY I,II (BA 1-3,BA 1-3)
Enrollment restricted to Ph.D. students in chemistry. No more than a total of 6 credits of laboratory rotation can be earned.
Introduction to the techniques of chemical research through participation in research projects of selected members of the graduate faculty.
- 16:160:611,612. SEMINAR IN CHEMISTRY (1,1)
For second- and third-year Ph.D. students.
Student seminars on topics of current interest in chemistry.
- 16:160:701,702. RESEARCH IN CHEMISTRY (BA,BA)

CITY AND REGIONAL PLANNING

(See the catalog of the Edward J. Bloustein School of Planning and Public Policy for information on its M.C.R.P. degree program.)

CIVIL AND ENVIRONMENTAL ENGINEERING 180

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Perumalsamy N. Balaguru,
Civil and Environmental Engineering Building, Busch Campus
(732/445-2232)

Members of the Graduate Faculty

- Perumalsamy N. Balaguru, Professor of Civil Engineering, CE; Ph.D., Illinois (Chicago)
Concrete structural systems; composite materials; construction management
- Yong S. Chae, Professor of Civil and Environmental Engineering, CE; Ph.D., Michigan
Soil dynamics; foundation analysis and design; environmental geotechnology; groundwater engineering
- Gary R. Consolazio, Assistant Professor of Civil Engineering, CE; Ph.D., Florida
Finite element analysis; computer-aided bridge engineering; numerical methods; neural networks
- Ellis H. Dill, Dean and Professor of Civil Engineering, CE; Ph.D., California (Berkeley)
Structural analysis and design; finite element methods; experimental stress analysis
- Nenad Gucunski, Associate Professor of Civil Engineering, CE; Ph.D., Michigan
Soil-structure interaction; nondestructive testing; numerical methods; soil and structural dynamics
- Qizhong Guo, Assistant Professor of Civil and Environmental Engineering, CE; Ph.D., Minnesota
Environmental, coastal, urban, and cold regions hydraulics; water quality; sediment transport and quality
- Barbara D. Hayes, Assistant Professor of Civil and Environmental Engineering, CE; Ph.D., Massachusetts Institute of Technology
Water resources/environmental engineering and policy; flood risks; numerical modeling
- Mohamad H. Maher, Chair and Associate Professor of Civil and Environmental Engineering, CE; Ph.D. Michigan
Soil/site improvement; soil composite materials; geosynthetics; soil dynamics; environmental geotechnology
- Edward G. Navy, Professor of Civil Engineering, CE; D.Eng., Pisa
Structural concrete; materials and systems; cold weather concrete construction
- Kaan M.A. Ozbay, Assistant Professor of Civil Engineering, CE; Ph.D., Virginia Polytechnic Institute
Transportation and traffic engineering; intelligent transportation systems; network flows, traffic simulation; real-time traffic control
- Trefor P. Williams, Associate Professor of Civil Engineering, CE; Ph.D., Georgia Institute of Technology
Construction management; traffic engineering; decision support systems; neural networks
- Yook-Kong Yong, Professor of Civil Engineering, CE; Ph.D., Princeton
Structural mechanics; computational mechanics; composite plates; finite element analysis

Adjunct Members of the Graduate Faculty

- M.H. Phillip Liu, Visiting Associate Professor in Environmental Engineering, CE; Ph.D., Rutgers
Environmental system analysis, modeling, biological waste treatment
- Steven J. Medlar, Visiting Professor of Environmental Engineering, CE; M.S., Tufts
Wastewater treatment; chemical feed; water quality and treatment

Research Members of the Graduate Faculty

- Yossi Berechman, B.A., Hebrew University of Jerusalem (Israel); M.B.A., Ph.D., Pennsylvania
Thomas J. Nosker, B.S., Georgia Institute of Technology; M.S., Ph.D., Rutgers
- Richard W. Renfree, B.A., M.S., Ph.D., Rutgers
- Nicholas Vitillo, Engineer, New Jersey Department of Transportation; B.S., M.S., Rutgers

Programs

Programs of graduate study leading to the M.S. and Ph.D. degrees may be arranged in a wide variety of areas. The fields of specialization available include structural analysis and design, computational mechanics, structural reliability, structural optimization, structural dynamics, concrete structures, experimental mechanics, soil mechanics and foundations, soil dynamics, soil composite materials, constitutive modeling of geomaterials, hydraulic engineering, hydromechanics, coastal studies, water and wastewater treatment, environmental fluid mechanics, water resource systems, transportation engineering, intelligent transportation systems, transportation infrastructure design operations, construction engineering, and management.

Students with a B.S. degree from an accredited civil engineering field may apply for direct admission to the graduate program. Students with backgrounds in engineering programs other than civil engineering are required to complete certain prerequisite undergraduate courses in civil engineering.

Master of Science degree candidates may elect either a thesis or nonthesis option. The thesis option consists of 24 credits of course work, 6 credits of research in a specialized area, and a final thesis presentation. In the nonthesis option, a candidate must complete 27 credits of course work, a 3-credit special project with a report, and pass an oral final examination.

Requirements for the M.S. degree may be satisfied for all options in a part-time evening program designed specifically for students employed in industry and other students whose obligations preclude full-time study. Admission and academic standards for part-time students are the same as for full-time students. This arrangement makes it possible for students to combine day and evening schedules simultaneously or at different periods in their academic careers.

The Master of Philosophy degree is available to doctoral students.

The degree of Doctor of Philosophy is primarily a research degree and is not conferred solely as a result of the completion of a series of prescribed courses. The requirements for the Ph.D. degree include a minimum of 48 credits of course work beyond the baccalaureate, a minimum of 24 credits of research beyond the M.S. degree, and the successful completion of a research dissertation. There is no language requirement. Ph.D. candidates are normally required to register for at least two consecutive terms as full-time students in residence. Exceptions to this requirement may be made in certain special situations.

The computer resources of the College of Engineering include two IBM Risc 6000 file servers and a number of IBM Risc 6000 workstations that also serve as a computer-aided design laboratory. Located within the College of Engineering is the Supercomputer Remote Access and Graphics Center, which provides facilities for development and implementation of large-scale computational programs, for high-speed access to the National Science Foundation's Supercomputer Centers, and for graphical processing and display. The Department of Civil and Environmental Engineering has a graduate Civil Engineering Computer Laboratory that has software packages specific to civil/environmental engineering and computer-aided drafting/design available. Several PC/UNIX based stations provide excellent computational capabilities and access to supercomputing resources. The department also has a cluster of X-terminals networked to the Supercomputer Remote Access and Graphics Center.

Degree programs in civil and environmental engineering may be arranged with the program director. Further details may be found in Program Information Manual for Graduate Students, available on request from the program office.

Graduate Courses

- 16:180:501. (F) ANALYTICAL METHODS IN CIVIL ENGINEERING (3)
Yong
Review of series solutions of differential equations; perturbation methods, applications in civil engineering; derivations of well-posed partial differential equations for engineering problems and their classical solutions; Fourier analysis; applications of probability and statistics to model loads and responses of engineering systems.

16:180:515. (F) STRUCTURAL ANALYSIS (3)

Balaguru

Principle of superposition as applied to statically indeterminate structures; energy methods; approximate methods for the analysis of trusses and frames; failure theories; plastic analysis; introduction to matrix methods for structural analysis; analysis of composite structures.

16:180:516. (S) ADVANCED STRUCTURAL DESIGN I (3)

Consolazio

Topics include elastic and inelastic column and plate buckling; plate girder design; bracing design; structural modeling and analysis; bridge design; composite design, connections.

16:180:517. (F) STRUCTURAL DYNAMICS (3)

Yong

Analysis of structural members and systems subjected to dynamic loads; single-degree-of-freedom and multi-degree-of-freedom analytical models of civil engineering structures; free vibrations, harmonic and transient excitation, foundation motion, response spectrum, Lagrange's equation; modal superposition and direct integration methods; response by a general purpose dynamic computer code.

16:180:519. (F) ADVANCED STRUCTURAL ANALYSIS (3)

Balaguru

Rigorous matrix formulation of the stiffness and flexibility methods of structural analysis applied to skeletal structures. Development of computer programs for the analysis of space and plane trusses and frames.

16:180:522. (S) FINITE ELEMENT METHODS IN CIVIL ENGINEERING (3)

Yong. Prerequisite: 14:180:402 or 515.

General finite element formulation of two- and three-dimensional boundary value problems; advanced finite element techniques; finite element formulation problems in continuum mechanics; applications in civil engineering problems; use of a general purpose finite element software package; introduction to the boundary element method.

16:180:523. (S) STRUCTURAL OPTIMIZATION (3)

Prerequisite: 16:180:519.

Developments in optimal structural design. Optimality criteria methods. Formulation of structural design problems as optimization problems using special techniques, linear and nonlinear optimization methods. Fully-stressed design versus optimal design.

16:180:525. STRUCTURAL RELIABILITY (3)

Elements of probability theory and its application to structural engineering, statistical distributions of load, probable strength of structural elements, safety analysis and reliability prediction of structural systems, and reliability-based designs.

16:180:526. STRUCTURAL STABILITY (3)

Elastic and inelastic buckling of members under pure compression, pure moment, and combined compression and moment; local buckling; elastic and inelastic buckling of frames; design criteria.

16:180:531. (F) TRAFFIC ENGINEERING: MODELING OF THE TRANSPORTATION SYSTEMS AND OPERATIONS (3)

Ozbay

Techniques and hardware used for real-time traffic data collection, sources of errors and sample size determination; design parameters, including economic and human factors and environmental constraints; experiment design for model development and transportation operations analyses; deterministic and stochastic models of traffic processes including queuing theory, headway distributions and gap acceptance; stream flow characteristics including car-following and multilane models, bottleneck, fuel consumption, and noise models; models for automatic vehicle control; network operations; models for modes of traffic; traffic control, short-term planning, and system evaluation.

16:180:532. (S) TRAFFIC OPERATIONS: ANALYSIS AND CONTROL OF TRANSPORTATION SYSTEMS OPERATIONS (3)

Ozbay

Real-time transportation operations; transportation system evaluation; demand modeling; time-sensitive transportation problems, including real-time traffic control and network-wide feedback control; linear and nonlinear network optimization; deterministic and stochastic queuing models of the control of rush hour traffic, traffic signal timing, and ramp metering; incident management; operations; strategic versus tactical transportation infrastructure planning; operation of parking facilities; congestion management strategies; automatic vehicle control.

16:180:533. (F) TRANSPORTATION PLANNING: INTELLIGENT TRANSPORTATION SYSTEMS (ITS) (3)

Ozbay

ITS projects in U.S., Europe, and Japan; advanced traveler information systems; advanced traffic management systems; automated highway systems; commercial vehicle operations; operational field tests; system architecture; human factors; safety; institutional and legal issues; multimodal ITS applications; modeling Intelligent Transportation Systems as hybrid systems; evaluation and selection of candidate Intelligent Transportation Systems.

16:180:534. (S) DESIGN OF TRANSPORTATION FACILITIES: ADVANCED TRANSPORTATION SYSTEMS DESIGN AND EVALUATION LABORATORY (3)

Ozbay

Software and hardware to design, test, and evaluate transportation systems; field studies, development and use of computer models, and instrumentation of small- and full-scale hardware models; geographic information systems, artificial intelligence, and computer graphics for design and evaluation; optimization software for vehicle scheduling and routing and traffic assignment; visual simulation development tools for rapid prototyping of selected transportation systems; simulation life-cycle analysis and validation techniques; data acquisition and control; advanced data visualization tools to test and evaluate developed models.

16:180:535. (F) MECHANISTIC PAVEMENT DESIGN (3)

Vitillo

Pavement design principles for new and rehabilitated pavements. Material characterization, flexible and rigid pavement design, laboratory and field data collection and analysis, pavement management practices. Deflection back calculation and pavement design software.

16:180:541. (F) ADVANCED REINFORCED CONCRETE I (3)

Nawy

Ultimate load theories in flexure, shear, diagonal tension, and torsion of symmetrical and non-symmetrical members; behavior of compression members in uniaxial and biaxial compression, stability of long columns; first order and second order solutions and the P- Δ effects; serviceability behavior and theories for deflection and cracking of one-dimensional and two-dimensional members; wind analysis and continuity in floor systems and frames; failure mechanisms in two-way slabs and plates, energy design solutions; seismic design of concrete structures.

16:180:542. (S) ADVANCED REINFORCED CONCRETE II (3)

Nawy

High-strength, high-performance concretes and composites; long-term effects; performance characteristics; biaxial and triaxial confinement; micro and macro mechanics of concrete; fracture mechanics theory; shear transfer in multilayered systems; limit theory at failure of indeterminate concrete frames and continuous beams; moment redistribution and ductility of joints; plastic hinging and rotational capacities of confined concrete members and structural systems; membrane and bending theories for the design and analysis of concrete shells and folded plates including buckling behavior.

16:180:544. (S) PRESTRESSED CONCRETE (3)

Navy

Theory of prestressed concrete; partial loss in prestressing and long-term effects due to creep, shrinkage, and relaxation; service load and ultimate load evaluation of pretensioned and post-tensioned elements in flexure, shear, and torsion; camber, deflection and crack control; two-way prestressed concrete floor systems; prestressed portal frames; post-tensioned liquid- and gas-retaining circular tanks; prestressed shells and dome roofs for circular tanks.

16:180:545. (F) ADVANCED CONSTRUCTION ENGINEERING MANAGEMENT I (3)

Williams, Balaguru. Prerequisites: 14:180:406,407, or equivalent.

Advanced techniques for financial and management control of construction projects; construction company financial control and accounting; project cost control; estimating and bid preparation; equipment management; computer and expert system applications to construction financial control.

16:180:546. (S) ADVANCED CONSTRUCTION ENGINEERING MANAGEMENT II (3)

Williams. Prerequisites: 14:180:406,407, or equivalent.

Analytical techniques for control of construction operations; network scheduling techniques (CPM and PERT); computerized scheduling; linear programming applied to construction; simulation of construction operations; decision and risk analysis.

16:180:553. (S) THEORY AND ANALYSIS OF PLATES AND SHELLS (3)

Consolazio. Prerequisite: 16:180:501.

Review of elastic equations; Kirchhoff-Love and Mindlin plate theories; classical and numerical solutions; theory and applications of shells; finite element analysis of plate and shell structures.

16:180:561. (F) ADVANCED WATER SUPPLY AND SEWERAGE (4)

Medlar

Development of sources of water supply; information analysis; design of collection, transmission, and distribution systems. Hydraulics and design of sewers.

16:180:562. (S) DESIGN OF WATER AND WASTEWATER TREATMENT (4)

Medlar

Functional study of plant loadings in relation to degree of treatment desired; layout, analysis, and design of treatment process units; mechanical and thermal energy requirements and equipment.

16:180:563. (F) ADVANCED HYDROLOGY (3)

Hayes

Hydrologic processes and modeling—evapotranspiration, infiltration, precipitation and snow melt, overland flow, subsurface and surface flow relations, channel and watershed routing; hydraulic flood routing, numerical methods; watershed modeling; stochastic processes in hydrology; flood and drought risks, flood plain analysis and management.

16:180:564. (S) UNIT PROCESSES IN ENVIRONMENTAL ENGINEERING (3)

Theory and laboratory experiments demonstrating the design requirements associated with unit processes in water and sewage treatment. Advanced methods of analysis such as spectroscopy, potentiometry, polarography, conductivity, and chromatography.

16:180:566. (F) SEDIMENT TRANSPORT (3)

Guo

Erosion, transport, and deposition of sediment within a watershed and, especially, the fluvial network; flow resistance in natural channels; suspended load, bed load, and total load; noncohesive vs. cohesive sediment; sedimentation; sediment transport as an index of pollutant movement, numerical modeling and field sampling.

16:180:567. (S) ANALYSIS OF RECEIVING WATER QUALITY (3)

Liu

Introduction to mathematical modeling of water quality; well- versus partially-mixed water bodies; turbulent diffusion, velocity-induced dispersion; reaction kinetics; biological processes, growth kinetics, BOD, dissolved oxygen, photosynthesis; development of water quality models.

16:180:568. (S) THERMAL EFFECTS ON RECEIVING WATERS (3)

Modes of heat transfer, energy equation; heat balance in well-mixed water bodies; heat exchange between atmosphere and water body; temperature dynamics in well-mixed bodies; thermal stratification in streams and reservoirs; heat dispersion; thermal jets and plumes; cooling ponds; temperature effects on water-quality parameters.

16:180:571. (F) ADVANCED SOIL MECHANICS (3)

Gucunski

Elasticity and plasticity models; stress-strain relations for soils; failure criteria; elastic solutions for half-space and layered systems; one- and three-dimensional consolidation theory; computer applications.

16:180:572. (S) SOILS ENGINEERING (3)

Maher

Earth pressure theories; stability of natural slopes and open cuts; stability of built embankments, earthquake effects, rapid drawdown and seepage problems, slope stabilization techniques; retaining walls; computer application in slope stability.

16:180:574. (S) GROUNDWATER ENGINEERING (3)

Chae

Porous media; fundamental equations of groundwater flow; confined flow; unconfined flow; hydraulics of wells; numerical methods; groundwater contamination; investigation; remediation and clean-up; monitoring; computer applications.

16:180:575. (F) THEORETICAL SOIL MECHANICS (3)

Gucunski. Prerequisites: 16:180:501,571.

Theory of semi-infinite elastic media; elastic equilibrium. Stress-strain behavior of soils, constitutive models for soils. Applications of plasticity models to compute soil behavior.

16:180:577. (F) ADVANCED FOUNDATION ENGINEERING (3)

Chae. Lec. 2 hrs., design lab. 3 hrs. Prerequisites: 16:180:571, 572.

Subsurface investigations; site preparation and improvement; flexible retaining structures; caissons; drilled shafts; underground structures; pile foundations; foundations subjected to dynamic loads; marine structures; environmental effects of construction.

16:180:578. (S) SOIL DYNAMICS (3)

Gucunski

Review of basic vibration theories as applied to soil dynamics; elastic wave propagation in soils; elements of seismic soil explorations; dynamic soil properties; laboratory evaluation of dynamic soil properties; liquefaction; machine foundations; fundamentals of soil-structure interaction; earthquake engineering; computer applications.

16:180:580. (S) ENGINEERING ROCK MECHANICS (3)

Methods of rock exploration, physical and mechanical properties of rocks; deformation; in-situ strength; hydrothermal effects on rocks; stability of rock masses; state of stress and strain around tunnels, shafts, and domes; stabilization of rocks.

16:180:581. (S) PHYSICO-CHEMICAL PROPERTIES AND STABILIZATION OF SOILS (3)

Maher

Relationship between physical properties and selected chemical and mineralogical characteristics emphasizing fine-grained and colloidal fractions; problems affecting site use including weak, compressible soil; high shrink-swell potential; erodibility; stabilization techniques including compaction, earth reinforcement, drainage and erosion control, admixture stabilization, precompression, grouting.

16:180:582. (S) EARTHQUAKE ENGINEERING: DYNAMIC SOIL-STRUCTURE INTERACTION (3)

Gucunski

Seismicity; size of earthquakes; estimation of ground motion parameters; seismic hazard analysis; site response analysis; design ground-motion building-code provisions; soil-structure interaction effects and formulation; simplified models; solutions in frequency and time domains.

16:180:586. (S) ADVANCED FLUID MECHANICS (3)

Guo

Basic laws and equations of fluid flows; exact and approximate solutions; potential flows; boundary layer flows; turbulent flows in pipes and open channels; free turbulent jets and wakes; turbulence and transport phenomena; transient flows.

16:180:588. (S) THEORY OF HYDRAULIC MODELS (3)

Geometric, kinematic, and dynamic similarity between prototypes and models. Similarity laws; Model techniques; undistorted and distorted models; models for hydraulic structures, free-surface flows, flows over erodible beds, and hydraulic machinery. Environmental applications.

16:180:590. (S) COASTAL ENGINEERING (3)

Guo

Generation and propagation of tides; salinity intrusion, pollutant flushing, and sedimentation in estuaries; circulation in the coastal ocean; coastal water quality modeling; coastal wetlands; gravity waves; coastal erosion; coastal structure design.

16:180:601,602. ADVANCED TOPICS IN CIVIL ENGINEERING (BA,BA)

Selected topics of current interest in any specialized field of civil engineering.

16:180:611,612. ADVANCED TOPICS IN ENVIRONMENTAL ENGINEERING (BA,BA)

Selected topics of current interest in any specialized field of environmental engineering.

16:180:691,692. SEMINAR IN CIVIL AND ENVIRONMENTAL ENGINEERING (N 0,N 0)

Contemporary developments and special topics in research and engineering design in civil and environmental engineering presented and discussed by faculty, students, and invited speakers.

16:180:693,694. SPECIAL PROJECT (3,3)

Nonthesis study. Special project under the supervision of a professor. Requires a technical report.

16:180:701,702. RESEARCH IN CIVIL AND ENVIRONMENTAL ENGINEERING (BA,BA)

Thesis work for M.S. or Ph.D. degree.

CLASSICS 190

Degree Programs Offered: Master of Arts, Master of Arts for Teachers, Doctor of Philosophy

Director of Graduate Program: Professor John Bodel,
009 Ruth Adams Building, Douglass Campus (732/932-9797)

Members of the Graduate Faculty

John Bodel, Associate Professor of Classics, FAS-NB; Ph.D., Michigan

Roman literature and social history, Latin epigraphy

Jack L. Cargill, Professor of History, FAS-NB; Ph.D., California (Berkeley)

Greek history and epigraphy

Lowell Edmunds, Professor of Classics, FAS-NB; Ph.D., Harvard

Greek literature, mythology, intellectual history

Thomas J. Figueira, Professor of Classics, FAS-NB; Ph.D., Pennsylvania

Greek political history; the social history of classical antiquity; Greek prose

William W. Fortenbaugh, Professor of Classics, FAS-NB; Ph.D., Pennsylvania

Ancient philosophy

John F. Kenfield III, Associate Professor of Art History, FAS-NB; Ph.D., Princeton

Greek and Roman art

Barbara A. Shailor, *Professor of Classics, FAS-NB and Dean of Douglass College; Ph.D., Cincinnati*

Medieval Latin, Latin paleography

Shirley Werner, *Assistant Professor of Classics, FAS-NB; Ph.D., Yale*

Roman poetry; Latin philology; textual transmission

Associate Member of the Graduate Faculty

Jocelyn P. Small, Professor of Art History, FAS-NB and Director, Lexicon

Iconographicum Mythologicae Classicae; Ph.D., Princeton

Classical art and archaeology, iconography, Etruscology

Programs

Graduate training in classics, based in the Department of Classics, focuses on the interpretation of the original texts in Latin and Greek in the light of modern literary criticism, archaeological data, and the theories and methodologies of the disciplines that deal with ancient Greece and Rome, e.g., ancient history, art history, philosophy, and archaeology.

While the examination of the original texts is central, this program attempts to put the texts into a perspective that shows the relevance of classics to the present day and prepares students to apply their knowledge of classics in the general humanistic tradition. The Ph.D. candidate is expected to have a knowledge of all major authors; to include work beyond the Greek fifth and fourth centuries B.C. and the Republican and Augustan periods of Rome; to have an acquaintance with the interdependence of Greek and Roman literature and culture; and to undertake research in a specific aspect of classics or classical archaeology.

Study in the program may be supplemented by work in related programs such as art history, comparative literature, history, or philosophy, according to individual interests.

The M.A. candidate must demonstrate a general knowledge of the principal ancient authors and may write a thesis (equivalent to 6 credits). The candidate may elect to emphasize either Greek or Latin, but must have a knowledge of both. The student is also expected to demonstrate a reading knowledge of French, German, or Italian. The M.A. examination tests the candidate's knowledge of the Greek and Latin languages, the material included in course work, and the material on the general reading list. It consists of three hours of translation and three hours of general knowledge questions in history, literature, and philosophy. Students may take the M.A. examination after completing 30 credits of graduate work. General reading lists for both the M.A. and Ph.D. degrees are available to all graduate students at the department office. Reading lists for special fields and authors can be worked out with the graduate adviser.

The M.A. program in Latin for teachers is designed to assist Latin teachers in secondary schools. The candidate is expected to pass a competency examination in ancient Greek or, alternatively, to demonstrate a reading knowledge of German, French, or Italian. The student is expected to complete a total of 30 credits, of which 24 are graduate credits and 6 are outside the field of Latin literature (e.g., ancient history, ancient philosophy); to complete an expository or critical essay (normally in conjunction with the course work); and to pass a comprehensive examination based on course work and the reading list of Latin authors.

The Ph.D. candidate is expected to complete at least 48 credits of course work beyond the bachelor's degree and to demonstrate a reading knowledge of German and either French or Italian. Course work includes Greek or Latin composition. This requirement may be waived upon successful completion of an equivalent examination. The qualifying examination covers the following four areas, with a three-hour examination in each: (1) a knowledge of the principal Greek and Latin authors as specified on the reading list; (2) a particular Greek or Latin author; (3) a special field, such as a period of ancient literature, a literary genre, ancient philosophy, or a period of Greek or Roman art and archaeology or history; and (4) translation from Latin and Greek. The Master of Philosophy degree is available to doctoral candidates.

An interdisciplinary Ph.D. in art history and classical archaeology may be worked out with advisers from both the art history and classics programs. Students in such a program would have to show proficiency in French, German, Greek, and Latin.

Graduate Courses

Two or three of the following courses are offered each term:

16:190:503. INTRODUCTION TO GRADUATE LITERARY STUDY: LATIN (3)

Close readings and basic critical techniques of interpreting Latin literature.

- 16:190:504. INTRODUCTION TO GRADUATE LITERARY STUDY: GREEK (3)
Close readings and basic critical techniques of interpreting Greek literature.
- 16:190:505. STUDIES IN CLASSICS (3)
Topics in the field of classics selected for special study.
- 16:190:507,508. READINGS IN CLASSICS (3,3)
Readings in areas of special interest in Latin and/or Greek authors.
- 16:190:509. PROSEMINAR: MATERIALS AND METHODS (3)
Prerequisite: Reading knowledge of Latin and Greek.
Introduction to the discipline of classical philology. Topics covered include bibliography, lexicography, linguistics, textual history and criticism, geography, paleography, papyrology, epigraphy, and literary theory.
- 16:190:510. HELLENISTIC LITERATURE (3)
Extensive readings in the major authors of the Hellenistic Age (350-30 B.C.), especially those who influenced Roman literature and thought.
- 16:190:511. GREEK LITERATURE OF THE ROMAN PERIOD (3)
Greek authors of the Roman period (30 B.C.–A.D. 500) selected with a view to their influence on the literature and thought of the Roman Empire.
- 16:190:519,520,521,522. LATIN POETRY SEMINAR (3,3,3,3)
The work of a different Latin poet each summer (e.g., Catullus, Propertius/Tibullus, Virgil, Ovid).
- 16:190:523. SEMINAR ON ROME AND POMPEII (3)
Research and instruction at Rutgers and in Italy on Rome and Pompeii. Includes oral presentations and a paper.
- 16:190:525. HISTORIANS OF REPUBLICAN ROME (3)
A critical reading of selected fragments from Roman annalistic writers, and an intensive study of the historical writings of Caesar and Sallust.
- 16:190:526. HISTORIANS OF IMPERIAL ROME (3)
Selected major Greek and Latin texts for the history of the Roman Empire. Chronological limits of the course are the periods covered by Tacitus and Ammianus Marcellinus.
- 16:190:530. ARISTOTLE: CONSTITUTION OF THE ATHENIANS (3)
An analysis of Aristotle's *Athenaion Politeia* and other documents pertaining to the development of Greek political institutions.
- 16:190:557. HOMER (3)
The *Iliad* and *Odyssey* in their historical, literary, and cultural background.
- 16:190:559,560. PLATO (3,3)
Several major dialogues of Plato studied with special emphasis on the philosophical problems they raise.
- 16:190:562. ATTIC HISTORIOGRAPHY (3)
Greek history of the sixth and fifth centuries B.C. in the Greek historiographic tradition. Emphasis on detailed study of the texts, especially Thucydides.
- 16:190:563,564. GREEK DRAMA (3,3)
Tragedians: Aeschylus, Sophocles, and Euripides; the comedies of Aristophanes.
- 16:190:565. HERODOTUS (3)
A study of the beginnings of the Greek historiographic tradition in the sixth and fifth centuries B.C., with primary emphasis on Herodotus.
- 16:190:566,567. ANCIENT NOVELS (3,3)
Greek and Roman prose fiction of the postclassical period in its literary and sociohistorical contexts.
- 16:190:569. ADVANCED GREEK PROSE COMPOSITION (3)
Study of the styles of Attic prose of the fifth and fourth centuries and composition in the manner of select authors of classical Attic Greek.
- 16:190:570. ADVANCED LATIN PROSE COMPOSITION (3)
Study of the stylistic development of Latin prose and composition in the manner of select classical authors.
- 16:190:571. ROMAN DRAMA (3)
Selected works from the dramatic literature of Rome.
- 16:190:573. ANCIENT COMEDY (3)
A study of the conventions of Greek and Roman comedy.
- 16:190:575. VERGIL (3)
The *Eclogues*, *Georgics*, or *Aeneid* of Vergil, with attention to literary predecessors, cultural context, influence, and ancient and modern criticism.
- 16:190:579. PROBLEMS IN AUGUSTAN LITERATURE (3)
Individual topics for research and criticism involving relationships among the elegiac poets, Horace, and Vergil.
- 16:190:612. GREEK AND ROMAN BIOGRAPHY (3)
Study of the development of classical biography through selected works from major authors in Greek and Latin, including Xenophon, Plutarch, Nepos, and Suetonius.
- 16:190:614. CLASSICAL EPIC (3)
A comparative study of Homer, Apollonius, Vergil, and Lucan as epic poets.
- 16:190:620,621. TOPICS IN GREEK AND ROMAN ARCHAEOLOGY (3,3)
Intensive study of special Greek and Roman archaeological monuments and their significance for the literature, religion, and history of the classical civilizations.
- 16:190:622. LATIN EPIGRAPHY (3)
A practical introduction to the study of Latin inscriptions, with emphasis on the reading, interpretation, and editing of texts on stone.
- 16:190:623. LATIN PALEOGRAPHY (3)
A practical introduction to the study of Latin manuscripts from the Middle Ages and Renaissance, with emphasis on the reading, interpretation, editing, and transmission of Latin texts.
- 16:190:625. ROME IN THE AGE OF AUGUSTUS (3)
An archaeological survey of urban planning, architectural and artistic achievements in Rome and the provinces seen in the broader perspective of Augustus's political and cultural program.
- 16:190:630. CLASSICAL GREEK SCULPTURE (3)
Stylistic and thematic discussion of the works of individual sculptors and of major monuments such as temple pediments and friezes from 480 B.C. to the end of the fourth century.
- 16:190:631. ROMAN SCULPTURE (3)
The major stylistic periods of Roman sculpture in historical reliefs, sarcophagi, and in portraiture from the late Republic to the age of Constantine the Great.
- 16:190:652. NEW COMEDY AND CHARACTER STUDY (3)
Theophrastus's *Characters* and at least two plays of Menander, with emphasis on the various kinds of characters recognized in Greek literature and their relationship to plot and dramatic action.

16:190:654. GREEK ORATORY (3)

Selected Greek public orations with emphasis on their significance in political history and their place in the development of Greek rhetoric.

16:190:655,656. ARISTOTLE (3,3)

Special philosophical problems studied in reference to Aristotle's work; emphasis on the variety of Aristotle's interests and the significance of his conceptual language.

16:190:671. LATIN SATIRE (3)

The continuity and development of satire in Greek and Latin literature. Major emphasis on the Roman satirists.

16:190:674. HELLENISTIC AND ROMAN PHILOSOPHY (3)

Major developments in ancient philosophy after Aristotle. Selected problems of philosophical significance in Stoic and Epicurean writings, with special reference to Lucretius, Cicero, and Seneca.

16:190:675. CICERO'S WORKS (3)

Selected orations, treatises, or letters of Cicero against the background of his private and public life, his sources in Greek and Roman thought, and his influence on later Western tradition.

16:190:677,678. HISTORY OF LATIN LITERATURE I:

THE REPUBLIC (3,3)

The origin and development of Latin literature from its birth in the third century B.C. down to the end of the Republic.

16:190:679,680. HISTORY OF LATIN LITERATURE II:

THE EMPIRE (3,3)

Extensive reading in the major authors of the first and second centuries of the Roman Empire, with emphasis on the continued development of poetry and prose.

16:190:682. ELEGIAC POETRY (3)

Historic, thematic, and stylistic consideration of the elegies of Catullus, Propertius, Tibullus, and Ovid, and their Greek antecedents.

16:190:701,702. RESEARCH IN CLASSICS (BA,BA)

COGNITIVE SCIENCE 185

Program Offered: Certificate in Cognitive Science

Director of the Certificate Program in Cognitive Science:

Professor Zenon Pylyshyn, Rutgers Center for Cognitive Science,
Psychology Building Addition, Busch Campus (732/445-0635)

Participating Faculty

The following members and associate members of the graduate faculty, identified more fully under the subject headings indicated, are among those who participate in the certificate program in cognitive science:

Saul Amarel, Computer Science
Nicholas Belkin, Communication, Information and Library Studies
Ira Black, Physiology and Neurobiology
Alexander Borgida, Computer Science
Gretchen Chapman, Psychology
Veneeta Dayal, Linguistics
Viviane Deprez, Linguistics
Sven Dickinson, Computer Science, RuCCS
Frances Egan, Philosophy
Thomas Ellman, Computer Science
Jacob Feldman, Psychology, RuCCS
James Flanagan, Electrical Engineering
Jerry Fodor, Philosophy, RuCCS
Jane Grimshaw, Linguistics, RuCCS
Haym Hirsh, Computer Science
Judith Hudson, Psychology
Bela Julesz, Psychology

Eileen Kowler, Psychology
Casimir Kulikowski, Computer Science
Ernest Lepore, Philosophy, RuCCS
Alan Leslie, Psychology, RuCCS
Michael Leyton, Psychology
Brian Loar, Philosophy
Barry Loewer, Philosophy
Thorne McCarty, Computer Science
Colin McGinn, Philosophy
Brian McLaughlin, Philosophy
Robert Matthews, Philosophy
Thomas Papathomas, Biomedical Engineering
Alan Prince, Linguistics, RuCCS
Zenon Pylyshyn, Psychology, RuCCS
Kenneth Safir, Linguistics
Charles Schmidt, Psychology, RuCCS
Roger Schwarzschild, Linguistics
Eduardo Sontag, Mathematics
Louis Steinberg, Computer Science
Suzanne Stevenson, Computer Science, RuCCS
Stephen Stich, Philosophy, RuCCS
Karen Stromswold, Psychology, RuCCS
Hubert Truckenbrodt, Linguistics
Evangelia Tzanakou, Biomedical Engineering
Arlene Walker-Andrews, Psychology

Certificate Program

Cognitive science is an interdisciplinary area of scholarship concerned with understanding the nature and development of such intelligent capacities as perception, language, reasoning, planning, and problem solving in both biological and artificial systems. This area of study is well represented in various departments at Rutgers–New Brunswick, and the Rutgers Center for Cognitive Science (RuCCS) at the Busch campus helps foster and coordinate such studies. Members of the center may have joint appointments with such participating academic departments as biomedical engineering, computer science, linguistics, philosophy, and psychology, as well as with such other research centers as the Laboratory for Vision Research and the Center for Computer Aids for Industrial Productivity.

The goal of the cognitive science certificate program is to provide a structured way for students enrolled in various graduate programs to study and carry out research in cognitive science with guidance from relevant faculty advisers and to bring interested students from different disciplines together into a common intellectual community and research environment.

Students with an interest in any aspect of cognitive science may pursue, in the course of their regular program of studies toward the degree of doctor of philosophy, a special concentration in cognitive science. Admission to the certificate program and subsequent selection of courses and research project are subject to the approval of the Cognitive Science Certificate Committee. Admission is based on academic performance and interests and requires the approval of the graduate program in which the student is enrolled.

Program Requirements

To receive the Certificate in Cognitive Science, the student must successfully complete the requirements for a Ph.D. in the department in which the student is registered and must also meet the following additional requirements:

1. Successful completion of 16:185:500 Proseminar in Cognitive Science.
2. Completion of a research project under the direction of a participating faculty member, normally outside the program in which the student is registered. Project proposals must be approved by the Cognitive Science Certificate Committee.
3. A minimum of 9 additional credits from approved courses in Biomedical Engineering, Cognitive Science, Computer Science, Linguistics, Philosophy, and Psychology. All 9 credits must be taken from outside the graduate program in which the student is registered. Courses in other related fields may be submitted by petition.

Graduate Courses

16:185:500. PROSEMINAR IN COGNITIVE SCIENCE (3)
Multidisciplinary introduction to the core areas of cognitive science. Promotes commonality among students' backgrounds. Student research interests discussed.

16:185:600,601. SEMINAR IN COGNITIVE SCIENCE I,II (3,3)
Topical seminar conducted by participating faculty or visiting scholars at the Center for Cognitive Science.

16:185:699. INDEPENDENT STUDIES IN COGNITIVE SCIENCE (BA)
May be used to meet the research project requirement for the Certificate in Cognitive Science with approval of certificate committee.
Supervised independent study.

COMMUNICATION, INFORMATION, AND LIBRARY STUDIES 194

Degree Program Offered: Doctor of Philosophy
Director of Graduate Program: Professor Lea P. Stewart,
School of Communication, Information and Library Studies,
4 Huntington Street, College Avenue Campus (732/932-7447);
(FAX 732/932-6916)

Members of the Graduate Faculty

James D. Anderson, Professor of Library and Information Studies, SCILS;
D.L.S., Columbia
Textual database design and evaluation
Jerome Aumente, Professor of Journalism and Mass Media, SCILS; Director,
Journalism Resources Institute; M.S., Columbia
Communication and information technology
Nicholas J. Belkin, Professor of Library and Information Studies, SCILS;
Ph.D., London
Information science and technology
Ralph Blasingame, Professor Emeritus of Library and Information Studies, SCILS;
D.L.S., Columbia
Management
Richard W. Budd, Professor of Communication, SCILS; Ph.D., Iowa
Communication, language and behavior
Hendrik Edelman, Professor of Library and Information Studies, SCILS;
M.L.S., Peabody
Library studies, scholarly communication
Radha S. Hegde, Assistant Professor of Communication, SCILS; Ph.D.,
Ohio State
Culture and interpersonal communication; ethnic adaptation and diversity
Lisa Henriksen, Assistant Professor of Communication, SCILS;
Ph.D., Stanford
Children and communication; mass communication theory effects;
health communication
Richard F. Hixson, Professor of Journalism and Mass Media, SCILS; M.A.,
Case Western Reserve
Information policy and law
Paul B. Kantor, Professor of Library and Information Studies, SCILS;
Ph.D., Princeton
Information and decision systems; information economics; evaluation; interfaces
Montague Kern, Associate Professor of Journalism and Mass Media, SCILS; Ph.D.,
Johns Hopkins
Mass media and public policy; political communication
Robert W. Kubey, Associate Professor of Communication, SCILS; Ph.D., Chicago
Mass communication theory and effects
Carol C. Kuhlthau, Associate Professor of Library and Information Studies, SCILS;
Ed.D., Rutgers
Educational media; information processes
Linda C. Lederman, Professor of Communication, SCILS; Ph.D., Rutgers
Communication processes; communication education
Jennifer S. Mandelbaum, Associate Professor of Communication, SCILS; Ph.D.,
Texas (Austin)
Interpersonal communication; conversation analysis
Shannon Martin, Assistant Professor of Journalism and Mass Media, SCILS;
Ph.D., North Carolina
Information law; access to federal government information
Hartmut B. Mokros, Associate Professor of Communication, SCILS; Ph.D., Chicago
Interpersonal communication; cognition and communication; research methods

Milton Mueller, Associate Professor of Communication, SCILS;
Ph.D., Pennsylvania
Domestic and international communications policy and regulation;
history of telecommunications industries and technologies
Ronald Rice, Professor of Communication, SCILS; Ph.D., Stanford
Social impacts of computer-mediated communications systems; network analysis;
public communication campaigns
Pamela Spence Richards, Professor of Library and Information Studies, SCILS;
D.L.S., Columbia
Information science and scholarly communication
Brent D. Ruben, Professor of Communication, SCILS; Ph.D., Iowa
Communication theory; communication and information systems; health and
medical communication
Tefko Saracevic, Professor of Library and Information Studies, SCILS; Ph.D., Case
Western Reserve
Information science; information education, management, information seeking
and retrieving
William S. Solomon, Associate Professor of Journalism and Mass Media, SCILS;
Ph.D., California (Berkeley)
Sociology of mass media; historical sociology; labor studies
Linda C. Steiner, Assistant Professor of Journalism and Mass Media, SCILS;
Ph.D., Illinois (Urbana)
Feminist theorizing; communication ethics; feminist and alternative media
Lea P. Stewart, Professor of Communication, SCILS; Ph.D., Purdue
Organizational communication; communication and gender;
communication ethics
Betty J. Turock, Professor of Library and Information Studies, SCILS;
Ph.D., Rutgers
Management, information services
Kay E. Vandergrift, Professor of Library and Information Studies, SCILS;
Ed.D., Columbia
Library services for children and young adults; educational media services
Jana Varlejs, Associate Professor of Library and Information Studies, SCILS; Ph.D.,
Wisconsin (Madison)
Continuing professional education; library education

Associate Members of the Graduate Faculty

Mark Aakhus, Assistant Professor of Communication, SCILS; Ph.D., Arizona
Organizational communication; decision-making and disputing processes;
new communication technology
David Carr, Associate Professor of Library and Information Studies, SCILS;
Ph.D., Rutgers
Learning in cultural institutions; thinking; tools
Nelson L. Chou, Librarian II, Head, East Asian Library; Ph.D., Chicago
Library and information science
Mark Frank, Assistant Professor of Communication, SCILS; Ph.D., Cornell
Expression of emotion and interpersonal deception
Cheryl Renee Gooch, Assistant Professor of Journalism and Mass Media, SCILS;
Ph.D., Florida State
International development communication; women and development; minority
media and activism; mass communication
Todd Hunt, Professor of Communication, SCILS; M.A., Ohio State
Mass communication; public relations; journalism
Daniel O. O'Connor, Associate Professor of Library and Information Studies,
SCILS; Ph.D., Syracuse
Research methods; library science
José Peres-Carballo, Assistant Professor of Library and Information Studies,
SCILS; Ph.D., New York
Text processing; networked information; information retrieval
Barbara S. Reed, Associate Professor of Journalism and Mass Media, SCILS;
Ph.D., Ohio
Ethnic press history and contemporary magazines
Patricia G. Reeling, Associate Professor of Library and Information Studies, SCILS;
D.L.S., Columbia
Library education; government information policy
L.J. Shrum, Assistant Professor of Marketing, SB-NB; Ph.D., Illinois (Urbana)
Cognitive processes underlying media effects
Jeffrey K. Smith, Professor of Educational Statistics and Measurement, GSE;
Ph.D., Chicago
Statistics and measurement
Chris Vaughan, Assistant Professor of Journalism and Mass Media, SCILS; Ph.D.,
California (Berkeley)
International communication and history; popular culture; alternative media
Silvio Waibord, Assistant Professor of Communication, SCILS; Ph.D., California
(San Diego)
International communication; broadcasting and journalism; Latin

Programs

The Ph.D. program provides doctoral-level course work and a degree program for students seeking theoretical and research skills for scholarly activity and/or professional leadership in communication and information fields.

The focus of the program is on the nature and functions of communication and information processes, systems, institutions, and policies, and their impact on individuals, and on social, organizational, national, and international affairs. Students may elect to focus their study in any of the following areas: communication processes, information structures and systems, institutions and policy, or library studies.

Course work in communication processes focuses on the study of face-to-face and mediated communication in interpersonal, organizational, scientific, societal, and global settings.

Information structures and systems is concerned with information behavior and systematic responses to it. As such, it seeks to develop understanding of, and research capability in, human information-seeking activity, information retrieval systems, and information structures.

Institutions and policy focuses on the study of communication and information institutions, and the process of policy development in organizational, national, and international contexts.

Library studies emphasizes library user behavior and the role of libraries and library education in society. Attention is devoted to the library environment, organization, collection development, special services, automation, and the evaluation thereof.

The Ph.D. degree requires the completion of a minimum of 36 credit hours of doctoral-level course work and 24 credit hours of dissertation research in addition to the completion of a minimum of 24 credits of masters-level course work.

As a part of the 36-credit course work requirement, students must take 16:194:602 Research Foundations, 16:194:603 Qualitative Research Methods, and 16:194:604 Quantitative Research Methods.

There is no language or residency requirement, and students may pursue the Ph.D. on either a full- or part-time basis. Students are required to enroll for a minimum of 6 credits during each of the first two terms in the program. Teaching and research assistantships that include tuition remission and various fellowships are available for a limited number of highly qualified full-time students.

The Master of Philosophy degree is also available to doctoral candidates. The School of Communication, Information and Library Studies (SCILS) offers an M.L.S. degree in library and information studies and a Master of Communication and Information Studies. These programs are described in the SCILS catalog.

Graduate Courses

16:194:600. PH.D. COLLOQUIUM (0)

L. Stewart. Required each term in course work. Forum for the presentation of research by guest speakers, faculty, and students.

16:194:601. INFORMATION AND COMMUNICATION PROCESSES (3)

Nature of information and communication processes, and the role of information and communication in individual, social, and institutional behavior. Particular emphasis on the conceptual linkages between information and communication processes.

16:194:602. RESEARCH FOUNDATIONS (3)

Concepts, method, and practices of social science research in relation to communication, information science, and library studies.

16:194:603. QUALITATIVE RESEARCH METHODS (3)

Qualitative approaches for examining information processes, including information definition, acquisition, evaluation, and use.

16:194:604. QUANTITATIVE RESEARCH METHODS (3)

Facets of research; problem areas; research techniques and experiments.

16:194:605. CURRENT RESEARCH ISSUES (3)

Integrative treatment of fundamental assumptions, paradigms, and directions in contemporary research on information, communication, and information systems in various fields, particularly information science and communication.

16:194:610. SEMINAR IN INFORMATION STUDIES (3)

Major problems, trends, and developments in information science and technology. Critical survey of current research and findings.

16:194:612. HUMAN INFORMATION BEHAVIOR (3)

Prerequisite: 16:194:610 or permission of instructor.

Precursors to, and characteristics of, human information-seeking behavior, individual and social, both within and outside of institutional information systems. Relations between such behavior and information system design and the relevant technologies.

16:194:614. INFORMATION RETRIEVAL THEORY (3)

Examines the basic problems of information retrieval from theoretical and experimental points of view. Develops a basis for the specification of design principles for IR systems.

16:194:617. KNOWLEDGE REPRESENTATION FOR INFORMATION RETRIEVAL (3)

Concurrent consideration of options for knowledge representation, methods for evaluating the effect of these options on costs and effectiveness, and research relating to knowledge representation for information retrieval.

16:194:619. EXPERIMENT AND EVALUATION IN INFORMATION SYSTEMS (3)

Prerequisites: 16:194:612, 614.

Measures, models, and methods for macroevaluation of impact of information systems within their environment and for microevaluation of performance of system components. Experiments—their design, conduct, and results.

16:194:620. INTERPERSONAL COMMUNICATION (3)

Contemporary theories and major lines of classic and current research concerning interpersonal communication.

16:194:621. ORGANIZATIONAL COMMUNICATION RESEARCH (3)

Survey of major principles and research and analytic techniques relative to organizational communication.

16:194:631. MASS COMMUNICATION THEORY AND RESEARCH (3)

Current mass communication theories and approaches analyzed from a research perspective. Topics include critical theory, audience ethnography, uses and gratifications, socialization processes and effects, and agenda setting.

16:194:632. SCHOLARLY AND SCIENTIFIC COMMUNICATION (3)

Study of the processes through which scholarly, scientific, and technical ideas are communicated: mentoring; professional, national, and international information networks; scholarly and scientific publishing; and other aspects of specialized information transfer.

16:194:633. RESEARCH IN SCHOLARLY AND SCIENTIFIC COMMUNICATION (3)

An interdisciplinary review and exploration of current research in the communication, structure, processes, and products of research and scholarship.

16:194:641. INFORMATION POLICY AND TECHNOLOGY (3)

Impact of modern revolution in information technology; the related challenges of the contemporary problems in information policies at individual, organizational, national, and international levels. Use of information indicators.

16:194:642. INFORMATION REGULATION AND LAW (3)

Historical and contemporary legal and regulatory issues stemming from the application of information technology.

16:194:643. INFORMATION INDICATORS (3)
Integrated treatment of measures, indicators, and methods for quantitative description of a variety of information and communication systems, resources, and activities. Emphasis on drawing relations among different measures and application to information policy studies.

16:194:645. ADVANCED CONCEPTS IN THE MANAGEMENT OF INFORMATION ORGANIZATIONS (3)

Prerequisite: 17:610:508 or equivalent.

Systematic consideration of the evolution of management theory leading to an evaluation of contemporary theoretical and research issues in planning, organizing, staffing, leading, and controlling the information organization.

16:194:648. ORGANIZATIONAL ASSESSMENT AND CHANGE (3)

Offered in alternate years.

Systematic consideration of the theories and strategies of assessment, planning, development, and change at the organizational and programmatic level in nonprofit and profit-seeking information organizations.

16:194:655. (S) MEASUREMENT AND EVALUATION OF LIBRARY SERVICES (3)

Major issues, obstacles, and developments in approaches to measurement and evaluation of information services. Emphasis on methodology and strategies for implementation.

16:194:656. THEORIES AND ISSUES IN LIBRARY STUDIES (3)

Examination of the intellectual foundations for librarianship as a discipline, the development of a broadened understanding of pervasive theories and research issues, and the identification and exploration of the research literature in librarianship and pertinent allied fields.

16:194:695. TEACHING APPRENTICESHIP (0)

Prerequisite: 9 credits in Ph.D. program.

A noncredit teaching apprenticeship to provide doctoral candidates with classroom experience.

16:194:696,697. SPECIAL TOPICS (3,3)

Possible topics include communication technology and policy, naturalistic inquiry, human/computer interaction, history of U.S. mass media, intercultural communication, and race, gender, and the media.

16:194:698. INDEPENDENT STUDY (3)

16:194:699. INDEPENDENT STUDY (3)

16:194:701,702. DISSERTATION RESEARCH (BA,BA)

COMPARATIVE LITERATURE 195

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Directors of Graduate Program: Professors Paul Schalow and Andrew Welsh, 205 Ruth Adams Building, Douglass Campus (732/932-7606)

Members of the Graduate Faculty

Derek Attridge, Professor of English, FAS-NB; Ph.D., Cambridge
Literary theory; literary language; poetic form; James Joyce
Louise K. Barnett, Professor of English, FAS-NB; Ph.D., Bryn Mawr
English and American literature
Stephen Bronner, Professor of Political Science, FAS-NB; Ph.D., California (Berkeley)
Critical theory; political theory
Abena P. A. Busia, Associate Professor of English, FAS-NB; D.Phil., Oxford
African women in British and American fiction
Harriet A. Davidson, Associate Professor of English, FAS-NB; Ph.D., Vanderbilt
Modern and contemporary poetry; modern British and American literature; critical theory
Marianne De Koven, Professor of English, FAS-NB; Ph.D., Stanford
Modernism; women's studies

Elin F. Diamond, Associate Professor of English, FAS-NB; Ph.D., California (Davis)
Drama and dramatic theory; feminist and literary theory
Josephine Diamond, Associate Professor of French, FAS-NB; Ph.D., Cornell
Nineteenth- and twentieth-century literature; critical theory; women's studies and feminist theory
Lowell Edmunds, Professor of Classics, FAS-NB; Ph.D., Harvard
Greek literature, mythology, intellectual history
Uri A. Eisenzweig, Professor of French, FAS-NB; Ph.D., Paris
French literature; literary theory; Western literature of the nineteenth and twentieth centuries
Franco Ferrucci, Professor of Italian, FAS-NB; Ph.D., Pavia
Renaissance studies; critical theory
Jerry Aline Fliieger, Professor of French, FAS-NB; Ph.D., California (Berkeley)
Twentieth-century literature; critical theory; women's studies and feminist theory
Sandy Flitterman-Lewis, Associate Professor of English, FAS-NB; Ph.D., California (Berkeley)
Feminist cultural analysis with an emphasis on film and literature
William Galperin, Professor of English, FAS-NB; Ph.D., Brown
Roman literature; literary theory; media studies
Mary S. Gossy, Associate Professor of Spanish, FAS-NB; Ph.D., Harvard
Spanish and Latin American literature; feminist and critical theory; lesbian and gay studies
Peter Li, Associate Professor of Chinese, FAS-NB; Ph.D., Chicago
Chinese studies
Michael McKeon, Professor of English, FAS-NB; Ph.D., Columbia
Seventeenth- and eighteenth-century literature; critical theory; historical criticism
Alicia Ostriker, Professor of English, FAS-NB; Ph.D., Wisconsin
Romantic and modern literature; contemporary poetry
Gerald Pirog, Associate Professor of Slavic Languages and Literature, FAS-NB; Ph.D., Yale
Slavic languages and literatures; critical theory; poetry
Bruce Robbins, Professor of English, FAS-NB; Ph.D., Harvard
Critical theory; modern fiction
Paul Schalow, Associate Professor of Japanese, FAS-NB; Ph.D., Harvard
Japanese literature (Edo period); gender and sexuality in Japanese literature; Japanese women's writing
Serge Sobolevitch, Associate Professor of Comparative Literature, FAS-NB; Ph.D., Princeton
Theater arts; symbolism; neoclassicism; theater history
Mary Speer, Professor of French, FAS-NB; Ph.D., Princeton
Medieval language and literature; theory and practice of editing
Antonia Tripolitis, Associate Professor of Religion, FAS-NB; Ph.D., Pennsylvania
Hellenistic Greek literature and thought; patristics; Neoplatonism
Ching-ITu, Professor of Chinese, FAS-NB; Ph.D., Washington
Chinese studies; poetry and literary criticism
Janet A. Walker, Associate Professor of Comparative Literature, FAS-NB; Ph.D., Harvard
The novel; comparative East-West poetics
Steven F. Walker, Associate Professor of Comparative Literature, FAS-NB; Ph.D., Harvard
Renaissance, literature and mythology; Jungian criticism
Andrew Welsh, Associate Professor of English, FAS-NB; Ph.D., Pittsburgh
Old English and medieval studies; poetry
Alan Williams, Professor of French, FAS-NB; Ph.D., SUNY (Buffalo)
Film history and theory; literary theory; contemporary French literature
Linda M.G. Zerilli, Associate Professor of Political Science, FAS-NB; Ph.D., California (Berkeley)
Feminist theory; political theory

Associate Members of the Graduate Faculty

Nina Cornyetz, Assistant Professor of Japanese, FAS-NB; Ph.D., Columbia
Japanese language and literature; film and Japanese women writers
Louisa Schein, Assistant Professor of Anthropology, FAS-NB; Ph.D., California (Berkeley)
China; cultural studies

Programs

The graduate program in comparative literature provides the student with an opportunity to pursue literary studies across national, cultural, linguistic, and disciplinary boundaries. Areas of focus are literary theory, the history of literary production, the study of genres, East-West poetics, the study of minority and marginalized literatures, and the relationship of literature to other fields. Drawing on a richly diverse faculty from many disciplines, the program seeks to combine rigor and flexibility by providing a carefully structured curriculum, while allowing students the freedom to

develop their own course of study. Students may take one-half of their credit requirements in other departments. Each student's program of study is arranged individually with an appointed adviser or the graduate program director.

Candidates for the Ph.D. degree who complete 30 credits of course work, pass two examinations in two languages other than English, and take written examinations in literary theory (after completion of the first year of courses) and an area of concentration of their choice may apply for the M.A. degree in comparative literature prior to completion of the Ph.D. degree requirements.

Candidates for the Ph.D. degree must complete 42 credits of course work. No full-time student may take more than 12 credits (four courses) per term. Candidates are expected to be fluent in at least one foreign language and literature and have knowledge of a second foreign language prior to admission to the program. After completing 12 credits at Rutgers, students holding a master's degree may apply for transfer credits after consulting with the graduate program director. While completing required course work, Ph.D. candidates are expected to pass examinations in two modern languages and one classical language (non-Western, Greek, or Latin). Candidates are also required to pass a written theory test at the end of their second year at Rutgers. After completion of the required 42 credits, candidates must pass one written and four oral examinations on a specific area of concentration from the following general categories: literature before 1500, literature from 1500 to 1900, a genre in diachronic perspective, literature after 1500, and a special topic directed toward the dissertation. Two of the five exams must include a non-Western component. Upon successful completion of these exams, the candidate must register for a minimum of 24 research credits during the period of thesis preparation. Each candidate must defend his or her thesis upon completion.

Appropriate work in disciplines other than literature, such as the social sciences or humanities, is encouraged with the approval of the graduate program director.

Applications requesting consideration for fellowship grants must be filed prior to February 1. A Guide for Graduate Students in Comparative Literature is available in the program office.

Graduate Courses

16:195:501. HISTORY OF LITERARY CRITICISM (3)

Required of all graduate students in comparative literature. Readings in the major theoretical statements of literary critics and aestheticians from Plato to the end of the nineteenth century.

16:195:502. WOMEN AND WRITING (3)

Social, aesthetic, and theoretical issues of women and writing through representative writers, movements, texts, and contexts.

16:195:503. POETRY IN TRANSLATION (3)

The study of translation as creative interpretation, with emphasis on Greco-Roman classics. Readings may include works by the following: Euripides, Homer, Aristophanes, and others.

16:195:505,506. STUDIES IN MEDIEVAL LITERATURE (3,3)

Basic English and continental texts, with emphasis on relationships with modern literature.

16:195:507,508. PROVENÇAL LANGUAGE AND LITERATURE (3,3)

An introduction to Old Provençal, with readings in major troubadours, and tracing of troubadour influences on the early lyrics of Western Europe.

16:195:509. STUDIES IN THE RENAISSANCE (3)

Survey of intellectual currents and study of representative works, including epic, lyric, prose fiction, and drama; analysis of stylistic changes from the early to the late Renaissance.

16:195:511. STUDIES IN THE NEOCLASSICAL PERIOD (3)

The late sixteenth- and seventeenth-century development of neoclassical intellectual, artistic, and literary doctrines, stressing the Italian baroque origins of the movement, its French development, and its English repercussions.

16:195:512. THE ENLIGHTENMENT (3)

Major authors studied with emphasis on literary and aesthetic concerns and their link to the philosophical.

16:195:513. ROMANTICISM (3)

European romanticism as a literary movement, emphasizing the genres of the lyric, the novel, and the drama.

16:195:514. SYMBOLISM (3)

The English, German, and American roots of French symbolism; its influence on such figures as Ruben Dario and A. Blok.

16:195:515. STUDIES IN CONTEMPORARY LITERATURE (3)

An assessment of major trends in today's literary production, with equal attention paid to the traditions they question and the evolving society they illustrate.

16:195:516. TOPICS IN COMPARATIVE LITERATURE (3)

16:195:517,518. INDIVIDUAL STUDIES IN COMPARATIVE LITERATURE (3,3)

Directed readings and frequent written analyses.

16:195:601. THE NOVEL (3)

A generic and thematic study of the novel as it evolved in Europe and the Western world in general. Some attention to the non-Western novel.

16:195:602. POETRY (3)

Studies in poetic genres.

16:195:603. DRAMA (3)

Studies in dramatic genres.

16:195:604. STUDIES IN NARRATIVE (3)

Studies in narrative genres.

16:195:605. MAJOR AUTHORS (3)

Close study, in a comparative context, of the works of one or more major authors.

16:195:606. THEORY AND PRACTICE OF TRANSLATION (3)

Consideration of various approaches to a common text, with attempts at creative practice.

16:195:607. STUDIES IN NONFICTIONAL PROSE (3)

From historical to scientific, to legal texts; from biography to autobiography, to private correspondence. The rhetoric and form of nonfictional prose and its relation to literature.

16:195:608. ADVANCED TOPICS IN COMPARATIVE LITERATURE (3)

16:195:609. COMPARATIVE LITERATURE AND OTHER FIELDS (3)
Relationships between literature and such fields as art, history, anthropology, philosophy, and music.

16:195:611. PSYCHOANALYTIC APPROACHES TO LITERATURE (3)

The function of literature viewed from a psychoanalytic perspective; the (psycho)analysis of the literary text; approaches to the biography of the artist; literary responses to modern psychoanalysis.

16:195:612. LITERATURE AND THE SOCIAL ORDER (3)

Society in the text; literary texts in society. Political and ideological aspects of a complex interaction.

16:195:613. MINORITY LITERATURES (3)

Literary texts written and read by minority groups in various contexts. The social, philosophical, and aesthetic implications of the very notion of minority literature.

16:195:614. COMPARATIVE EAST-WEST POETICS (3)

The comparison of the literary systems of the Eastern and Western worlds, including conceptions of literature, literary genres, and critical terminology.

16:195:615. EAST-WEST LITERARY RELATIONS (3)
Literary works of Eastern and Western worlds studied in the comparative context of actual historical meetings.

16:195:617. TOPICS IN ADVANCED LITERARY THEORY (3)
Prerequisite: 16:617:510 or its equivalent.

16:195:701,702. RESEARCH IN COMPARATIVE LITERATURE (BA,BA)

Interdisciplinary Graduate Course

15:617:510. INTRODUCTION TO LITERARY THEORY (3)
Flieger, Marsh, Eisenzweig, Edmunds, Persin, Galperin, Davidson, et al.
Prerequisite: Open to second-term graduate students; priority given to students from programs participating in the Council of Languages and Literature.

An introduction to contemporary literary theory, including formalism, structuralism, poststructuralism, feminism, psycho-analysis, cultural studies, and other approaches. Readings of theoretical texts and applications to short literary texts from a variety of literatures.

COMPUTER SCIENCE 198

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Vasek Chvatal,
H486 Hill Center, Busch Campus (732/445-2657)

Members of the Graduate Faculty

Eric Allender, Associate Professor of Computer Science, FAS-NB; Ph.D., Georgia Institute of Technology
Complexity theory; parallel and probabilistic computation
Saul Amarel, Alan M. Turing Professor of Computer Science, FAS-NB;
D.Eng.Sc., Columbia
Artificial intelligence; representation and theory formation; computational design
B.R. Badrinath, Associate Professor of Computer Science, FAS-NB;
Ph.D., Massachusetts
Distributed systems and databases; mobile wireless computing
Alexander Borgida, Professor of Computer Science, FAS-NB; Ph.D., Toronto
Artificial intelligence in the design of information systems
Vasek Chvatal, Professor of Computer Science, FAS-NB; Ph.D., Waterloo
Algorithms; combinatorics; graph theory; operations research
Sven Dickinson, Assistant Professor of Computer Science, FAS-NB/CCS;
Ph.D., Maryland
Computer vision; object modeling; artificial intelligence
Martin Farach, Assistant Professor of Computer Science, FAS-NB; M.D., Johns Hopkins; Ph.D., Maryland
Computational biology; design and analysis of algorithms
Michael L. Fredman, Professor of Computer Science, FAS-NB; Ph.D., Stanford
Data structures and algorithms; computational complexity
Herbert Freeman, State of New Jersey Professor of Computer Engineering, CE;
Eng.Sc.D., Columbia
Computer engineering; digital computer systems; computer architecture; image processing and graphics
Apostolos Gerasoulis, Professor of Computer Science, FAS-NB; Ph.D. SUNY (Stony Brook)
Parallel processing; algorithms; numerical analysis
Michael D. Grigoriadis, Professor of Computer Science, FAS-NB;
Ph.D., Wisconsin
Algorithms for network optimization
Peter Hammer, Professor of Mathematics and Operations Research, FAS-NB;
Ph.D., Bucharest
Boolean methods in operations research; discrete optimization
Haym Hirsh, Associate Professor of Computer Science, FAS-NB; Ph.D., Stanford
Artificial intelligence; machine learning
Tomasz Imielinski, Chairperson and Associate Professor of Computer Science, FAS-NB; Ph.D., Polish Academy of Sciences
Logical foundations of databases; mobile wireless computing
Jeffrey Kahn, Professor of Mathematics, FAS-NB; Ph.D., Ohio State
Combinatorics
Bahman Kalantari, Associate Professor of Computer Science, FAS-NB;
Ph.D., Minnesota
Mathematical programming; global and discrete optimization
Kenneth R. Kaplan, Associate Chairperson and Associate Professor of Computer Science, FAS-NB; Ph.D., Polytechnic Institute of New York
Algorithms; queueing theory; modeling; discrete simulation

Leonid Khachiyan, Professor of Computer Science, FAS-NB; Ph.D., D.Sc., USSR Academy of Sciences
Mathematical programming; complexity; discrete optimization
Janos Komlos, Professor of Mathematics, FAS-NB; Ph.D. Eotvos
Combinatorics; probability; theoretical computer science
Casimir Kulikowski, Professor of Computer Science, FAS-NB; Ph.D., Hawaii
Artificial intelligence; pattern recognition; imaging; biomedical applications
Saul Y. Levy, Associate Professor of Computer Science, FAS-NB; Ph.D., Yeshiva
Massively parallel architectures; algorithms; environments
L. Thorne McCarty, Professor of Computer Science and Law, FAS-NB/SL-N;
J.D., Harvard
Artificial intelligence; logic programming; legal reasoning
Naftaly H. Minsky, Professor of Computer Science, FAS-NB; Ph.D., Hebrew
Software engineering; programming languages; systems; distributed computing
Marvin C. Paull, Professor of Computer Science, FAS-NB; B.S., Clarkson
Design and analysis of algorithms; principles and practice
Gerard R. Richter, Professor of Computer Science, FAS-NB; Ph.D., Harvard
Numerical solutions of differential and integral equations
Barbara Ryder, Professor of Computer Science, FAS-NB; Ph.D., Rutgers
Programming languages; software engineering; parallel computation
Charles F. Schmidt, Professor of Psychology, FAS-NB; Ph.D., Iowa
Artificial intelligence; belief systems; inference; cognition
Eduardo Sontag, Professor of Mathematics, FAS-NB; Ph.D., Florida
Nonlinear control; neural networks
Diane L. Souvaine, Associate Professor of Computer Science, FAS-NB;
Ph.D., Princeton
Design and analysis of geometric and graph-theoretic algorithms
Chitoor V. Srinivasan, Associate Professor of Computer Science, FAS-NB;
D.Eng.Sc., Columbia
Knowledge-based systems; concurrent computation
William L. Steiger, Professor of Computer Science, FAS-NB; Ph.D., Australian National
Algorithms; parallel computations; computational geometry
Louis Steinberg, Associate Professor of Computer Science, FAS-NB;
Ph.D., Stanford
Artificial intelligence; knowledge-based design; VLSI; machine learning
Endre Szemerédi, State of New Jersey Professor of Computer Science, FAS-NB;
Sc.D., Moscow
Number theory; extremal graphs; theoretical computer science
Evangelia Micheli-Tzanakou, Professor of Biomedical Engineering, CE;
Ph.D., Syracuse
Visual pattern recognition; neural networks, neural computing
Robert Vichnevetsky, Professor of Computer Science, FAS-NB; Ph.D., Brussels
Numerical analysis; simulation of systems; computational fluid dynamics
Sholom M. Weiss, Professor of Computer Science, FAS-NB; Ph.D., Rutgers
Artificial intelligence; expert systems
Ann Yasuhara, Associate Professor of Computer Science, FAS-NB; Ph.D., Illinois
Theoretical computer science

Associate Members of the Graduate Faculty

Stanley Dunn, Assistant Professor of Biomedical Engineering, CE;
Ph.D., Maryland
Computer vision; image understanding; pattern recognition
Thomas P. Ellman, Assistant Professor of Computer Science, FAS-NB;
Ph.D., Columbia
Machine learning; knowledge compilation; qualitative physics
Charles L. Hedrick, Assistant Professor of Computer Science, FAS-NB; Ph.D., Carnegie-Mellon
Artificial intelligence; distributed computing environments
Ulrich Kremer, Assistant Professor of Computer Science, FAS-NB; Ph.D., Rice
Computation techniques and interactive programming environments for distributed-memory and shared-memory multiprocessor
Miles Murdocca, Assistant Professor of Computer Science, FAS-NB;
Ph.D., Rutgers
Optical computing; adaptive architectures; parallel processing
Donald E. Smith, Assistant Professor of Computer Science, FAS-NB;
Ph.D., Rutgers
Parallel architectures; VLSI; artificial intelligence
Suzanne Stevenson, Assistant Professor of Computer Science, FAS-NB/CCS;
Ph.D., Maryland
Computational linguistics; cognitive modeling

Programs

The program in computer science offers a comprehensive program of study in most areas of this field and provides a set of flexible options for advanced study and research.

In addition to the general admission criteria of the Graduate School–New Brunswick, the program requires that applicants have completed an accredited undergraduate program in computer science, or at least have taken the core courses required for an undergraduate degree in computer science. This includes a substantial background in mathematics, especially calculus, linear algebra, discrete mathematics, and probability/combinatorics, including at least one term in each of these areas with a second term of calculus; high-level languages, data structures, assembly language and machine organization, and algorithm design and analysis, as well as an advanced undergraduate elective course. All applicants are required to take the Graduate Record Examination's general and computer science subject examinations.

A candidate for the M.S. degree must complete 30 credits of course work and an expository essay, or 24 credits of course work and a master's thesis (6 credits). The candidate must also satisfy a distributional requirement with a relatively high grade-point average, which takes the place of a comprehensive examination.

A candidate for the Ph.D. degree must complete 48 credits of course work beyond the bachelor's degree, including the courses required for the M.S. degree. A student who enters the program after earning a master's degree may apply to transfer up to 24 of the required 48 credits. Normally, a one-year residence in the program is required of Ph.D. students, but, in special cases, alternatives to full-time residence are considered. The student must pass a qualifying examination before beginning thesis research. Thesis research is a major part of the Ph.D. program (24 credits); the thesis should cover original investigations in one or more problems in computer science. A Master of Philosophy degree is available to doctoral candidates.

Current research by the graduate faculty is expected to stimulate doctoral research. Faculty research interests include: algorithms, artificial intelligence (with applications to design, genetics, law, medicine), combinatorics, complexity theory, computational geometry, databases, data structures, distributed systems, expert systems, logical foundations of knowledge-based systems, machine learning, mathematical programming, numerical analysis, operating systems, optimization, parallel computation, programming languages, and software engineering. All qualified graduate students are eligible to be considered for teaching assistantships and fellowships. Also, a number of grant-supported research projects have research assistantships for advanced graduate students.

Computing facilities for the department are run by the staff of the Laboratory for Computer Science Research (LCSR). The principal facility consists of a network of about 100 Sun Workstations and servers. There are also dedicated, special-purpose facilities and high-performance graphics terminals. IBM mainframe-type computing is available through Rutgers University Computing Services (RUCS), and supercomputing is accessible via the national networks. N CUBE and Butterfly computers are also available for experimental and smaller-scale parallel computing by arrangement with the state-sponsored Center for Aids for Industrial Productivity (CAIP).

Instructional computing is supported by RUCS. Computing for introductory courses is provided by networks of Apple Macintosh computers; other undergraduate courses are served by Sun Workstations. Graduate instruction is, except for some special-purpose computing, provided through the network of Suns.

All facilities are located in the CoRE (Computer Research and Engineering) Building, which also houses CAIP, and the Hill Center for the Mathematical Sciences, which also houses the Library of Mathematical Sciences.

Further information on these and related matters may be found in The Graduate Program in Computer Science, a brochure available from the program.

Graduate Courses

16:198:503. (F) DATA STRUCTURES AND ALGORITHMS (3)

Kaplan. Intended for students who have not had undergraduate preparation in the subject. May not be taken for credit toward a graduate degree in computer science. Models of computation and complexity. Sorting, stacks, queues, linked lists, trees, search trees, hashing, heaps, graphs, and graph algorithms.

16:198:505. COMPUTER STRUCTURES (3)

Levy, Paull. Prerequisite: Admission requirements. A brief review of combinational and sequential switching circuits. Computer organization, memory systems, arithmetic, I/O, control, data communications, parallel processors, RISC architectures, and other topics of current interest.

16:198:509. (F) FOUNDATIONS OF COMPUTER SCIENCE (3)

Allender, Yasuhara. Prerequisite: Admission requirements. Introduction to first-order logic, emphasizing methods used in computer science. Introduction to mathematical models of computation, especially deterministic and nondeterministic Turing machines, computability theory, and space and time complexity theory. P and NP.

16:198:510. NUMERICAL ANALYSIS (3)

Gerasoulis, Richter, Vichnevetsky. Prerequisites: Ability to use a high-level language such as PL/1 or FORTRAN IV; a minimum of four terms of undergraduate mathematics including calculus and linear algebra. Derivation, analysis, and application of methods used to solve numerical problems with computers; solution of equations by iteration, approximation of functions, differentiation and quadrature, differential equations, linear equations and matrices, least squares.

16:198:513. DESIGN AND ANALYSIS OF DATA STRUCTURES AND ALGORITHMS I (3)

Chvatal, Souvaine, Steiger. Prerequisites: Admission requirements; familiarity with Prim and Kruskal minimum spanning tree algorithms and Dijkstra's shortest path algorithm. Worst case, average case, and amortized analysis. Data structures: search trees, hash tables, heaps, Fibonacci heaps, union-find. Algorithms: string matching, sorting and ordering statistics, graph algorithms. NP-completeness.

16:198:514. (S) DESIGN AND ANALYSIS OF DATA STRUCTURES AND ALGORITHMS II (3)

Chvatal, Fredman, Khachiyan, Steiger. Prerequisite: 16:198:513. Advanced data structures such as splay trees, link-cut dynamic trees. Algorithms for convex hull, search, parsing, unification. Advanced models of computation: parallelism, approximation, probabilistic. Sample algorithms and their complexity. Algorithms for arithmetic.

16:198:515. (F) PROGRAMMING LANGUAGES AND COMPILERS I (3)

Borgida, Ryder. Prerequisite: 01:198:315 or equivalent. Pre- or corequisite: 16:198:513. LR parsing; attributed grammars; code generation; types and polymorphism; programming language paradigms: logic, functional, object-oriented; data abstraction; formal semantics: axiomatic l-calculus, denotational.

16:198:516. (S) PROGRAMMING LANGUAGES AND COMPILERS II (3)

Ryder. Prerequisite: 16:198:515. Advanced topics in compiler design and modern programming language paradigms chosen from: optimization, especially register allocation methods; data flow analysis techniques including interprocedural analysis; parallelization of sequential programs; incremental compilation.

16:198:517. (F) QUEUEING SYSTEMS AND PERFORMANCE MODELS (3)

Kaplan. Prerequisites: First-year graduate courses in computer science; four terms of undergraduate mathematics; strong background in probability. Mathematical tools for modeling complex systems. Emphasis on stochastic processes, Markov chains, and queueing theory. Generation of random variates for simulation. Applications to the modeling and evaluation of computer subsystems, configurations, and networks.

16:198:519. (F) OPERATING SYSTEMS THEORY (3)

Badrinath. Prerequisite: 01:198:416 or equivalent. Operating system basics, process management, synchronization, memory management. Interprocess communication, pipes, sockets. Network protocols, RPC, broadcast protocols, client-server architectures. Current trends in operating systems and case studies.

- 16:198:520. INTRODUCTION TO ARTIFICIAL INTELLIGENCE (3)
Hirsh, Ellman, McCarty, Dickinson, Stevenson. Prerequisite: Admission requirements.
Overview of artificial intelligence. Basic problems and methods; heuristic search, game playing, problem solving; deductive inference, theorem proving; simple planning. Basic LISP and Prolog programming.
- 16:198:521. (F) LINEAR PROGRAMMING (3)
Chvatal, Grigoriadis, Khachiyan. Prerequisites: Linear algebra and admission requirements.
Linear inequalities, extreme points and rays, fundamental theorems. Optimality and duality. Geometric view. Primal and dual simplex methods. Degeneracy. Primal-dual method. Sensitivity. Basis factorization, implementation issues. Column generation. Structured models. Unimodularity. Network simplex method. Polynomial-time projective algorithm, affine variant. Emphasis on theoretical and computational aspects.
- 16:198:522. (S) NETWORK AND COMBINATORIAL OPTIMIZATION ALGORITHMS (3)
Grigoriadis. Prerequisites: 16:198:503 or 513 or equivalent; elementary knowledge of linear programming; or permission of instructor.
Shortest paths. Maximum flow and minimum cost flow networks. Parametric flows. Generalized and multicommodity flows. Cardinality and weighted general matching. Scaling methods. Introduction to matroids. Greedy algorithms. Minimum spanning trees. Network synthesis. Special structures. Approximation algorithms. Emphasis on design and analysis of fast algorithms.
- 16:198:523. (F) COMPUTER GRAPHICS (3)
Prerequisites: 16:198:510, 513, or equivalent experience, especially in matrix algebra, tree structure, and recursion.
Representation and manipulation of geometric objects by computer.
- 16:198:524. (S) NONLINEAR PROGRAMMING ALGORITHMS (3)
Kalantari, Khachiyan. Prerequisites: 16:198:521 or equivalent, four terms of calculus.
Convex sets and functions. Unconstrained and constrained optimization. First- and second-order optimality conditions. Duality theory. Conjugate and quasi-Newton methods. Line search and feasible direction methods. Quadratic programming, linear complementarity. Approaches to global optimization. Karmarkar's algorithm. Path-following Newton methods. Matrix scaling.
- 16:198:525,526. ADVANCED NUMERICAL ANALYSIS (3,3)
Richter, Vichnevetsky. Prerequisite: 16:198:510 or equivalent.
In-depth analysis of selected topics from the following: linear algebraic systems; computation of eigenvalues and eigenvectors; numerical solution of initial and boundary value problems for ordinary differential equations; spline and Fourier approximation.
- 16:198:527. (S) COMPUTER METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (3)
Vichnevetsky. Prerequisites: Background in numerical analysis, computer programming, and elementary theory of partial differential equations.
Principles of advanced numerical analysis and computer programming for the solution of partial differential equations. Introduction to finite element methods. Theory of stability and accuracy of methods for hyperbolic, parabolic, and elliptic problems. Emphasis on applications in science and engineering.
- 16:198:528. (S) PARALLEL NUMERICAL COMPUTING (3)
Gerasoulis. Prerequisites: Numerical algorithms (01:198:323 or 16:198:510) and nonnumerical algorithms (01:198:344 or 16:198:503); basics of Unix, Fortran, or C.
Analysis of numerical algorithms for a variety of parallel architectures. Parallelization of existing algorithms. Mapping of algorithms onto various architectures. Techniques for developing fast parallel numerical algorithms. Algorithms implemented on existing simulators or actual parallel machines.
- 16:198:529. (F) COMPUTATIONAL GEOMETRY (3)
Souvaine or Steiger. Prerequisite: 16:198:513. Recommended: 16:198:514.
Design and analysis of algorithms for geometric problems. Topics include proof of lower bounds, convex hulls, searching and point location, plane sweep and arrangements of lines, Voronoi diagrams, intersection problems, decomposition and partitioning, farthest-pairs and closest-pairs, curved and rectilinear geometry.
- 16:198:530. (F) KNOWLEDGE-BASED SYSTEMS (3)
Ellman. Prerequisite: 16:198:520.
Problem-solving paradigms: planning, design, diagnosis, control, simulation, and program synthesis. Inference techniques: constraint satisfaction, constraint-logic programming, classical planning, decision-theoretic planning, model-based reasoning, probabilistic reasoning, and deductive program synthesis. A methodology for knowledge engineering.
- 16:198:531. (F) ARTIFICIAL INTELLIGENCE SOFTWARE: TECHNIQUES AND LANGUAGES (3)
Steinberg. Prerequisite: 16:198:520.
The programming tools needed to write or understand AI systems. Search, pattern matching, LISP, logic programming, objects and frames, rules.
- 16:198:532. (S) LOGICAL FOUNDATIONS OF KNOWLEDGE REPRESENTATION (3)
Borgida, McCarty. Prerequisites: 16:198:509, 520.
A course on the knowledge representation problem in AI, with an emphasis on the use of logical techniques. Computational logic. Modal logics of time, action, knowledge, belief. Formal analysis of reasoning that is not strictly deductive (e.g., nonmonotonic reasoning, abductive reasoning). Approaches to tractable reasoning.
- 16:198:533. (F) NATURAL LANGUAGE PROCESSING (3)
Prerequisites: 16:198:520; a working familiarity with context free languages; facility with LISP or Prolog.
Implementation of computer-based natural language understanding systems. Algorithmic approaches to natural language syntax, semantics, inferencing, use of world knowledge. Analysis of existing systems.
- 16:198:534. (F) IMAGE UNDERSTANDING (3)
Dickinson. Prerequisite: 16:198:520 or permission of the instructor.
Explores the problem of high-level computer vision (image understanding), focusing on the tightly coupled issues of three-dimensional object representation and recognition. Object modeling issues include object-centered vs. viewer-centered models, physical vs. geometrical vs. functional models, and deformable vs. rigid models. Recognition topics include constrained search, alignment, graph matching, and geometric hashing.
- 16:198:535. (F) PATTERN RECOGNITION THEORY AND APPLICATIONS (3)
Kulikowski. Prerequisites: Linear algebra, probability, random variables, statistics.
Pattern recognition as an inductive process, statistical classification, parametric and nonparametric methods, adaptive methods, error estimation, applications in image processing, character, speech recognition, and diagnostic decision making.
- 16:198:536. (F) MACHINE LEARNING (3)
Hirsh. Prerequisite: 16:198:520 or permission of instructor.
Survey of past work and current research in machine learning, including decision-tree and neural-network approaches to inductive learning, explanation-based learning, analogy and case-based reasoning, and discovery.
- 16:198:538. (S) COMPLEXITY OF COMPUTATION (3)
Allender. Prerequisites: 16:198:509, 513.
Complexity classes, reducibilities, and complete sets. Relationships between time and space complexity, between serial and parallel computation, and among deterministic, probabilistic, and nondeterministic computation. Complexity theoretic notions of randomness.

16:198:539. (F) THEORY OF COMPUTATION (3)

Yasuhara. Prerequisite: 16:198:509 or equivalent.
Mathematical theory of computing machines. Computable functions, recursive and recursively enumerable sets, recursion and fixed-point theorems, abstract complexity and complexity theoretic analogues of aspects of recursive function theory, algorithmic (Kolmogoroff) complexity theory.

16:198:540. (S) COMBINATORIAL METHODS IN COMPLEXITY THEORY (3)

Szemerédi. Prerequisites: 16:198:509, 513.
Threshold formulas. Deterministic and randomized protocols in communication complexity. Interactive proof systems, approximation, and consequences.

16:198:541. (S) DATABASE SYSTEMS (3)

Borgida, Imielinski. Prerequisites: 01:198:435 or equivalent; 16:198:513.
Recommended: 16:198:509 or equivalent.
Relational data model. Relational query languages and their expressiveness. Dependency theory and relational normalization. Physical database design. Deductive databases and object oriented databases. Optimization of relational queries.

16:198:550. (F) INTRODUCTION TO VERY LARGE SCALE INTEGRATED SYSTEMS (3)

Prerequisites: 16:198:503, 505.
Introduction to VLSI technology and the design of VLSI systems. Topics include computer-aided design, system level design, NMOS circuit design, and parallel computation. Students design an integrated circuit for fabrication.

16:198:556. (F) PARALLELISM: ALGORITHMS AND COMPLEXITY (3)

Fredman, Steiger, Szemerédi. Prerequisite: 16:198:513.
Recommended: 16:198:505, 514.
Models of parallelism. Complexity classes. Lower bounds, simulations, separation results. Algorithms: arithmetic, comparison tasks, matrices, graphs. Routing and scheduling problems. Architectures and structures.

16:198:580. (S) TOPICS IN COMPUTERS IN BIOMEDICINE (3)

Kulikowski, Noordevier. Prerequisite: 16:198:520.
Description of biomedical systems that can be realized on a computer. Selection of a problem area as a project, e.g., biomedical modeling, automated diagnosis, computer-assisted instruction, image recognition and reconstruction, medical data structures, automated monitoring and treatment. Genome representation and mapping, etc.

16:198:583. (S) TOPICS IN SOFTWARE DESIGN (3)

Minsky. Prerequisites: Proficiency in at least two of the following areas: database systems, operating systems, programming languages, and AI.
In-depth study of selected topics in the areas of software engineering and systems. Course leads to research in these areas.

16:198:587. (F) EXPERT SYSTEMS (3)

Noordevier. Prerequisites: 16:198:520 and permission of instructor.
Scope and characterization of expert systems. Consultation processes and expertise. Knowledge acquisition and representation. Methods of inference under uncertainty and problem-solving strategies. Review of existing expert systems and specialized languages.

16:198:594. (S) TOPICS IN PROGRAMMING LANGUAGES (3)

Ryder. Prerequisite: 16:198:515.
Advanced topics in the design and implementation of programming languages, e.g., compiling for parallel architectures, data flow analysis and its applications, very high-level program optimization, automatic programming, theory of programming languages.

16:198:596. (S) TOPICS IN THE FOUNDATIONS OF COMPUTER SCIENCE (3)

Allender, Fredman, Steiger, Szemerédi, Yasuhara. Prerequisites: 16:198:509 and, depending on the topic, 16:198:538 and/or 539 and/or 540.
Careful study of papers on the topic selected for the given term. Examples include parallelism and zero-knowledge proofs, randomness and information theory, probabilistic aspects of computation, topics in complexity theory.

16:198:598. (S) TOPICS IN PROBLEM-SOLVING METHODS (3)

Amarel. Prerequisite: Permission of instructor.
Concepts, methods, and techniques in artificial intelligence research, with emphasis on computer problem solving. Study of recent research in representations.

16:198:601,602, 603, 604, 605, 606. SELECTED PROBLEMS IN COMPUTER SCIENCE (BA,BA,BA,BA,BA,BA)

Prerequisite: 6 graduate credits in computer science with grades of B+ or better.
In-depth study of a topic chosen by the student and professor.

16:198:607,608. PROBLEMS IN NUMERICAL METHODS (BA,BA)

Vichnevetsky, Gerasoulis. Prerequisites: 16:198:525 or 526 or 527 or equivalent experience, and permission of instructor.
Formal lectures and individual projects under the guidance of the instructor. Topics follow the material covered in 16:198:525,526, and/or 527. Final project may include the implementation and evaluation of computer programs.

16:198:671,672, 673, 674, 675, 676. SEMINAR IN COMPUTER SCIENCE (3,3,3,3,3,3)

For advanced graduate students who have at least 18 graduate credits in computer science.
Current research. Several seminars are given each term.

16:198:701,702. RESEARCH IN COMPUTER SCIENCE (BA,BA)

Prerequisite: Permission of thesis adviser. For students working on their master's theses or doctoral dissertations.

ECOLOGY AND EVOLUTION 215

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Peter Smouse, Foran Hall,
Cook Campus (732/932-2971)

Members of the Graduate Faculty

Kenneth W. Able, Professor and Director of the Marine Field Station,
CC/FAS-NB; Ph.D., William and Mary
Ecology and behavior of fishes
Standish K. Allen, Jr., Assistant Research Professor of Marine Sciences, CC;
Ph.D., Washington
Genetics of fish and shellfish, applied to aquaculture and fisheries
James E. Applegate, Professor of Ecology, Evolution, and Natural Resources, CC;
Ph.D., Pennsylvania
Wildlife management
Joanna Burger, Professor of Biology, FAS-NB, and of Ecology, Evolution, and
Natural Resources, CC; Ph.D., Minnesota
Behavioral ecology, avian and reptilian ecology, behavioral toxicology;
salt marsh ecology, ecological risk
Donald F. Caccamise, Professor of Entomology, CC; Ph.D. New Mexico State
Avian ecology
Timothy M. Casey, Professor of Entomology, and of Ecology, Evolution, and
Natural Resources, CC; Ph.D., California (Los Angeles)
Physiological ecology; energetics and thermoregulation
Jonathan J. Cole, Associate Scientist, Institute of Ecosystem Studies; Ph.D., Cornell
Aquatic ecosystems; biogeochemistry; microbiology; chemical cycles
John Dighton, Professor of Biology, FAS-C; Ph.D., London
Role of fungi in nutrient dynamics in forest soils and impacts of pollution
David W. Ehrenfeld, Professor of Biology, and of Ecology, Evolution, and Natural
Resources, CC; M.D., Harvard; Ph.D., Florida
Conservation ecology; biology of marine turtles
Joan G. Ehrenfeld, Associate Professor of Ecology, Evolution, and Natural
Resources, CC; Ph.D., CUNY
Plant community ecology; ecosystems ecology; pollution impacts
Douglas E. Eveleigh, Professor of Biochemistry and Microbiology, and of Ecology,
Evolution, and Natural Resources, CC; Ph.D., Exeter
Microbial ecology
Stuart E. G. Findlay, Assistant Scientist, Institute of Ecosystem Studies;
Ph.D., Georgia
Aquatic ecology; benthos, detritus, microbial ecology
Dunne Fong, Associate Professor of Biological Sciences, FAS-NB; Ph.D., Princeton
Biodiversity; free-living parasite protozoa
Susan E. Ford, Associate Research Professor of Marine and Coastal Sciences, CC;
Ph.D., Duke
Invertebrate pathology and parasitology genetics and mechanisms of resistance
to pathogens
Randy Gaugler, Professor of Entomology, CC; Ph.D., Wisconsin
Invertebrate pathology; behavioral ecology

- Brandon S. Gaut, Associate Professor of Plant Sciences, CC; Ph.D., California (Riverside)
Molecular evolution; population genetics in plants
- Michael Gochfeld, Professor of Environmental and Community Medicine, UMDNJ-RWJMS; M.D., Albert Einstein; Ph.D., CUNY (Queens)
Environmental toxicology; avian ecology; behavioral development and occupational medicine
- J. Frederick Grassle, Director and Professor, Institute of Marine and Coastal Sciences, CC; Ph.D., Duke
Ecology of marine bottom-dwelling organisms
- Judith P. Grassle, Professor of Marine and Coastal Sciences, IMCS/CC; Ph.D., Duke
Marine benthic ecology; population genetics; larval recruitment
- Edwin J. Green, Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Virginia Polytechnic Institute
Empirical Bayes estimation; sampling; quantitative methods in forestry
- Peter M. Groffman, Associate Scientist, Institute of Ecosystem Studies; Ph.D., Georgia
Terrestrial microbial ecology
- Steven N. Handel, Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Cornell
Plant population biology; pollination; restoration ecology
- Jean M. Hartman, Associate Professor of Landscape Architecture, CC; Ph.D., Connecticut
Plant community and population ecology; natural disturbance patterns
- Geoff Henebry, Assistant Professor of Biological Sciences, FAS-N; Ph.D., Texas (Dallas)
Landscape ecology, disturbance-maintained ecosystems, remote sensing, ecological modeling
- Emanuel B. Hey, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., SUNY (Stony Brook)
Molecular evolution
- Henry B. John-Alder, Associate Professor of Animal Sciences, CC; Ph.D., California (Irvine)
Ecological/comparative physiology and endocrinology, especially of ectothermic vertebrates
- John Kuser, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Oregon State
Genealogy of trees, tree improvement, and urban forestry
- Richard G. Lathrop, Jr., Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Wisconsin (Madison)
Remotesensing and spatial modeling of terrestrial/aquatic ecosystems
- Charles F. Leck, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Cornell
Avian ecology and behavior; New Jersey natural history; tropical biology
- Daniel E. Lieberman, Assistant Professor of Anthropology, FAS-NB; Ph.D., Harvard
Human evolution; craniofacial growth and development; bone biology
- Gene E. Likens, Senior Scientist and Director, Institute of Ecosystems Studies; Ph.D., Wisconsin
Limnology; biogeochemistry; analysis of ecosystems; acid precipitation
- Robert E. Loveland, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Harvard
Physiological ecology; growth and modeling; salt marsh ecology
- Gary M. Lovett, Associate Scientist, Institute of Ecosystem Studies; Ph.D., Dartmouth
Plant ecology; nutrient cycling; forest-atmosphere interactions
- Richard A. Lutz, Professor of Marine and Coastal Sciences, CC; Ph.D., Maine
Biology of deep-sea hydrothermal vents; molluscan fisheries and aquaculture; marine ecology
- Michael L. May, Associate Professor of Entomology, CC; Ph.D., Florida
Physiological and behavioral ecology of insects
- Bonnie J. McCay, Professor of Anthropology and Human Ecology, CC; Ph.D., Columbia
Ecological anthropology; fisheries; common problems
- George R. McGhee, Jr., Associate Professor of Geology, FAS-NB; Ph.D., Rochester
Marine paleoecology; evolutionary theory; mass extinction
- Terry R. McGuire, Associate Professor of Biological Sciences, FAS-NB; Ph.D., Illinois
Behavioral and biochemical genetics
- Thomas R. Meagher, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Duke
Plant population biology, population genetics
- Mark D. Morgan, Associate Professor of Biology, FAS-C; Ph.D., California (Davis)
Nutrient cycles and their impact on aquatic biota
- Peter J. Morin, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Duke
Community ecology; herpetology; entomology
- George E.B. Morren, Jr., Professor of Human Ecology, CC; Ph.D., Columbia
Human ecology
- Bertram G. Murray, Jr., Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Michigan
Theoretical population ecology and evolution
- Richard S. Ostfeld, Assistant Scientist, Institute of Ecosystem Studies; Ph.D., California (Berkeley)
Ecology and evolutionary biology of mammals
- Michael L. Pace, Associate Scientist, Institute of Ecosystem Studies; Ph.D., Georgia
Community and ecosystem ecology in fresh and marine waters
- Stewart T.A. Pickett, Scientist, Institute of Ecosystem Studies; Ph.D., Illinois
Plant community organization and interaction; vegetation dynamics
- Harry W. Power, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Michigan
Evolution of social behavior
- James A. Quinn, Jr., Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Colorado State
Population ecology; species interactions; evolutionary biology
- Anna-Louise Reysenbach, Assistant Professor of Biochemistry and Microbiology, IMCS/CC; Ph.D., Cape Town
Ecology and evolution of thermophilic microorganisms
- Emily W.B. Russell, Associate Research Professor of Geological Sciences, FAS-N; Ph.D., Rutgers
Paleoecology; long-term plant succession; human impact on vegetation
- Kathleen M. Scott, Associate Professor of Biological Sciences, FAS-NB; Ph.D., Yale
Mammalogy, functional morphology, and paleoecology of ungulates
- Peter E. Smouse, Professor of Theoretical and Applied Genetics, and of Ecology, Evolution, and Natural Resources, CC; Ph.D., North Carolina State
Studies aimed at elucidating the interface between genetics and ecology
- Edmund W. Stiles, Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Washington
Plant-animal interactions; evolutionary ecology; vertebrate ecology
- David L. Strayer, Assistant Scientist, Institute of Ecosystem Studies; Ph.D., Cornell
Aquatic ecology; freshwater invertebrates; energy flow; habitat and niche
- Michael V.K. Sukhdeo, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., McGill
Behavioral ecology of helminth parasites in their hosts
- Gary L. Taghon, Associate Professor of Marine and Coastal Sciences, CC; Ph.D., Washington
Marine benthic ecology; feeding energetics
- Richard Triemer, Professor of Biological Sciences, FAS-NB; Ph.D., North Carolina (Chapel Hill)
Evolution of algae and protozoa
- Robert Trivers, Professor of Anthropology, FAS-NB; Ph.D., Harvard
Natural selection and social theory; evolutionary genetics
- Robert K. Tucker, Director and Research Professor, Ecopolity Center, CC; Ph.D., Duke
Policy: ecological risk, coastal resources, land-use, water quality
- Andrew P. Vayda, Professor of Anthropology and Human Ecology, CC; Ph.D., Columbia
Human ecology; methodology and explanation; human impact on tropical forests
- Robert C. Vrijenhoek, Professor of Theoretical and Applied Genetics, CC; Ph.D., Connecticut
Evolutionary genetics; ecology
- Sam Wainright, Assistant Professor of Marine and Coastal Sciences, CC; Ph.D., Georgia
Marine and aquatic food webs
- Daniel Wartenberg, Associate Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., SUNY (Stony Brook)
Multivariate statistics, spatial pattern, community ecology
- Judith S. Weis, Professor of Biology, FAS-N; Ph.D., New York
Effects of environmental factors, including pollutants on development and growth of estuarine organisms
- Daniel C. Wilhoft, Professor of Biology, FAS-N; Ph.D., California (Berkeley)
Physiological ecology of ectotherms

Adjunct Members of the Graduate Faculty

- Vlatcheslav Douchenkov, Research Scientist, Polytech, Inc., CC; Ph.D., Moscow Pedagogical
Plant response to heavy-metal-contaminated soils
- Brian L. Howes, Assistant Scientist, Woods Hole Oceanographic Institution; Ph.D., Boston
Biogeochemistry of coastal wetlands
- Laura R. Meagher, Associate Dean of Research, CC; Ph.D., Duke
Science policy; applied aspects of evolution
- C. Lavett Smith, Curator, American Museum of Natural History; Ph.D., Michigan
Fishes ecology

Programs

The graduate program in ecology and evolution, concerned with the relations between organisms and the environment and with interactions among organisms, is conducted under sponsorship of participating faculties in the biological sciences. Normally, a one-year residence of two full-time, consecutive terms following the qualifying examination is required for the Ph.D. candidate.

A minimum of 72 credits (30 in course work, 42 in research) is required. Two M.S. options are available—with a thesis or without. Both M.S. programs require 30 credits, 18 credits of which must be at the graduate level.

The program provides a broad spectrum of courses and research opportunities to qualified students who seek careers in university teaching and research or opportunities in governmental agencies or private institutions.

Areas of specialization encompass the various aspects of ecology and evolution including: behavior, conservation biology, ecosystem ecology, evolutionary biology, marine biology, population and community ecology, population genetics, molecular evolution, restoration ecology, and behavior.

Graduate Courses

16:215:506. (F) ESTUARINE ECOLOGY (4)

Able, Loveland. Sem. 2 hrs., lab. 3 hrs.
Fundamental study of aquatic organisms in the estuarine waters of coastal New Jersey; life cycles, food chains, and the relationships of organisms to one another.

16:215:510. CONSERVATION ECOLOGY (3)

D. Ehrenfeld
Major threats to ecosystems and species; the differential responses of different ecosystems to external perturbations; techniques of ameliorating environmental damage and preserving species; the role of the ecologist in conservation.

16:215:513. POPULATION GENETICS (3)

Vrijenhoek, Smouse. Prerequisite: Genetics.
Factors affecting gene frequencies in populations and leading to the origin of new species. An introduction to the analysis of continuously distributed polygenic traits.

16:215:514. CONSERVATION GENETICS (3)

Vrijenhoek
Focus on applications of population genetic and quantitative genetic approaches to captive breeding and in situ conservation of endangered species. Genetic considerations intertwined with demographic problems facing species in decline resulting from habitat loss or fragmentation.

16:215:515. (F) NATURAL HISTORY OF NEW JERSEY (3)

Leck. Lec. 2 hrs., lab. 3 hrs. Prerequisite: General biology.
Ecological aspects of the natural history of New Jersey. Field and laboratory studies of special use and interest to biology teachers.

16:215:525. (F) ECOLOGY OF FRESHWATER ORGANISMS (4)

Lec. 3 hrs., lab. 3 hrs. Prerequisite: Limnology or aquatic biology.
Detailed consideration of distribution, abundance, and metabolism of organisms in lakes and streams. An introduction to the theory and techniques of systems ecology.

16:215:528. (S) BEHAVIORAL ECOLOGY OF FISH (3)

Able. Prerequisite: 01:119:420.
An investigation into fish behavior, with emphasis on the ecological significance of migrations, reproduction, feeding, habitat selection, and antipredator strategies. Student research topics.

16:215:531. (F) ADVANCED ORNITHOLOGY (3)

Leck
A study of avian biology, including taxonomy, population dynamics, and distribution of birds, and a critical review of current ornithological research. The laboratory consists of field and museum experience and independent research.

16:215:533. (S) THE BEHAVIOR OF ANIMAL POPULATIONS (3)

Burger, Leck. Prerequisite: Animal behavior or ecology.
Topics in ecological adaptations of behavior; emphasis on the population level. Student research topics.

16:215:546. BEHAVIORAL GENETICS (4)

McGuire. Prerequisites: Background in genetics, behavior. Recommended: Statistics.
Single and multiple gene effects on behavior; methods of behavior-genetic analysis. Mechanisms of action of behavior genes. Darwinian considerations in behavioral evolution. Evolution of social systems.

16:215:550. ADVANCED EVOLUTION (4)

Hey, Handel. Prerequisite: Genetics.
Examination of the major elements and controversies of evolutionary theory. Emphasis on genetic variation, natural selection, adaptation, and speciation.

16:215:555. ECOLOGY AND ECOLOGICAL RISK (3)

Burger
Principles of ecology and risk analysis, environmental hazards and resultant risk analysis.

16:215:560. THEORY AND PRACTICE OF GENETIC ENGINEERING: EVOLUTIONARY ASPECTS (3)

Day, Meagher
Applications of evolutionary concepts to genetic engineering. Material ranges from articulation of the basic genetic technology to specific applications, with emphasis on ecological implications.

16:215:565. COMMUNITY DYNAMICS (4)

Meagher, Morin
Patterns and processes involving sets of two or more coexisting species. Theoretical and empirical studies.

16:215:570. MOLECULAR EVOLUTION (3)

Gaut, Hey
Analysis of actual data sets estimating historical process.

16:215:575. (F) QUANTITATIVE ECOLOGY AND EVOLUTION (3)

Morin. Prerequisite: Calculus. Recommended: FORTRAN programming.
The application of differential equations and linear algebra to specific ecological phenomena, e.g., growth, competition, predator-prey. Dynamic modeling of simple (three- and four-component) ecosystems; students develop their own models.

16:215:580. DARWIN, THE GENETICAL THEORY OF EVOLUTION (BA)

Gaut
Evolutionary theory, works of Darwin, Mendel, Fisher, Wright, and Haldane.

16:215:582. TOPICS IN SOCIOBIOLOGY (3)

Power. Prerequisites: Genetics, ecology, and permission of instructor.
The application of Darwinian reasoning and the comparative method to the study of the evolution and expression of social behavior. Rigorous formation and testing of disprovable hypotheses emphasized.

16:215:588. TOPICS IN ADVANCED ECOLOGY (3)

Literature review and synthesis of a selected current topic in applied or theoretical ecology.

16:215:590. (S) POPULATION ECOLOGY (4)

Quinn, Stiles. Lec./sem. 3 hrs., lab./field 3 hrs. Prerequisite: Ecology.
Population dynamics and demography, natural selection and evolution, life history strategies, population regulatory mechanisms, species interactions and coevolution, variability among populations and ecological differentiation, and island biogeography.

16:215:595. (F) COADAPTION OF PLANTS AND ANIMALS (3)

Stiles. Prerequisite: Botany or ecology or evolutionary biology.
Introduction to coevolution, plant-herbivore interaction, pollination biology, seed predation, and dispersal.

16:215:601. SEMINAR IN ECOLOGY (1)

Sukhdeo
Introductory seminar required for all first year ecology and evolution students.

16:215:603,604. SPECIAL TOPICS IN ECOLOGY (BA,BA)

16:215:605,606. ADVANCED PROBLEMS IN ECOLOGY (BA,BA)
Individual study in an area of expertise of the faculty.

16:215:650. FUNDAMENTALS OF ECOSYSTEM ECOLOGY (4)
A critical review of ecosystem ecology, including biogeochemical cycles and budgets, ecosystem energetics, the theory and history of ecosystem ecology, and the response of ecosystems to disturbance.

16:215:701,702. RESEARCH IN ECOLOGY (BA,BA)

Graduate Courses in Other Programs

Descriptions for the courses listed below can be found elsewhere in this catalog and in the graduate catalogs for Camden and Newark. In addition to these courses taught by members and associates of the ecology program, there are many other courses of interest to ecology graduate students offered by the programs in entomology, environmental sciences, geography, geological sciences, meteorology, and plant science and technology.

- 16:070:559. EVOLUTION OF BEHAVIOR (3)
- 16:070:567. HUMAN VARIATION (3)
- 56:120:503. ESTUARINE BIOLOGY (3)
- 56:120:505. MARINE BIOLOGY (4)
- 56:120:507. PLANT GEOGRAPHY (4)
- 56:120:590. POPULATION ECOLOGY (3)
- 16:370:507. BIOLOGICAL CONTROL OF INSECT PESTS (3)
- 16:370:525. INSECT ECOLOGY (3)
- 16:450:617. SEMINAR IN REMOTE SENSING OF THE BIOSPHERE (3)
- 16:460:538. EVOLUTIONARY PALEOECOLOGY (3)
- 16:681:502. MICROBIAL AND MOLECULAR GENETICS (3)
- 16:681:572. MICROBIAL ECOLOGY (4)
- 16:681:580. FUNDAMENTALS OF MOLECULAR GENETICS (3)
- 16:761:520. ENVIRONMENTAL PHYSIOLOGY (3)
- 16:765:522. APPLIED PLANT SCIENCE (3)
- 16:960:582. INTRODUCTION TO METHODS AND THEORY OF PROBABILITY (3)
- 16:960:590. DESIGN OF EXPERIMENTS (3)

ECONOMICS 220

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Director of Graduate Program: Professor Barry Sopher,
New Jersey Hall, College Avenue Campus (732/932-7451)

Members of the Graduate Faculty

- Robert J. Alexander, Professor Emeritus of Economics, FAS-NB; Ph.D., Columbia
Latin American economic development and politics; history of radical movement
- Alexander Balinky, Professor Emeritus of Economics, FAS-NB; Ph.D., Harvard
Marxian economics; comparative economics systems
- Monroe Berkowitz, Professor Emeritus of Economics, FAS-NB; Ph.D., Columbia
Economics of disability programs
- Douglas H. Blair, Professor of Economics, FAS-NB; Ph.D., Yale
Microeconomic theory; social choice theory
- Michael D. Bordo, Professor of Economics, FAS-NB; Ph.D., Chicago
Monetary history and theory
- John F. Burton, Jr., Dean of the School of Management and Labor Relations and Professor of Industrial Relations and Human Resources, SMLR; Ph.D., Michigan
Social insurance; employment law; collective bargaining
- Manoranjan Dutta, Professor of Economics, FAS-NB; Ph.D., Pennsylvania
U.S.-Asia economics; econometric models; macroeconomics—new perspectives
- Ira N. Gang, Associate Professor of Economics, FAS-NB; Ph.D., Cornell
Economic development
- Gary A. Gigliotti, Professor of Economics, FAS-NB; Ph.D., Columbia
Economic theory and social choice

- Norman Glickman, Director, Center for Urban Policy Research and State of New Jersey Professor of Urban Planning and Policy Research, EJBSPPP; Ph.D., Pennsylvania
Urban and regional economics
 - H. Peter Gray, Professor Emeritus of Economics; Ph.D., California
International finance
 - Mark R. Killingsworth, Professor of Economics, FAS-NB; D.Phil., Oxford
Labor and human resources; discrimination
 - Roger W. Klein, Professor of Economics, FAS-NB; Ph.D., Yale
Econometrics
 - Cheng-few Lee, Professor of Finance, SB-NB; Ph.D., SUNY (Buffalo)
Applying econometrics and economic theory in finance and accounting research
 - Peter D. Loeb, Professor of Economics, FAS-N; Ph.D., Rutgers
Applied econometrics and transportation economics
 - Richard P. McLean, Professor of Economics, FAS-NB; Ph.D., SUNY (Stony Brook)
Game theory and its applications
 - Mattiyahu Marcus, Professor of Economics, FAS-NB; Ph.D., Brown
Competition in regulated industries; cost of capital of public utilities
 - Bruce Mizrach, Associate Professor of Economics, FAS-NB; Ph.D., Pennsylvania
Macroeconomics; international finance; time series econometrics
 - Peter J. Parks, Associate Professor of Agricultural Economics, CC; Ph.D., California (Berkeley)
Environmental and resource economics; policy analysis; applied econometrics
 - Martin K. Perry, Professor of Economics, FAS-NB; Ph.D., Stanford
Vertical integration and controls; monopolistic competition
 - Carl E. Pray, Associate Professor of Agricultural Economics, CC; Ph.D., Pennsylvania
Technical change in LDC agriculture; science and technology policy
 - Thomas J. Prusa, Associate Professor of Economics, FAS-NB; Ph.D., Stanford
International trade; trade policy
 - Hugh T. Rockoff, Professor of Economics, FAS-NB; Ph.D., Chicago
American economic history
 - Jeffrey Rubin, Professor of Economics, FAS-NB; Ph.D., Duke
Health economics
 - Louise B. Russell, Professor of Economics, FAS-NB; Ph.D., Harvard
Economics of medical care; cost-effectiveness and cost-benefit analysis
 - Kazuo Sato, Professor of Economics, FAS-NB; Ph.D., Yale
Macroeconomic theory and international economics
 - Joseph J. Seneca, Professor of Economics, FAS-NB; University Vice President for Academic Affairs; Ph.D., Pennsylvania
Environmental economics; state and local economic policy
 - Neil Sheflin, Associate Professor of Economics, FAS-NB; Ph.D., Rutgers
Applied econometrics; financial economics
 - Sidney Simon, Professor Emeritus of Economics; Ph.D., New York
Business law; accounting; insurance
 - Leslie E. Small, Professor of Agricultural Economics, CC; Ph.D., Cornell
Irrigation management and agricultural development in Asia
 - Barry Sopher, Associate Professor of Economics, FAS-NB; Ph.D., Iowa
Experimental economics
 - Robert C. Stuart, Professor of Economics, FAS-NB; Ph.D., Wisconsin
Comparative economics systems
 - Shanti S. Tangri, Professor of Economics, FAS-NB; Ph.D., California (Berkeley)
Population; development; environmental economics
 - Michael K. Taussig, Professor Emeritus of Economics, FAS-NB; Ph.D., Massachusetts Institute of Technology
Income and wealth distributions
 - Hiroki Tsurumi, Professor of Economics, FAS-NB; Ph.D., Pennsylvania
Bayesian econometrics and statistical inference
 - Eugene N. White, Chairperson of the Department and Professor of Economics, FAS-NB; Ph.D., Illinois
Monetary and financial history
 - John D. Worrall, Professor of Economics, FAS-C; Ph.D., Rutgers
Labor supply; Workers' Compensation Insurance; economics of disability
- ### Associate Members of the Graduate Faculty
- Adesoji O. Adelaja, Associate Professor of Agricultural Economics, CC; Ph.D., West Virginia
Production economics; econometrics; economics of food firms; industrial organization; agricultural policy
 - Rosanne Altshuler, Assistant Professor of Economics, FAS-NB; Ph.D., Pennsylvania
Tax policy analysis
 - Sewin Chan, Assistant Professor of Economics, FAS-NB; Ph.D., Columbia
Public economics; household behavior
 - Simon J. Evenett, Assistant Professor of Economics, FAS-NB; Ph.D., Yale
International trade; industrial organization
 - Eric Friedman, Assistant Professor of Economics, FAS-NB; Ph.D., California (Berkeley)
Microeconomics, game theory, cost allocation learning
 - Jessie C. Hartline, Associate Professor of Economics, FAS-NB; Ph.D., Rutgers
Finance; international finance development; service sector productivity

Joseph P. Hughes, Associate Professor of Economics, FAS-NB; Ph.D., North Carolina
Microeconomic theory

Peter Ireland, Assistant Professor of Economics, FAS-NB; Ph.D., Chicago
Monetary theory and policy

Douglas L. Kruse, Associate Professor of Human Resource Management, SMLR; Ph.D., Harvard
Profit sharing; employee ownership; worker displacement; wage differentials

Jinpeng Ma, Assistant Professor of Economics, FAS-C; Ph.D., SUNY (Stony Brook)
Economic theory

Bartholomew J. Moore, Assistant Professor of Economics, FAS-NB; Ph.D., Columbia
Expectations and unemployment in macroeconomic theory

Oded Palmon, Associate Professor of Finance, SB-NB; Ph.D., Chicago
Public finance; applied microeconomics; corporate finance

Tito Pietra, Assistant Professor of Economics, FAS-NB; Ph.D., Pennsylvania
General equilibrium

Charles J. Romeo, Assistant Professor of Economics, FAS-NB; Ph.D., Duke
Bayesian econometrics; labor economics

Dominique Simard, Assistant Professor of Economics, FAS-NB; Ph.D., Queen's
Theories of macroeconomic fluctuations; international policy coordination

Yanni Tournas, Assistant Professor of Economics, FAS-N; Ph.D., Northwestern
Theory of the firm; information economics; industrial organization; bargaining theory

Francis G.M. Vella, Assistant Professor of Economics, FAS-NB; Ph.D., Rochester
Applied econometrics

Programs

The M.A. and Ph.D. are full-time day programs. Entering M.A. and Ph.D. students are expected to have a basic knowledge of calculus (differential and integral) and linear algebra, which are used in the basic microeconomics and statistics courses. Advanced Economic Statistics (16:220:506) is a required course, but entering students may satisfy the requirement by passing a proficiency examination. Courses 16:220:500, 501, 502, 503, 504, 505, 506, and 507 are prerequisites for each elective field course.

The M.A. program can be completed by fulfilling one of the following options: (1) 27 credits of course work and 3 credits of directed research leading to a master's essay. The oral examination in defense of the essay includes tests of economic theory and quantitative methods and serves as the comprehensive examination for the master's degree. Students in the M.A. program are required to take one term course each in microeconomic theory and macroeconomic theory and one course in statistical methods and two courses in econometrics. (2) Students who complete 30 credits and pass the theory portions of the Ph.D. qualifying examinations are eligible for the M.A. degree without writing a master's essay.

The Ph.D. program consists of course work, qualifying examinations, and the dissertation. The Ph.D. requires 48 credits of course work (sixteen courses). Students are not permitted to take more than four courses a term; thus course work for the Ph.D. requires at least two academic years to complete. Graduate and teaching assistants normally are not permitted to take more than three courses a term. The Master of Philosophy degree is available to doctoral candidates. Ph.D. students take two courses in mathematical methods, two courses in microeconomic theory and two courses in macroeconomic theory, 6 credits in statistical methods and econometrics, one course in economic history, and one course in either applied microeconometrics or macroeconometrics. The balance of the course of study is chosen with regards to the student's individual requirements. To ensure breadth of coverage, each Ph.D. student is required to take at least two courses in two elective fields offered in the program.

There are nine elective fields: economic theory, econometrics, economic history, monetary theory, public finance, development economics and economic systems, international economics, labor and human resources, and industrial organization.

The first part of the Ph.D. qualifying examination is a written test in microeconomic theory and macroeconomic theory. Students are expected to take this part after one year of course work. The second part of the qualifying exam consisting of exams in two elective fields must be taken within 18 months of successful completion of the microeconomic and macroeconomic theory examinations. A student who fails any written examination must retake it at the next examination period. (Examinations are given twice yearly.)

Within six months of successful completion of the Ph.D. written examinations, each student must submit a dissertation proposal for approval. The dissertation is written under the supervision of a faculty committee and must be defended in a final examination before the student's committee. A detailed guide for writing a dissertation proposal is available from the program director.

Graduate Courses

16:220:500. MATHEMATICAL METHODS FOR MICROECONOMICS (3)

Prerequisites: Background in calculus and linear algebra.
Basic mathematical tools for consumer and producer theory. Compact sets; differentiability; convex sets; separation theorems; constrained optimization and the Kuhn-Tucker theorem; applications in consumer and producer theory.

16:220:501. MICROECONOMIC THEORY I (3)

Prerequisite: 16:220:500 or permission of instructor.
General equilibrium theory; the Arrow-Debreu model, decision making under uncertainty; the Von-Neumann Morgenstern theory, risk aversion, applications to insurance problems and portfolio choice, applications to competitive equilibrium with uncertainty.

16:220:502. MICROECONOMIC THEORY II (3)

Prerequisite: 16:220:501.
Introduction to the theory of games and related economic models with informational asymmetries. Topics include noncooperative games and models of moral hazard and adverse selection.

16:220:503. MATHEMATICAL METHODS FOR MICROECONOMICS (3)

Prerequisites: Background in calculus and linear algebra.
Basic mathematical tools for dynamic economic models. Linear algebra from echelon form to projection operators; quadratic forms; linear difference and differential equations; dynamic programming and control theory; applications to dynamic models of macroeconomics; growth and human capital.

16:220:504. MACROECONOMIC THEORY I (3)

Prerequisite: 16:220:503 or permission of instructor.
Introduction to economic dynamics, economic growth, business cycles, and the role of macroeconomic policy.

16:220:505. MACROECONOMIC THEORY II (3)

Prerequisite: 16:220:504.
General equilibrium modeling of the macroeconomy. Topics include the stochastic growth model and multiple equilibrium. Empirical validation is stressed.

16:220:506. ADVANCED ECONOMIC STATISTICS (3)

Prerequisites: Background in calculus and linear algebra.
Background in statistical inferential procedures used in economic data analyses. Sampling theory and Bayesian viewpoints. Probability, random variables and distributions, estimation, testing hypotheses, and sampling distribution of estimators.

16:220:507. ECONOMETRICS I (3)

Prerequisite: 16:220:506 or equivalent.
Focus on measurement of economic parameters. Statistical estimation and inference of regression equation models. Properties of OLS, GLS, JGLS, 2SLS, 3SLS, and Maximum Likelihood Estimators. Introduction to time-series analysis and quantitative response models. Use of linear algebra and statistical packages. Emphasis is on theory.

16:220:508. ECONOMETRICS II (3)

Prerequisite: 16:220:507.
Estimation and testing in simultaneous equation systems. Multivariate methods and time series analysis. Bayesian inference in econometrics.

16:220:509. APPLIED ECONOMETRICS FOR MICROECONOMICS (3)

Prerequisite: 16:220:507 or permission of instructor.
Econometric tools for empirical microeconomic models. Parametric and nonparametric qualitative choice models; survival analysis. Recent papers discussed.

- 16:220:510. APPLIED ECONOMETRICS FOR MACROECONOMICS (3)
Prerequisite: 16:220:507 or permission of instructor.
Econometric tools for empirical macroeconomic time-series models. Exogeneity tests; spectral analysis; non-stationarity; state-space models; structural shifts and prediction. Recent papers discussed.
- 16:220:513. MONETARY THEORY (3)
Theories of the role of money in relation to the volume of economic activity and the price level.
- 16:220:514. STRUCTURE OF THE FINANCIAL SYSTEM (3)
The financial system and its relationship to the real sector, including portfolio theory, the term structure of interest rates, and other theoretical and empirical issues in finance.
- 16:220:515. PUBLIC ECONOMICS I (3)
Welfare theory, collective action, externalities, public goods, benefit-cost analysis, social welfare programs, social insurance.
- 16:220:516. PUBLIC ECONOMICS II (3)
Tax policy analysis. Optimal taxation; tax incidence analysis; the efficiency costs of taxation; and the measurement of the effects of taxation on economic behavior.
- 16:220:517. THE ECONOMICS OF THE STATE AND LOCAL PUBLIC SECTOR (3)
Economics of state and local governments. Evolution of federalism; expenditure and revenue decisions and intergovernmental grants; stabilization and distributional aspects of state/local finances. Several specific state/local problems.
- 16:220:518. INTERNATIONAL ECONOMICS I (3)
Major areas of trade theory, including comparative advantage theory, general equilibrium-factor endowments trade theory, and commercial policy. Recent developments, such as imperfect competition and uncertainty models of international trade theory.
- 16:220:519. INTERNATIONAL ECONOMICS II (3)
Theory of the balance of payments and balance-of-payments adjustment. International business cycles; international financial markets; current account and fiscal policy; sovereign debt. Issues in exchange rate regimes. International policy coordination. Growth in the international economy.
- 16:220:520. ECONOMICS OF THE LABOR MARKET (3)
Theory and evidence on labor supply, static and dynamic. Theory and evidence on labor demand. Wage differentials and unemployment. Applications to policy problems: economics of the welfare system; low-income labor markets. Economics of trade unions.
- 16:220:521. ECONOMICS OF HUMAN RESOURCES (3)
Analysis of advanced topics in labor economics, with emphasis on prospects for original research. Topics may include: investment in human capital; job search, matching, and turnover; labor contracts; race and sex discrimination; bargaining and strikes; economics of the family; population economics; unemployment; distribution of earnings.
- 16:220:522. INDUSTRIAL ORGANIZATION I (3)
Models of imperfect competition. Applications to price discrimination, vertical integration, product quality, advertising, and research and development. Strategic models of entry deterrence and contracting. Implications for antitrust policy. Empirical research on industry structure, conduct, and performance.
- 16:220:523. INDUSTRIAL ORGANIZATION II (3)
Natural monopoly and rate of return regulation. Optimal pricing including Ramsey, nonlinear, and peak-load pricing. Regulation models with uncertainty or asymmetric information. Regulation of price, entry, product quality, health, safety, and the environment. Empirical research on performance in regulated industries.
- 16:220:525. ECONOMIC SYSTEMS (3)
Analysis of differing economic systems with special emphasis on plan/market comparisons, performance, economic reform, and contemporary issues of transition.
- 16:220:526. ECONOMIC DEVELOPMENT I (3)
Problems of resource allocation for promoting economic growth and structural change in the context of poverty and inequality.
- 16:220:527. ECONOMIC DEVELOPMENT II (3)
Selected topics in contemporary development economics.
- 16:220:540. EUROPEAN ECONOMIC HISTORY (3)
Medieval economy; mercantilism; origins and spread of industrialization; world war and depression; economic integration.
- 16:220:541. AMERICAN ECONOMIC HISTORY (3)
The colonial economy; economics of slavery; industrialization; development of agriculture; banking and financial markets; the Great Depression; the role of government.
- 16:220:545. UNCERTAINTY AND IMPERFECT INFORMATION (3)
Blair, McLean. Prerequisite: 16:220:501.
Theory of choice under risk and uncertainty, risk aversion, stochastic dominance. Selected applications include contingent claims, rational expectations, screening, search, adverse selection, moral hazard, agency, common knowledge, and games of incomplete information.
- 16:220:546. TOPICS IN GAME THEORY (3)
Introduction to topics in noncooperative and cooperative game theory that are of relevance to economic problems.
- 16:220:547. THEORY OF SOCIAL CHOICE AND VOTING (3)
Selected problems in the design and economic analysis of voting systems. Emphasis on the role of voting institutions in various applied contexts in micro- and macroeconomics.
- 16:220:548. ADVANCED TOPICS IN MICROECONOMICS (3)
Topics chosen by instructor may include theory of optimal control, general equilibrium, natural resources, incomplete markets.
- 16:220:549. EXPERIMENTAL ECONOMICS (3)
Introduction to analysis by experimental methods of selected problems in economic theory, focusing on theory of individual choice under uncertainty and game theory, as well as bargaining theory, industrial organization, social choice theory, and financial markets.
- 16:220:602. SEMINAR IN ECONOMETRICS (3)
Statistical inference in econometrics from Bayesian and non-Bayesian points of view. Special topics may include inference on structural shifts, model selection, Kalman-filter models, and qualitative choice models.
- 16:220:603. SEMINAR IN MONETARY THEORY (3)
- 16:220:604. SEMINAR IN PUBLIC ECONOMICS (3)
Advanced topics with emphasis on the main current controversies in the field.
- 16:220:605. SEMINAR IN LABOR AND HUMAN RESOURCES (3)
Special topics. Topics have included economics of transfer programs, economics of health, economics of fertility.
- 16:220:606. SEMINAR IN INTERNATIONAL ECONOMICS (3)
- 16:220:607. SEMINAR IN ECONOMICS OF LATIN AMERICA (3)
- 16:220:608. SEMINAR IN ECONOMIC SYSTEMS (3)
Analysis of selected topics relating to the comparison of planned and market economic systems and related issues of transition.
- 16:220:609. SEMINAR IN ECONOMIC DEVELOPMENT (3)
Advanced topics in development economics emphasizing skills of modeling and estimation.

16:220:610. SEMINAR IN MICROECONOMICS (3)
Papers by students, faculty, and visiting scholars on topics selected by the seminar participants.

16:220:612. SEMINAR IN MACROECONOMICS (3)
Topics and controversies at the frontier of macroeconomics. Emphasis on development of analytical skills and use of empirical and theoretical tools.

16:220:613. SEMINAR IN APPLIED ECONOMETRICS (3)
Applied work in macroeconometrics and microeconometrics; use of data and standard statistical packages.

16:220:614. SEMINAR IN ECONOMIC HISTORY (3)
Selected topics in recent research in economic history.

16:220:620. INDIVIDUAL STUDIES IN ECONOMICS (3)

16:220:701,702. RESEARCH IN ECONOMICS (BA,BA)

EDUCATION (See the catalog of the Graduate School of Education for information about programs that lead to the degrees of Master of Education, Specialist in Education, and Doctor of Education.)

EDUCATIONAL POLICY

Program

Students completing master's degrees in economics, political science, or sociology may go on to an interdisciplinary Ph.D. in educational policy through a program arranged in cooperation with the Graduate School of Education and the Center for Educational Policy Analysis in New Jersey. The course of study, in addition to the aforementioned master's degrees, requires 6 credits in research methods and 15 credits in education. For further information, contact Professor William Firestone at the Graduate School of Education.

ELECTRICAL AND COMPUTER ENGINEERING 332

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor David Daut, 134 Electrical Engineering Building, Busch Campus (732/445-2578)

Members of the Graduate Faculty

Grigore C. Burdea, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., New York
Robotic complex sensors; assembly with task unknowns; compliance

Michael L. Bushnell, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Carnegie-Mellon
Computer engineering: computer-aided design of VLSI integrated circuits; silicon compilers; artificial intelligence techniques

David G. Daut, Professor of Electrical and Computer Engineering, CE; Ph.D., Rensselaer Polytechnic Institute
Communications and information processing: digital communication system design and analysis; image coding and transmission

James L. Flanagan, Board of Governors Professor of Electrical and Computer Engineering, CE; Ph.D., Massachusetts Institute of Technology
Speech and image processing; multimedia systems; parallel computing

Herbert Freeman, State of New Jersey Professor of Computer Engineering, CE; Eng. Sc.D., Columbia
Computer engineering: digital computer systems; computer architecture; image processing and graphics

Zoran R. Gajic, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Michigan State
Systems and control

David J. Goodman, Professor of Electrical and Computer Engineering, CE; Ph.D., Imperial College (London)
Wireless access to information networks

Jack M. Holtzman, Research Professor of Electrical and Computer Engineering, CE; Ph.D., Polytechnic Institute of Brooklyn
Telecommunications; wireless communications; performance analysis

Joseph Yu-Ngai Hui, Professor of Electrical and Computer Engineering, CE; Ph.D., Massachusetts Institute of Technology
Wireless information and broadband integrated networks, communications

Bogoljub Lalevic, Professor of Electrical and Computer Engineering, CE; Ph.D., Temple
Solid state electronics: gaseous and chemical semiconducting device sensors; high-power and microwave switching devices

Morton H. Lewin, Professor of Electrical and Computer Engineering, CE; Ph.D., Princeton
Computer engineering: digital logic and microprocessor system design; UNIX operating system

John K.-J. Li, Professor of Biomedical Engineering, CE; Ph.D., Pennsylvania
Circulatory dynamics; instrumentation; physiological control

Yicheng Lu, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Colorado
Metal-semiconductor contacts; thin dielectric films; VLSI processing

Richard Mammone, Professor of Electrical and Computer Engineering, CE; Ph.D., CUNY
Digital signal processing: image restoration; speech recognition; medical imaging

Thomas G. Marshall, Professor of Electrical and Computer Engineering, CE; Ph.D., Chalmers (Gothenburg)
Digital signal processing: algorithms and specialized signal processing computers

Sigrid R. McAfee, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Polytechnic Institute of New York
Solid-state electronics: deep levels in semiconductors; molecular beam epitaxy and MO-CVD Gallium Arsenide, AlGaAs, and GaAs on silicon

Peter Meer, Associate Professor of Electrical and Computer Engineering, CE; D.Sc., Technion (Israel)
Computer vision; image processing; pattern recognition

Evangelia Micheli-Tzanakou, Professor of Biomedical Engineering, CE; Ph.D., Syracuse
Visual pattern recognition; evoked potentials; image quality

Sophocles J. Orfanidis, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Yale
Adaptive signal processing; spectrum estimation; neural networks

Paul Panayotatos, Associate Professor of Electrical and Computer Engineering, CE; Eng. Sc.D., Columbia
Solid state electronics: organic semiconductor p-n heterojunction solar cells

Narindra N. Puri, Professor of Electrical and Computer Engineering, CE; Ph.D., Pennsylvania
Systems and controls: optimal adaptive control systems

Christopher Rose, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Massachusetts Institute of Technology
Dynamic behavior of multi-element networks: communications, neural, etc.

Peddapullaiah Sannuti, Professor of Electrical and Computer Engineering, CE; Ph.D., Illinois
Communication and control systems: singular perturbation analysis of Kalman filter with weak measurement noise

George K. Shoane, Professor of Biomedical Engineering, CE; Ph.D., California (Berkeley)
Binocular vision; vergence; accommodation model; amblyopia

Deborah E. Silver, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Princeton
Visualization; computer graphics; computational geometry; numerical analysis

Edwardo D. Sontag, Professor of Mathematics, FAS-NB; Ph.D., Florida
Linear and nonlinear control; neural networks; feedback design

Joseph Wilder, Research Professor of Electrical and Computer Engineering, CE; Ph.D., Pennsylvania
Image processing; pattern recognition; machine vision

Roy D. Yates, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Massachusetts Institute of Technology
Data networks; queueing; stochastic processes

Jian H. Zhao, Associate Professor of Electrical and Computer Engineering, CE; Ph.D., Carnegie-Mellon
Semiconductor heteroepitaxial growth and optoelectronic devices

Associate Members of the Graduate Faculty

Michael F. Caggiano, Assistant Professor of Electrical and Computer Engineering, CE; Ph.D., California (Los Angeles)
High performance and microwave IC device packaging

Sekhar Darbha, Assistant Professor of Electrical and Computer Engineering, CE; Ph.D., North Carolina State
Parallel computing; task scheduling for multiprocessor systems; load balancing and process migration

Stanley M. Dunn, Associate Professor of Biomedical Engineering, CE; Ph.D., Maryland
 Computer engineering: image processing; pattern recognition; machine vision; software engineering

Narayan B. Mandayam, Assistant Professor of Electrical and Computer Engineering, CE; Ph.D., Rice
 Communication theory; spread spectrum; wireless systems; multi-access protocols

Steve Petrucelli, Professor of Biomedical Engineering, CE; Ph.D., Rutgers
 Electronics: pulse circuits design and analysis; analytical instrumentation

Adjunct Member of the Graduate Faculty

Ravi P. Ramachandran, Visiting Professor of Electrical and Computer Engineering, CE; Ph.D., McGill
 Digital signal processing; speech analysis and coding; communication theory

Programs

The graduate program in electrical engineering has facilities for education and research in the following areas: computer engineering, control systems, digital signal processing, communications, and solid-state electronics. Computer engineering involves the architecture and design of computing machines, information processing, and software engineering. Control systems is concerned with the design, analysis, simulation, and mathematical modeling of systems to assure that an automatic process, e.g., robot or spacecraft, meets and maintains certain criteria. Digital signal processing deals with discrete-time information processing, digital filter design, spectral analysis, and special-purpose signal processors. Electrical communications systems analysis and design is concentrated in the areas of source and channel encoding, analog and digital modulation methods, information theory, and telecommunication networks. Wireless communications and wireless information networks focus on analysis, measurement, and simulations. Solid state electronics encompasses the areas of microwave switching devices, semiconductor lasers, electro-optical modulation, solar cells, integrated circuits, and characterization of semiconductor materials and devices. This broad base of research areas provides students with the flexibility to tailor individual programs of study.

Students with a B.S. degree from an accredited electrical engineering school may apply for direct admission to the graduate program. Students with backgrounds in other concentrations, such as physics, mathematics, computer science, and engineering programs other than electrical engineering are required to pass certain prerequisite undergraduate courses in electrical engineering. Students from electrical technology programs may be required to take a number of undergraduate courses in addition to the graduate program requirements. The Graduate Record Examination general test is required for admission to the program.

Masters of Science degree candidates may elect either a thesis or nonthesis option. The thesis option consists of 24 credits of course work, 6 credits of research in a specialized area, and a final thesis presentation. In the nonthesis option, a candidate must complete 30 credits of course work, pass a written comprehensive examination, and submit a satisfactory tutorial paper. The M.S. comprehensive examination is given twice a year.

Requirements for the M.S. degree may be satisfied for all options in a part-time evening program designed specifically for students employed in industry and other students whose obligations preclude full-time study. Admission and academic standards for part-time students are the same as for full-time students. This arrangement makes it possible for students to combine day and evening schedules simultaneously or at different periods in their academic careers. Students completing the requirements for the M.S. degree or the Ph.D. degree are also eligible for the Certificate in Wireless Communications; see the Wireless Communications subject heading for further information and requirements for this certificate.

Admission into the Ph.D. program requires an M.S. degree in electrical engineering. Applicants having an M.S. degree in a closely related discipline may be admitted into the doctoral program provided their preparation has no significant deficiencies. Students are considered to be Ph.D. candidates after satisfactory completion of the qualifying examination and presentation of their dissertation

topic. The Ph.D. qualifying examination normally consists of four preliminary oral exams, a major oral exam, and a thesis proposal presentation. The oral qualifying examination is generally given twice a year. A Ph.D. candidate, in conjunction with an adviser, is required to select a dissertation committee, submit a plan of study, and orally present a dissertation proposal.

Minimum requirements for the Ph.D. degree include 48 credits beyond the baccalaureate degree in courses approved by the dissertation adviser, in addition to 24 credits of dissertation research beyond the M.S. degree. A public defense serves as the final Ph.D. dissertation examination. There is no foreign language requirement. The residence requirement depends upon the area of specialization. The Master of Philosophy degree is available to doctoral candidates.

Graduate Courses

16:332:501. (F) SYSTEM ANALYSIS (3)

Fundamental system concepts, solution of linear differential and difference equations. Transform methods involving Fourier and Laplace transforms, double-sided Laplace transforms, Z-transforms, Hilbert transforms, convolution in time and frequency domain. Complex variables and application of Residue Theorem for transform inversion. Review of matrix algebra involving similarity transformations. Cayley-Hamilton theorem; state space concepts, controllability, observability, minimal realization.

16:332:503,504. ELECTRIC NETWORK THEORY I, II (3,3)

Prerequisite: 16:332:501.

Network synthesis of driving point and transfer impedances using Foster, Bott-Duffin, Brune, and Darlington techniques; topological methods for analysis of active and passive networks; flow-graph techniques; state-space formulation of general networks; computer-aided network design.

16:332:505. (S) CONTROL SYSTEM THEORY I (3)

Prerequisite: 16:332:501.

Transform theory and transfer function concepts; Nyquist and Bode plots. Nyquist and Hurwitz criterion of stability and design techniques involving Hall and Nichols charts. Design of compensating networks via root locus technique. State-space formulation of control systems. Definition of stability in time domain for general systems; methods of finding stability constraints. Discrete systems; z-transforms; difference equations; stability criterion.

16:332:506. (F) CONTROL SYSTEM THEORY II (3)

Prerequisite: 16:332:505.

Review of state-space techniques; transfer function matrices; concepts of controllability, observability, and identifiability. Identification algorithms for multivariable systems; minimal realization of a system and its construction from experimental data. State-space theory of digital systems. Design of a three-mode controller via spectral factorization.

16:332:508. (S) SAMPLED DATA CONTROL SYSTEMS (3)

Prerequisite: 16:332:505.

Methods of analysis and synthesis of discrete time systems; various transformations and semigraphical techniques applied to both digital and digitally controlled continuous processes with deterministic and/or random signals.

16:332:510. (S) SYNTHESIS OF OPTIMUM CONTROL SYSTEMS (3)

Prerequisites: 16:332:505,506.

Formulation of both deterministic and stochastic optimal control problems. Various performance indices; calculus of variations; derivation of Euler-Lagrange and Hamilton-Jacobi equations and their connection to two-point boundary value problems, linear regulator and the Riccati equations. Pontryagin's maximum principle, its application to minimum time, minimum fuel, and bang-bang control. Numerical techniques for Hamiltonian minimization. Bellman dynamic programming; maximum principle and invariant imbedding.

- 16:332:512. (S) NONLINEAR AND ADAPTIVE CONTROL THEORY (3)
Prerequisite: 16:332:505.
Nonlinear servo systems; general nonlinearities; describing function and other linearization methods; phase plane analysis and Poincare theorems. Liapunov's method of stability; Popov criterion; circle criterion for stability. Adaptive and learning systems; identification algorithms and observer theory; input adaptive, model reference adaptive, and self-optimizing systems. Estimation and adaptive algorithms via stochastic approximation. Multivariable systems under uncertain environment.
- 16:332:514. (S) STATISTICAL DESIGN OF AUTOMATIC CONTROL SYSTEMS (3)
Prerequisite: 16:332:505.
Response of linear and nonlinear systems to random inputs. Determination of statistical character of linear and nonlinear filter outputs. Correlation functions; performance indices for stochastic systems; design of optimal physically realizable transfer functions. Wiener-Hopf equations; formulation of the filtering and estimation problems; Wiener-Kalman filter. Instabilities of Kalman filter and appropriate modifications for stable mechanization. System identification and modeling in presence of measurement noise.
- 16:332:519. ADVANCED TOPICS IN SYSTEMS ENGINEERING (3)
Prerequisite: Permission of instructor.
Advanced study of various aspects of automatic control systems. Possible topics include identification, filtering, optimal and adaptive control, learning systems, digital and sampled data implementations, singular perturbation theory, large-scale systems, game theory, geometric control theory, and control of large flexible structures. Topics vary from year to year.
- 16:332:521. (F) DIGITAL SIGNALS AND FILTERS (3)
Corequisite: 16:332:501.
Sampling and quantization of analog signals; z-transforms; digital filter structures and hardware realizations; digital filter design methods; DFT and FFT methods and their application to fast convolution and spectrum estimation; introduction to discrete-time random signals.
- 16:332:525. (F) OPTIMUM SIGNAL PROCESSING (3)
Prerequisite: 16:332:521; or permission of instructor.
Block processing and adaptive signal processing techniques for optimum filtering, linear prediction, signal modeling, and high-resolution spectral analysis. Lattice filters for linear prediction and Wiener filtering. Levinson and Schur algorithms and their split versions. Fast Cholesky factorizations. Periodogram and parametric spectrum estimation and superresolution array processing. LMS, RLS, and lattice adaptive filters and their applications. Adaptation algorithms for multilayer neural nets.
- 16:332:526. (S) ROBOTIC SYSTEMS ENGINEERING (3)
Introduction to robotics; robot kinematics and dynamics. Trajectory planning and control. Systems with force, touch, and vision sensors. Telemanipulation. Programming languages for industrial robots. Robotic simulation examples.
- 16:332:527. (S) DIGITAL SPEECH PROCESSING (3)
Prerequisite: 16:332:521.
Acoustics of speech generation; perceptual criteria for digital representation of audio signals; signal processing methods for speech analysis; waveform coders; vocoders; linear prediction; differential coders (DPCM, delta modulation); speech synthesis; automatic speech recognition; voice-interactive information systems.
- 16:332:529. (S) IMAGE CODING AND PROCESSING (3)
Prerequisites: 16:332:521, 16:642:550. Recommended: 16:332:535.
Visual information, image restoration, coding for compression and error control, motion compensation, advanced television.
- 16:332:533. (S) COMPUTATIONAL METHODS FOR SIGNAL RECOVERY (3)
Prerequisites: 16:332:521, 541.
Linear shift varying systems; discrete constrained estimation techniques; applications in image restoration; image reconstruction; spectral estimation and channel equalization using decision feedback.
- 16:332:535. (F) MULTIREOLUTION SIGNAL PROCESSING ALGORITHMS (3)
Prerequisite: 16:332:521 or permission of instructor. Corequisite: 16:642:550.
Algebraic models and algorithms, sampling lattices, multiresolution transforms, filters, rate conversion, deconvolution and projection.
- 16:332:539. ADVANCED TOPICS IN DIGITAL SIGNAL PROCESSING (3)
Prerequisite: Permission of instructor.
Emphasis on current research areas. Advanced treatment of such topics as digital filter design, digital filtering of random signals, discrete spectral analysis methods, and digital signal processor architectures.
- 16:332:541. (F) STOCHASTIC SIGNALS AND SYSTEMS (3)
Corequisite: 16:332:501.
Axioms of probability; conditional probability and independence; random variables and functions thereof; mathematical expectation; characteristic functions; conditional expectation; Gaussian random vectors; mean square estimation; convergence of a sequence of random variables; laws of large numbers and Central Limit Theorem; stochastic processes, stationarity, autocorrelation, and power spectral density; linear systems with stochastic inputs; linear estimation; independent increment, Markov, Wiener, and Poisson processes.
- 16:332:542. (S) INFORMATION THEORY AND CODING (3)
Prerequisite: 16:332:541.
Noiseless channels and channel capacity; entropy, mutual information, Kullback-Leibler distance, and other measures of information; typical sequences, asymptotic equipartition theorem; prefix codes, block codes, data compression, optimal codes, Huffman, Shannon-Fano-Elias, arithmetic coding; memoryless channel capacity, coding theorem and converse; Hamming, BCH, cyclic codes; Gaussian channels and capacity; coding for channels with input constraint; introduction to source coding with a fidelity criterion.
- 16:332:543. (F) COMMUNICATION NETWORKS I (3)
Prerequisite: 14:332:349 or equivalent.
Introduction to telephony and integrated networks. Multiplexing schematics. Circuit and packet switching networks. Telephone switches and fast packet switches. Teletraffic characterization. Delay and blocking analysis. Queuing network analysis.
- 16:332:544. (S) COMMUNICATION NETWORKS II (3)
Prerequisite: 16:332:543.
Network and protocol architectures. Layered connection management, including network design, path dimensioning, dynamic routing, flow control, and random access algorithms. Protocols for error control, signaling, addressing, fault management, and security control.
- 16:332:545. (S) COMMUNICATION THEORY (3)
Prerequisite: 16:332:541.
Orthonormal expansions, effect of additive noise in electrical communications, vector channels, waveform channels, matched filters, band width, and dimensionality. Optimum receiver structures, probability of error, bit and block signaling, introduction to coding techniques.
- 16:332:547. (F) DIGITAL COMMUNICATIONS I (3)
Prerequisite: 16:332:545.
The functional characterization of digital signals and transmission facilities, band-limited and time-limited signals, modulation and demodulation techniques for digital signals, error probability, intersymbol interference and its effects, equalization and optimization of baseband binary and M-ary signaling schemes. Application to satellite and space communication systems emphasized.

16:332:548. (S) DIGITAL COMMUNICATIONS II (3)

Prerequisite: 16:332:547. Corequisite: 16:332:542.

Continuation of 16:332:547. Application of information-theoretic principles to communication system analysis and design. Source and channel coding considerations, rudiments of rate-distortion theory. Probabilistic error control coding impact on system performance. Introduction to various channel models of practical interest, spread spectrum communication fundamentals. Current practices in modern digital communication system design and operation.

16:332:549. (S) DETECTION AND ESTIMATION THEORY (3)

Prerequisite: 16:332:541.

Statistical decision theory, hypothesis testing, detection of known signals and signals with unknown parameters in noise, receiver performance and error probability, applications to radar and communications. Statistical estimation theory, performance measures and bounds, efficient estimators. Estimation of unknown signal parameters, optimum demodulation, applications. Linear estimation, Wiener filtering, Kalman filtering.

16:332:551. (S) FADING COMMUNICATION CHANNELS (3)

Prerequisite: 16:332:548.

The characterization and modeling of fading and/or dispersive channels, analog and digital communication system performance, diversity reception, optimum demodulators for channel memory effects. Applications include troposcatter, HF, atmospheric scattering, and optical channels. Emphasis on analysis of space communication and optical communication system performance.

16:332:553. (S) WIRELESS ACCESS TO INFORMATION NETWORKS (3)

Prerequisites: 14:332:349, 450; or equivalent.

Cellular mobile radio; cordless telephones; systems architecture; network control; switching; channel assignment techniques; short-range microwave radio propagation; wireless information transmission including multiple access techniques, modulation, source coding, and channel coding.

16:332:555. (F) MICROWAVE CIRCUITS: DESIGN AND ENGINEERING (3)

Prerequisite: 16:332:580 or equivalent.

Overview of modern microwave engineering including transmission line, network analysis, integrated circuits, diodes, amplifier and oscillator design.

16:332:556. (S) MICROWAVE SYSTEMS (3)

Prerequisite: 16:332:580 or equivalent.

Microwave subsystems including front-end and transmitter components, antennas, radar, terrestrial communications, and satellites.

16:332:559. ADVANCED TOPICS IN COMMUNICATIONS ENGINEERING (3)

Prerequisite: Permission of instructor.

Topics such as source and channel coding, modern modulation techniques, telecommunication networks, and information processing.

16:332:560. (F) COMPUTER GRAPHICS (3)

Computer display systems, algorithms, and languages for interactive graphics. Vector, curve, and surface generation algorithms. Hidden-line and hidden-surface elimination. Free-form curve and surface modeling. High-realism image rendering.

16:332:561. (F) MACHINE VISION (3)

Prerequisite: 16:332:501.

Image processing and pattern recognition. Principles of image understanding. Image formation, boundary detection, region growing, texture, and characterization of shape. Shape from monocular cues, stereo, and motion. Representation and recognition of 3-D structure.

16:332:562. (S) VISUALIZATION AND ADVANCED COMPUTER GRAPHICS (3)

Prerequisite: 16:332:560.

Advanced visualization techniques, including volume representation, volume rendering, ray tracing, composition, surface representation, advanced data structures. User interface design, parallel and object-oriented graphic techniques, advanced modeling techniques.

16:332:563. (F) COMPUTER ARCHITECTURE I (3)

Fundamentals of computer architecture using quantitative and qualitative principles. Instruction set design with examples and measurements of use, basic processor implementation: hardwired logic and microcode, pipelining; hazards and dynamic scheduling, vector processors, memory hierarchy; caching, main memory and virtual memory, input/output, and introduction to parallel processors; SIMD and MIMD organizations.

16:332:564. (S) COMPUTER ARCHITECTURE II (3)

Prerequisite: 16:332:563.

Implementation of computer architecture at the circuit level. Introduction to computer hardware description languages. Computer arithmetic, microcoding; horizontal, vertical, and two-level, finite-state control and asynchronous state machines, data-path design, memories; SRAMs, DRAMs, FIFOs, busses; asynchronous and synchronous protocols, I/O devices; disks, networks, terminals, transmission lines.

16:332:565. (F) NEUROCOMPUTER SYSTEM DESIGN (3)

Prerequisite: 16:332:563.

Principles of neural-based computers, data acquisition, hardware architectures for multilayer, tree, and competitive learning neural networks, applications in speech recognition, machine vision, target identification, and robotics.

16:332:566. (S) PARALLEL COMPUTER DESIGN (3)

Prerequisites: 16:332:563, 564.

Supercomputer architectures; pipelined and vector processors; parallel processors; structures and algorithms for vector and parallel computers; shared and distributed memory architectures; data flow architectures; application-oriented architectures.

16:332:567. (F) SOFTWARE ENGINEERING I (3)

Overview of software development process. Formal techniques for requirements analysis, system specification, and system testing. Distributed systems, system security, and system reliability. Software models and metrics. Case studies.

16:332:568. (S) SOFTWARE ENGINEERING II (3)

Prerequisite: 16:332:567.

Program development and software design methodologies. Abstract data types, information hiding, program documentation. Program testing and reusability. Axiomatic and functional models. Case studies.

16:332:569. (F) DATABASE SYSTEM ENGINEERING (3)

Relational data model, relational database management system, relational query languages, parallel database systems, database computers, and distributed database systems.

16:332:570. (S) ROBUST COMPUTER VISION (3)

Prerequisite: 16:332:561.

A toolbox of advanced methods for computer vision, using robust estimation, clustering, probabilistic techniques, invariance. Applications include feature extraction, image segmentation, object recognition, and 3-D recovery.

16:332:571. VIRTUAL REALITY TECHNOLOGY (3)

Prerequisite: 16:332:560.

Introduction to virtual reality. Input/output tools. Computing architecture. Modeling. Virtual reality programming. Human factors. Applications. Future systems.

16:332:574. COMPUTER-AIDED DIGITAL VLSI DESIGN (3)
Advanced computer-aided digital VLSI chip design, CMOS technology, domino logic, precharged busses, case studies of chips, floor planning, layout synthesis, routing, compaction circuit extraction, multilevel circuit simulation, circuit modeling, fabrication processes and other computer-aided design tools.

16:332:575. (S) VLSI ARRAY PROCESSORS (3)

Prerequisite: 16:332:574.

VLSI technology and algorithms; systolic and wavefront array architecture; bit-serial pipelined architecture; DSP architecture; transputer; interconnection networks; wafer-scale integration; neural networks.

16:332:576. TESTING OF ULTRA LARGE SCALE CIRCUITS (3)

Prerequisite: 16:332:563.

Algorithms for test-pattern generation for combinational, sequential, and CMOS circuits. Design of circuits for easy testability. Design of built-in self-testing circuits.

16:332:579. ADVANCED TOPICS IN COMPUTER ENGINEERING (3)

Prerequisite: Permission of instructor.

In-depth study of topics pertaining to computer engineering, such as microprocessor system design; fault-tolerant computing; real-time system design. Subject areas vary from year to year.

16:332:580. ELECTRIC WAVES AND RADIATION (3)

Prerequisite: Elementary electromagnetics.

Static boundary value problems, dielectrics, wave equations, propagation in lossless and lossy media, boundary problems, waveguides and resonators, radiation fields, antenna patterns and parameters, arrays, transmit-receive systems, antenna types.

16:332:581. INTRODUCTION TO SOLID-STATE ELECTRONICS (3)

Introduction to quantum mechanics; WKB method; perturbation theory; hydrogen atom; identical particles; chemical bonding; crystal structures; statistical mechanics; free-electron model; quantum theory of electrons in periodic lattices.

16:332:583. (F) SEMICONDUCTOR DEVICES I (3)

Charge transport, diffusion and drift current, injection, lifetime, recombination, and generation processes, p-n junction devices, transient behavior, FET's, I-V, and frequency characteristics, MOS devices C-V, C-f, and I-V characteristics, operation of bipolar transistors.

16:332:584. (S) SEMICONDUCTOR DEVICES II (3)

Prerequisite: 16:332:583.

Review of microwave devices, O- and M-type devices, microwave diodes, Gunn, IMPATT, TRAPATT, etc., scattering parameters and microwave amplifiers, heterostructures and III-V compound-based BJTs and FETs.

16:332:587. (F) TRANSISTOR CIRCUIT DESIGN (3)

Design of discrete transistor circuits; amplifiers for L.F., H.F., tuned, and power applications biasing; computer-aided design; noise; switching applications; operational amplifiers; linear circuits.

16:332:588. (S) INTEGRATED TRANSISTOR CIRCUIT DESIGN (3)

Prerequisite: 16:332:587.

Design of digital integrated circuits based on NMOS, CMOS, bipolar, BiCMOS and GaAs FETs; fabrication and modeling; analysis of saturating and nonsaturating digital circuits, sequential logic circuits, semiconductor memories, gate arrays, PLA and GaAs LSI circuits.

16:332:590. (S) INTEGRATED CIRCUITS (3)

Prerequisite: 16:332:583.

Basic processing of IC's, diffusion, and ion implantation; isolation methods; integrated resistors and inductors; junction capacitors; diodes, FET, MOS and bipolar transistors; thermal effects and basic linear integrated circuits.

16:332:591. (F) OPTO-ELECTRONICS I (3)

Prerequisites: 16:332:580, and 581 or 583.

Principles of laser action, efficiency, CW and pulse operation, mode locking, output coupling, equivalent circuits, gaseous and molecular lasers, solid-state lasers, single and double heterojunction lasers, different geometrics, fabrication, degradation, and application to holography, communication, medicine, and fusion.

16:332:592. (S) OPTO-ELECTRONICS II (3)

Prerequisite: 16:332:591.

Photodetectors including avalanche, Schottky, p-i-n, and multi-element detectors; display devices including semiconductor, liquid crystals, electrochromics, electroluminescent panels; optoisolators; fiber optics communication and opto-electronics in information systems.

16:332:594. (F) SOLAR CELLS (3)

Prerequisite: 16:332:583 or equivalent.

Photovoltaic material and devices, efficiency criteria, Schottky barrier, p-n diode, heterojunction and MOS devices, processing technology, concentrator systems, power system designs, and storage.

16:332:596. (S) SEMICONDUCTOR SURFACES (3)

Surface composition and structure of semiconductor, ultra-high vacuum technology, Auger electron spectroscopy, low-energy electron diffraction, photoemission spectroscopy, secondary ion mass-spectroscopy.

16:332:597. (S) MATERIAL ASPECTS OF SEMICONDUCTORS (3)

Prerequisite: 16:332:581.

Preparation of elemental and compound semiconductors. Bulk crystal growth techniques. Epitaxial growth techniques. Impurities and defects and their incorporation. Characterization techniques to study the structural, electrical, and optical properties.

16:332:599. ADVANCED TOPICS IN SOLID-STATE ELECTRONICS (3)

Prerequisite: Permission of instructor.

Topics vary and include semiconductor materials, surfaces, and devices; opto-electronic devices; sensors; photovoltaics; fiber optics; and analog/digital circuit design.

16:332:601,602. SPECIAL PROBLEMS (BA,BA)

Prerequisite: Permission of instructor.

Investigation in selected areas of electrical engineering.

16:332:618. SEMINAR IN SYSTEMS ENGINEERING (1)

Presentation involving current research given by advanced students and invited speakers. Term papers required.

16:332:638. SEMINAR IN DIGITAL SIGNAL PROCESSING (1)

Presentation involving current research given by advanced students and invited speakers. Term papers required.

16:332:658. SEMINAR IN COMMUNICATIONS ENGINEERING (1)

Presentation involving current research given by advanced students and invited speakers. Term papers required.

16:332:678. SEMINAR IN COMPUTER ENGINEERING (1)

Presentation involving current research given by advanced students and invited speakers. Term papers required.

16:332:698. SEMINAR IN SOLID-STATE ELECTRONICS (1)

Presentation involving current research given by advanced students and invited speakers. Term papers required.

16:332:701,702. RESEARCH IN ELECTRICAL ENGINEERING (3,3)

ENGLISH, LITERATURES IN (English 350, American Literature 352)

Degree Programs Offered: Master of Arts, Doctor of Philosophy

Director of Graduate Program: Professor Derek Attridge,
Murray Hall, College Avenue Campus (732/932-7674)

Members of the Graduate Faculty

Derek Attridge, Professor of English, FAS-NB; Ph.D., Cambridge
Literary theory; modernism; poetics

Louise K. Barnett, Professor of English, FAS-NB; Ph.D., Bryn Mawr
Nineteenth- and twentieth-century American novel; nineteenth-century American
culture; women's studies

Emily Bartels, Associate Professor of English, FAS-NB; Ph.D., Harvard
Renaissance dramatic literature; colonialist discourse

John H. Belton, Professor of English, FAS-NB; Ph.D., Harvard
Cinema studies; cultural studies

Paul Bertram, Professor of English, FAS-NB; Ph.D., Harvard
Renaissance drama and literature

Wesley C. Brown, Professor of English, FAS-NB; M.A., CUNY
Nineteenth- and twentieth-century American literature; modern drama

Abena P.A. Busia, Associate Professor of English, FAS-NB; D.Phil., Oxford
African-American and African diaspora literature

Elaine Chang, Assistant Professor of English, FAS-NB; Ph.D., Stanford
Twentieth-century Anglophone novel; postcolonial studies; women's studies

Maurice Charney, Professor of English, FAS-NB; Ph.D., Princeton
Renaissance drama; comedy

Christine Chism, Assistant Professor of English, FAS-NB; Ph.D., Duke
Medieval literature, medieval drama, women's studies, cultural
studies, historiography

Ed Cohen, Associate Professor of English, FAS-NB; Ph.D., Stanford
Literary and social theory; gay and gender studies; late Victorian culture

Ann Baynes Coiro, Associate Professor of English, FAS-NB; Ph.D., Maryland
Renaissance and seventeenth-century literature; women's studies

Anne Cotterill, Assistant Professor of English, FAS-NB; Ph.D., Washington
Early modern English literature; Renaissance women writers; poetics

Susan Crane, Professor of English, FAS-NB; Ph.D., California (Berkeley)
Medieval studies; cultural studies; women's studies

Alice C. Crozier, Associate Professor of English, FAS-NB; Ph.D., Harvard
American literature

Harriet A. Davidson, Associate Professor of English, FAS-NB; Ph.D., Vanderbilt
Modern and contemporary poetry; critical theory

Marianne DeKoven, Professor of English, FAS-NB; Ph.D., Stanford
Modernism; women's studies

Elin Diamond, Professor of English, FAS-NB; Ph.D., California (Davis)
Drama and dramatic theory; feminist and literary theory

William C. Dowling, Professor of English, FAS-NB; Ph.D., Harvard
Eighteenth-century literature; colonial-American literature and literature of the
early American republic; critical theory

Brent Edwards, Assistant Professor of English, FAS-NB; Ph.D., Columbia
African-American literature; Francophone literature; twentieth-century poetry
of the Americas; music and literature; cultural studies

Katherine Ellis, Associate Professor of English, FAS-NB; Ph.D., Columbia
Women's studies; eighteenth-century fiction

Sandy Flitterman-Lewis, Associate Professor of English, FAS-NB; Ph.D.,
California (Berkeley)
Cinema studies; feminist critical analysis

William H. Galperin, Professor of English, FAS-NB; Ph.D., Brown
Romantic literature; literary theory; media studies

Donald Gibson, Professor of English, FAS-NB; Ph.D., Brown
American and African-American literature

James Guetti, Professor of English, FAS-NB; Ph.D., Cornell
American literature; language, philosophy, and literary theory

Daniel Harris, Professor of English, FAS-NB; Ph.D., Yale
Victorian and modern literature; Jewish studies

Marjorie Howes, Associate Professor of English, FAS-NB; Ph.D., Princeton
Anglo-Irish and modern British literature; critical theory

Marcia Ian, Associate Professor of English, FAS-NB; Ph.D., Virginia
Modern British and American literatures; critical theory; the novel

Virginia Jackson, Assistant Professor of English, FAS-NB; Ph.D., Princeton
Theory and history of lyric; nineteenth-century American poetry and culture;
history of literary criticism; feminist theory

Myra Jehlen, Board of Governors Professor of Literature and Culture, FAS-NB;
Ph.D., California (Berkeley)
American literature; feminist criticism; cultural history

Samira Kawash, Assistant Professor of English, FAS-NB; Ph.D., Duke
Nineteenth- and twentieth-century minority and African-American literature;
literary and cultural theory; race and ethnicity

George Kearns, Professor of English, FAS-NB; Ph.D., Boston
Modernism

Jonathan Brody Kramnick, Assistant Professor of English, FAS-NB; Ph.D.,
Johns Hopkins
Renaissance and eighteenth-century literature and culture; history of criticism;
Marxist and post-Marxist cultural theory

Daphne Lamothe, Assistant Professor of English, FAS-NB; Ph.D., Princeton
African-American fiction; Black Atlantic culture and theories of migration;
ethnography; folk culture

Ronald Levao, Associate Professor of English, FAS-NB; Ph.D.,
California (Berkeley)
English Renaissance literature and intellectual history

George Levine, Kenneth Burke Professor of English, FAS-NB/CCACC;
Ph.D., Minnesota
Victorian literature; literature and science

Bridget Gellert Lyons, Professor of English, FAS-NB; Ph.D., Columbia
Renaissance literature

Marc K. Manganaro, Associate Professor of English, FAS-NB; Ph.D.,
North Carolina (Chapel Hill)
Modern literature/literary theory and anthropology; folklore and myth

John A. McClure, Professor of English, FAS-NB; Ph.D., Stanford
Contemporary American fiction; colonial and postcolonial discourse

Meredith L. McGill, Assistant Professor of English, FAS-NB; Ph.D.,
Johns Hopkins
Nineteenth-century American literature, the history of the book, American poetry

Michael McKeon, Board of Governors Professor of English, FAS-NB;
Ph.D., Columbia
Seventeenth- and eighteenth-century literature

Jacqueline T. Miller, Associate Professor of English, FAS-NB; Ph.D.,
Johns Hopkins
Renaissance literature

Richard Miller, Assistant Professor of English, FAS-NB; Ph.D., Pittsburgh
Composition; pedagogy; cultural studies

Alicia Ostriker, Professor of English, FAS-NB; Ph.D., Wisconsin
Romantic, modern, and contemporary poetry; women's studies

Richard Poirier, Marius Bewley Professor of English, FAS-NB; Ph.D., Harvard
American and modern literature; criticism

Barry V. Qualls, Professor of English, FAS-NB; Ph.D., Northwestern
Victorian literature

Bruce Robbins, Professor of English, FAS-NB; Ph.D., Harvard
Literary theory; Marxism; cultural studies

Judylyn Ryan, Assistant Professor of English, FAS-NB; Ph.D., Wisconsin
African diaspora literatures; black women's literature

Larry Scanlon, Associate Professor of English, FAS-NB; Ph.D., Johns Hopkins
Medieval studies; cultural studies; literary theory

Carol H. Smith, Professor of English, FAS-NB; Ph.D., Michigan
Modern literature; women's studies

Kurt Spellmeyer, Associate Professor of English, FAS-NB; Ph.D., Washington
Composition and rhetoric; seventeenth-century literature

Patricia L. Tobin, Associate Professor of English, FAS-NB; Ph.D., Pittsburgh
The novel; critical theory

William Vesterman, Associate Professor of English, FAS-NB; Ph.D., Rutgers
Eighteenth-century and American literature

Cheryl Wall, Professor of English, FAS-NB; Ph.D., Harvard
American and African-American literature; women's studies

William Walling, Professor of English, FAS-NB; Ph.D., New York
English romantics

Michael D. Warner, Professor of English, FAS-NB; Ph.D., Johns Hopkins
Colonial and nineteenth-century American literature; queer theory; social theory

Andrew Welsh, Associate Professor of English, FAS-NB; Ph.D., Pittsburgh
Old English and medieval studies; poetry

Carolyn S. Williams, Associate Professor of English, FAS-NB; Ph.D., Virginia
Victorian literature; women's studies; cultural studies

Associate Members of the Graduate Faculty

Robert Barton, Associate Professor of English, FAS-NB; Ph.D., Stanford
Medieval studies

Richard Quaintance, Jr., Associate Professor of English, FAS-NB; Ph.D., Yale
Eighteenth-century literature

Programs

The M.A. and Ph.D. programs are open to students with outstanding academic records and other evidence of critical and scholarly talents. Applications for September admission to the New Brunswick programs must be completed by January 20. Students who have already earned an M.A. degree at another institution are welcome to apply for admission to the Ph.D. program.

The principal aim of the master's program is to ensure that students have a historically, culturally, and intellectually broad foundation in literary studies as a basis for more concentrated work in the Ph.D. program. Because the two programs are integrally related, only students intending to proceed to the doctoral program

are eligible for admission to the master's program. For students continuing on to the Ph.D., attainment of the M.A. degree comes with the completion of 30 credits of graduate study and the foreign language requirement. For the minority of students who do not proceed to the doctoral program, the M.A. degree is attained by successfully completing 30 credits including the distribution requirements, 16:350:517 Critical Reading, the foreign language requirement, and a written master's examination.

Eight 3-credit courses are required specifically for the M.A. degree, in addition to two 1.5-credit courses (16:350:517 Critical Reading and 16:350:518 Introduction to Advanced Research) and the expository writing requirement (16:352:552 Teaching Writing: Theory and Practice). Six of the eight courses must be taken to satisfy the M.A. distribution requirements. The remaining two courses are electives. The distribution requirements fall into three general types. First, students must choose at least one course in four of the following five categories: (1) medieval studies, (2) Renaissance studies, (3) Restoration and Enlightenment studies (British) or Puritan and colonial studies (American), (4) nineteenth-century studies, (5) twentieth-century studies. Second, students must choose at least one course in theory, defined for these purposes as courses whose central study is of texts in literary and critical theory and philosophy rather than of literary texts. Third, students must choose at least one course whose central study is of a significant body of literature traditionally neglected in academic curricula. This category would include courses in African-American/African diaspora literature, writing by women, ethnic studies, gay and lesbian writing, popular culture, and working-class literature. In addition, all students are required to take, among their courses at the M.A. level, at least one course in American literature. In all cases, students' selections of courses are made in close consultation with their advisers.

The Ph.D. requires 48 credits of course work (at least fourteen courses) including the course work done for the M.A. degree and 6 credits of supervised reading and study in preparation for the qualifying examination. The normal full-time course load is three courses per term. Part-time study is also permitted. Of the courses required in the graduate program three are specific course requirements. All students are required to take 16:352:552 Teaching Writing: Theory and Practice for credit if they intend to teach at any stage of their tenure in the graduate program or as an audit if they do not teach. All students are also required to take two 1.5-credit courses that together equal one full course of the required fourteen: 16:350:517 Critical Reading in their first term of graduate work and 16:350:518 Introduction to Advanced Research, which may be taken as early as their second or as late as their sixth term of study. Each 1.5-credit course may be taken on top of the normal three-course per term course load.

Graduate courses in the 500 series are designed to treat subjects that are important to graduate English literary studies, in a way that makes the material accessible to sophisticated students who may have had no college experience of it. The 600-level concentration seminars allow more advanced and concentrated work in more particularized areas of study.

The foreign language requirement for either the M.A. or Ph.D. degree is formulated so as to emphasize the relationship between the knowledge of foreign languages and the study of literature. Students are asked to apply to take a written exam on a language of their choice (subject to approval by the Graduate Foreign Language Committee). As far as possible, students should choose a language they anticipate will be relevant to their eventual areas of concentration. Students will be urged to take the exam as soon as possible, but in any case before the conclusion of their course work.

The Ph.D. qualifying examination consists of two hours of oral questioning in four concentration categories: (1) a chronological period or periods, (2) a form or discursive tradition, (3) a methodological procedure(s) or theoretical framework(s), (4) an author or authors. A central purpose of the exam, that it provide an occasion for specialized and concentrated study, is served by the coextensive or overlapping nature of the four chosen concentration categories. However, the exam also aims to test the student's knowledge of the broader terrain of the four categories (the other productions of the period(s) and author(s), the larger history of the form or discourse, the wider implications and applications of the method or theory).

Within three months of the Ph.D. qualifying exam, the student submits a dissertation prospectus to the prospective dissertation director. Once students fulfill the language and course requirements, pass the qualifying examination, and submit a dissertation proposal approved by the students' dissertation committee, which consists of three members of the program's faculty and one outside reader, they are admitted to candidacy for the Ph.D. degree. After the completed dissertation has been approved by the dissertation committee for submission to defense, the student participates in a one- to two-hour defense with the committee.

All applicants are strongly urged to contact the Graduate Program in Literatures in English for further information, including information about financial assistance and fuller details of the program structure (given in the booklet *The Graduate Program in Literatures in English*), by calling or writing to the Graduate Program in Literatures in English, Rutgers, The State University of New Jersey, Murray Hall, New Brunswick, NJ 08903 (732/932-7674).

Graduate Courses (350)

16:350:501,502. INDIVIDUAL STUDIES IN BRITISH AND AMERICAN LITERATURE (3,3)

An independent study course in directed readings available only by special arrangement.

16:350:507. STUDIES IN FICTION (3)

Tobin, McClure, Robbins, McKeon, Chang

Types of narrative—the tale, legend, romance, epic—and their relation to the novel.

16:350:508. CRITICAL THEORY (3)

Attridge, Davidson, Manganaro, Robbins, Cohen, Howes

Study of twentieth-century critical debates in America and Europe: new criticism, Marxist theory, structuralism, and deconstruction.

16:350:510. STUDIES IN DRAMATIC FORM (3)

Charney, Diamond

Studies in types of comedy, tragedy, and history, with emphasis on English dramatists.

16:350:511. TECHNIQUE IN ENGLISH POETRY (3)

Ostriker, Vesterman, Attridge

A study of expressive conventions in poetry from the Renaissance to modern times. Prosody, diction, metaphor, structure.

16:350:512. THE CRITICISM OF POETRY (3)

Davidson, Kearns, Attridge

Problems in the reading and interpretation of poetry. Introduces students to critical theory by testing various approaches against the practice of particular poets or groups of poets.

16:350:513. HISTORY OF THE ENGLISH LANGUAGE (3)

Scanlon, Chism

The nature of language; the course of phonemic change; history of English syntax; grammatical approaches, semantic processes.

16:350:514. LITERATURE AND POLITICS (3)

McClure, Howes, Robbins, Kawash

A study of literary texts directly connected to political debate and of critical theories, especially Marxist criticism, generated by the intersection of politics and literary form.

16:350:515. MYTH AND LITERATURE (3)

Welsh, Manganaro

Recurrences and transformation of mythic motifs in selected works of British and American literature; some attention to theories of myth.

16:350:516. TEXTS AND CRITICAL ISSUES IN MODERNISM (3)

Kearns, DeKoven, Diamond, Davidson, Attridge, Manganaro

Technical innovation, critical positions, and concerns of writers such as Eliot, Joyce, Yeats, Woolf, Stein, and Pound, with some attention to nineteenth-century influences.

- 16:350:517. CRITICAL READING (1.5)
Various ways of reading texts, with attention to the history and theory of modes of reading from “new criticism” to poststructuralism.
- 16:350:518. INTRODUCTION TO ADVANCED RESEARCH (1.5)
Methods and resources for research in literary criticism, textual criticism, and related historical and cultural topics.
- 16:350:526. LITERARY CRITICISM: THE MAJOR TEXTS (3)
Welsh, Robbins
A study of conventions and recurrent problems in critical discourse from Aristotle to the present. Emphasis on generic theory and on criticism as a unique form of rhetoric.
- 16:350:527. PSYCHOANALYTIC CRITICISM (3)
Tobin, Ian
The uses of Freudian and other psychoanalytical vocabularies for describing literary responses; emphasis on critical analysis of selected nineteenth- and twentieth-century literary works.
- 16:350:529,530. OLD ENGLISH (3,3)
Welsh
First term: introduction to Old English grammar, with readings from selected texts. Second term: Beowulf.
- 16:350:532. CHAUCER (3)
Crane, Scanlon, Chism
Major works of Geoffrey Chaucer, including Troilus and Criseyde and the Canterbury Tales, in relation to late medieval culture.
- 16:350:535. TEXTS AND CRITICAL ISSUES IN MEDIEVAL LITERATURE (3)
Crane, Scanlon, Welsh, Chism
Introduction to medieval studies through major Old and Middle English works, with attention to medieval and contemporary critical approaches.
- 16:350:536. STUDIES IN MEDIEVAL LITERATURE (3)
Welsh, Scanlon, Chism
Relations between English medieval literature and other literatures such as classical and continental; literary relations with other disciplines such as folklore, history, and anthropology.
- 16:350:539. TEXTS AND CRITICAL ISSUES IN RENAISSANCE LITERATURE (3)
Coiro, Levao, Bartels, Charney, J. Miller
Major writers of the sixteenth and early seventeenth centuries approached through modern critical ideas of form, genre, convention, theme, and style.
- 16:350:540. RENAISSANCE LITERATURE: TEXTS AND CONTEXTS (3)
Lyons, Coiro, Bartels
Major texts read against the social, cultural, philosophical, and literary history of the Renaissance period. Studies, for example, of Paradise Lost, or The Faerie Queene, or selected plays of Shakespeare in conjunction with a range of related documents, literary and otherwise.
- 16:350:541,542. FORMS OF RENAISSANCE LITERATURE (3,3)
J. Miller, Lyons, Coiro, Levao
Studies in literary forms that gave expression to major themes in the sixteenth and early seventeenth centuries; heroic, pastoral, satirical, tragic, comic.
- 16:350:543. DRAMA IN THE AGE OF SHAKESPEARE (3)
Charney, Bertram, Bartels
Readings from selected Tudor and Stuart playwrights.
- 16:350:545. SHAKESPEARE (3)
Bertram, Bartels, Levao
General study of Shakespeare’s works.
- 16:350:551,552. WRITERS OF THE ENGLISH RENAISSANCE (3,3)
Lyons, J. Miller, Bartels, Coiro, Levao
Intensive study of one or two major writers of the period.
- 16:350:554. MILTON (3)
Coiro, Lyons, Levao
Milton’s poetry and selected prose.
- 16:350:556. AGE OF DRYDEN (3)
McKeon
A study of the poetry and drama that marks the reestablishment of the Stuart court: Dryden, Rochester, Marvell, Butler, Etherege, Farquhar, Wycherley, Congreve, and others.
- 16:350:557. RESTORATION AND EIGHTEENTH-CENTURY DRAMA (3)
Charney
Restoration comedy, tragedy, heroic play, and dramatic criticism; eighteenth-century survivals and transformations.
- 16:350:559. TEXTS AND CRITICAL ISSUES IN EIGHTEENTH-CENTURY LITERATURE (3)
Dowling, McKeon, Ellis
The main modes, actions, and styles in eighteenth-century writing.
- 16:350:562. EIGHTEENTH-CENTURY LITERATURE: TEXTS AND CONTEXTS (3)
McKeon, Dowling, Ellis, Barash
The relation of major works by a single author to the literary, social, and cultural terms of the period. A different author studied each year.
- 16:350:565. TEXTS AND CRITICAL ISSUES IN ENGLISH FICTION 1700–1820 (3)
McKeon
The emergence of prose fiction as a literary genre and its evolution into a complex and self-conscious form: Defoe, Richardson, Fielding, Sterne, Smollett, Scott, Jane Austen.
- 16:350:566. TEXTS AND CRITICAL ISSUES IN ENGLISH FICTION 1800–1900 (3)
Levine, Qualls, Williams, Robbins
Readings in selected novels and novelists from about 1800 to 1900, drawing especially on the works of Scott, Dickens, Thackeray, the Brontës, George Eliot, James.
- 16:350:568. THE FRENCH REVOLUTION AND ENGLISH ROMANTICISM (3)
Walling, Galperin
English literature from late Burke to early Carlyle, studied from the perspective of the French Revolution. Emphasis on the major English poets of the period.
- 16:350:569. TEXTS AND CRITICAL ISSUES IN ENGLISH ROMANTICISM (3)
Walling, Galperin
The revolt against tradition and the redefinition of poetry and the poet.
- 16:350:570. THE ENGLISH ROMANTICS: TEXT AND CONTEXT (3)
Walling, Galperin
The development and diversity of new poetic methods and identities, considered in their historical and cultural context.
- 16:350:571. TEXTS AND CRITICAL ISSUES IN VICTORIAN LITERATURE (3)
Harris, Levine, Qualls, Williams, Cohen, Howes
A study of the major preoccupations and styles of the period in nonfiction, poetry, and the novel. Larger emphasis on nonfiction, poetry, and the effects of external historical and social developments on the literature.
- 16:350:572. VICTORIAN LITERATURE: TEXTS AND CONTEXTS (3)
Levine, Williams, Cohen, Qualls
Studies in major Victorian essays, novels, and poems in the context of religious, scientific, and social developments of the time, and of the journalism, nonfiction, biographical, and autobiographical works that may help illuminate their modes and meanings.

- 16:350:574. TEXTS AND CRITICAL ISSUES IN VICTORIAN POETRY (3)
Harris, Williams, Howes
Emphasis on major figures and topics. Tennyson, Barrett Browning, Browning, Arnold; the principal Pre-Raphaelites; Thomas Hardy and early Yeats. Toward a Victorian poetics; the persistence and permutations of romanticism; poetry versus science; the poet's role in culture and society.
- 16:350:576. TEXTS AND CRITICAL ISSUES IN VICTORIAN PROSE (3)
Levine, Williams
Nonfictional prose of major Victorian and early modern writers, including Carlyle, Mill, Macaulay, Ruskin, Arnold, Pater, Morris, and Wilde.
- 16:350:578. IDEAS OF COMMUNITY IN BRITISH LITERATURE (3)
Walling, Howes
Nineteenth- and early twentieth-century works from Wordsworth and Austen to Orwell and Shaw that create or redefine the character of the British social and cultural community.
- 16:350:579. LATE VICTORIAN AND EDWARDIAN LITERATURE (3)
Williams, Cohen
A study of aesthetic and philosophical developments: Pater, Meredith, Hardy, Conrad, Wells, Beerbohm, and others.
- 16:350:581. THE MINORITY PLACE IN LITERATURE (3)
Gibson, Wall, Busia, Kawash
The study of central texts of English and American literature from the perspective of minorities and non-Western people.
- 16:350:583. MAJOR BRITISH FICTION OF THE TWENTIETH CENTURY (3)
McClure, Kearns
- 16:350:584. GENDER AND POWER IN VICTORIAN ENGLAND (3)
Williams
Study of the relationships between gender representations in political and literary writing and female experience in Victorian England.
- 16:350:585. TEXTS AND CRITICAL ISSUES IN MODERN DRAMA (3)
Diamond, Brown
Major works in the modern dramatic tradition, concentrating on Ibsen, Strindberg, Chekhov, Shaw, and O'Neill.
- 16:350:586. EARLY TWENTIETH-CENTURY POETRY (3)
Davidson, Harris, Kearns, Smith
Hardy, Yeats, Pound, Eliot, Stevens, and others.
- 16:350:588. LATER TWENTIETH-CENTURY POETRY (3)
Kearns, Davidson, Smith
A study of continuity and change in the poetry of the mid-twentieth century. Focus on the interpretation of work by several pivotal figures. Contextual readings in biography, social history, and the poet's other writings.
- 16:350:601,602. READINGS IN BRITISH AND AMERICAN LITERATURE (BA,BA)
Intensive reading in any period of English and American literature in preparation for the Ph.D. qualifying examination.
- 16:350:605. SEMINAR: NINETEENTH-CENTURY AUTOBIOGRAPHY (3)
Williams
The aesthetic and generic characteristics of autobiography, its relation to other genres, and its illumination of the psychology of literary creation.
- 16:350:620. SEMINAR: CHAUCER (3)
Crane, Welsh, Scanlon
Chaucer's works and issues for research: history of criticism, theoretical frameworks, relations between Chaucer and his late medieval milieu.
- 16:350:625. SEMINAR: MEDIEVAL LITERATURE (3)
Welsh, Scanlon
Works of writers other than Chaucer; topics such as advanced Old English language and literature, the Arthurian tradition, Middle English dialects, women mystics, lyric poetry, medieval literary theory.
- 16:350:626. SEMINAR: MEDIEVAL ROMANCE (3)
Crane
English and continental works, such as Sir Gawain and the Green Knight, Malory's *Le Morte d'Arthur*, and the *Romance of the Rose* considered in generic terms as well as from other perspectives such as historicist, feminist, and poststructuralist.
- 16:350:629. SEMINAR: SPENSER AND HIS CONTEMPORARIES (3)
Levao, J. Miller, Coiro
Study of the poetry and related criticism.
- 16:350:634. SEMINAR: ELIZABETHAN DRAMATIC CONVENTIONS (3)
Charney, Bertram, Lyons, Bartels
Aspects of form in Elizabethan drama, with some attention to Shakespeare. Staging, dramatic structure, conventions of character, the interplay of verbal and nonverbal symbolism.
- 16:350:636. SEMINAR: SHAKESPEARE (3)
Lyons, Bertram, Charney, Levao, Bartels
Selected poems and plays; readings in related materials.
- 16:350:642. SEMINAR: JONSON AND DONNE (3)
Miller, Coiro, Lyons
Poems of Donne; poems and comedies of Jonson.
- 16:350:651. SEMINAR: EIGHTEENTH-CENTURY PROSE (3)
Dowling, McKeon
A study of motives, conventions, styles, and cultural contexts with emphasis on politics and rhetoric—Swift, Pope, Johnson, and their contemporaries.
- 16:350:652. SEMINAR: EIGHTEENTH-CENTURY FICTION (3)
McKeon, Ellis
Studies in Defoe, Fielding, Richardson, Sterne, Austen, and their contemporaries.
- 16:350:653. SEMINAR: BLAKE (3)
Ostriker
A study of Blake's styles, aesthetics, ideas, myths, and symbols; some attention to his influence.
- 16:350:654. SEMINAR: EIGHTEENTH-CENTURY LITERARY CRITICISM AND THEORY (3)
Dowling, McKeon
The major critical writings of Dryden, Addison, Johnson, and Reynolds; classical and continental backgrounds; the emergence of post-Augustan theories of imagination.
- 16:350:656. SEMINAR: DRAMATIC MONOLOGUE: HISTORY AND THEORY (3)
Harris
The evolution of the genre, from Coleridge, Tennyson, and Browning through Yeats and Woolf; the social and poetic theory that informs its operation.
- 16:350:661. SEMINAR: ENGLISH ROMANTIC POETS (3)
Galperin
Critical study of two or more romantic poets in the context of the British and continental romantic movement.
- 16:350:663. SEMINAR: WORDSWORTH AND COLERIDGE (3)
Walling, Galperin
Critical study of the major works, with some significant attention devoted to the relationship of Wordsworth and Coleridge to each other as well as to their differing critical concepts.

16:350:664. SEMINAR: WORDSWORTH (3)

Galperin

An extended exploration of the poetry and prose of William Wordsworth, with particular attention to the major lyrics, the literary criticism, and the differing versions of *The Prelude*.

16:350:665. SEMINAR: JANE AUSTEN (3)

McKeon, Galperin, Walling, Ellis

The novels of Jane Austen considered in the contexts of eighteenth-century literature and social history, and of Victorian and modern criticism of fiction.

16:350:666. SEMINAR: BYRON AND SHELLEY (3)

Galperin, Walling

The most important expressive achievements and problems in the major poetry of Byron and Shelley; consideration of the biographical and critical works of their personal and literary relationship.

16:350:676. STUDIES IN VICTORIAN NONFICTION PROSE (3)

Levine, Cohen, Williams

Examines in depth the work of one or more nineteenth-century prose writers: Carlyle, Mill, Newman, Darwin, Arnold, Ruskin, Pater; or focuses on the relation of nonfiction prose writing to the historical and cultural situations of the period; or examines the ways Victorian prose participates in—articulates, challenges, is complicit with—ideologies that dominate the work of the period. Examination of this prose in the context of critical and theoretical discussions of prose writing by such critics as Bakhtin, LaCapra, Fish, Levine, and others.

16:350:678. STUDIES IN VICTORIAN POETRY (3)

Harris

Study of one or more of the major Victorian poets—Tennyson, Barrett Browning, Browning, Arnold, Christina Rossetti, the Pre-Raphaelites, Hardy, Hopkins; or of significant issues of genre and form: the dramatic monologue, the novel in verse, the attempts at elegy and epic; or of the relation of selected poetry or poets to the historical and cultural situations that produced it.

16:350:681. SEMINAR: THE AESTHETIC TRADITION: 1850–1914 (3)

Cohen, Williams

Aestheticism as a reaction against Victorianism and an outgrowth of it; its transmutations in *fin de siècle* and symbolist art; its influence both thematically and stylistically on some twentieth-century novelists.

16:350:684. STUDIES IN VICTORIAN FICTION (3)

Qualls, Williams, Levine

A study of one or more of the major writers—Scott, Dickens, Thackeray, the Brontës, George Eliot, Hardy; or of major movements in Victorian fiction: the historical novel, the writers and the novel, popular fiction; or of the novel in conjunction with other significantly related genres in the period: the long poem, history, biography; or of the Victorian novel in relation to current theoretical work on narrative.

16:350:685. SEMINAR: YEATS AND THE IRISH RENAISSANCE (3)

Howes

Study of the poetry, prose, and plays.

16:350:686. SEMINAR: THE IRISH LITERARY COMMUNITY (3)

Howes

Yeats, Synge, Joyce, and others, considered in their cultural, social, and artistic contexts.

16:350:687. SEMINAR: MODERN ENGLISH FICTION (3)

Kearns, McClure, Robbins

The development of modern English fiction in relation to the developments within the novel form that were moving it from nineteenth-century realism to modernism.

16:350:688. SEMINAR: VIRGINIA WOOLF AND THE BLOOMSBURY GROUP (3)

DeKoven, McClure, Smith

The major works of Virginia Woolf and E.M. Forster in the intellectual and political contexts of the Bloomsbury group.

16:350:691. SEMINAR: JAMES JOYCE (3)

Attridge, Smith

Joyce's fiction; related materials in classical and English literature.

16:350:693. SEMINAR: FICTION AND NARRATIVE THEORY (3)

Robbins, McKeon, Chang

The novel as genre considered in its relations both to other narrative forms, e.g., biography, psychological case history, ethnography, and to the interdisciplinary theory of narrative.

16:350:697. LITERARY CRITICISM AND SOCIAL CRITIQUE (3)

McClure, McKeon, Robbins, Kawash, Howes

16:350:698. SEMINAR: CONTEMPORARY CRITICISM AND ITS FORERUNNERS (3)

Attridge, Guetti, Poirier, Robbins

Emerson, Nietzsche, the Jameses, Stevens, Leavis, Lukacs, Frye, Bachelard, Poulet, Barthes, Kermode, Bloom, Hartman, Derrida, and others.

16:350:701,702. RESEARCH IN LITERATURE (BA,BA)

Graduate Courses in American Literature, Women's Studies, Film Studies, Composition (352)

16:352:509. TEXTS AND CRITICAL ISSUES IN AMERICAN LITERATURE (3)

Crozier, Warner, Jehlen, McGill

A limited number of major American writers of common historical background and intellectual temper.

16:352:511. AMERICAN LITERATURE TO 1855 (3)

Dowling, Warner, Jehlen, Barnett, McGill

Selected colonial and early nineteenth-century writers, with special emphasis on modern scholarship, criticism, and intellectual history.

16:352:512. AMERICAN LITERATURE: 1855–1900 (3)

Gibson, Poirier, Brown, Barnett

Writings of the last half of the nineteenth century, with some extension into the twentieth.

16:352:515. ANGLO-AMERICAN LITERARY RELATIONS (3)

Poirier, Ian, DeKoven, McGill

Exploration of the similarities between British and American literature in order to discover reasons for the comparative uniqueness of each. Close comparisons of specific texts.

16:352:522. MAJOR FICTION OF TWENTIETH-CENTURY AMERICA (3)

Vesterman, Crozier, Guetti, Brown, Barnett

16:352:527. HISTORY AND CRITICISM OF FILM (3)

Flitterman-Lewis, Belton

The development of film as an art form; film technique; theoretical and practical criticism.

16:352:528. SPECIAL STUDIES IN FILM (3)

Belton, Flitterman-Lewis

Examination of a selected topic in film studies such as women and film, literature and film, or film and society.

16:352:529. AFRICAN-AMERICAN WRITERS AND AMERICAN LITERATURE (3)

Gibson, Wall, Busia, Ryan, Kawash

The work of various black American writers read in conjunction with other examples of American literature of the twentieth century.

16:352:551. THEORY OF COMPOSITION (3)

Spellmeyer, R. Miller

Recent theories of the composition process, with attention to invention, arrangement, and style; theories of syntax and error analysis. Emphasis on application in teaching composition.

16:352:552. TEACHING WRITING: THEORY AND PRACTICE (3)
Spellmeyer, R. Miller
The teaching of writing in English courses and in other academic disciplines. New theories of rhetoric and their relevance to the development of curriculum and the improvement of pedagogy. The relationship between critical reading and effective writing.

16:352:553. READINGS IN CLASSICAL AND MODERN THEORIES OF RHETORIC (3)
Robbins. See also courses offered by the Graduate School of Education: 15:252:515 Language in Education and 15:252:518 Topics in English Education.
Basic texts in the rhetorical tradition from Aristotle to the twentieth century; the use of these theories in the teaching of literature.

16:352:583. INTRODUCTION TO THE STUDY OF WOMEN WRITERS (3)
Ostriker, Williams, DeKoven, Smith, Howes, Ellis
The feminine experience as recorded in works by Brontë, Eliot, Woolf, Lessing, Morrison, Plath, and others.

16:352:584. GENDER AND POWER IN VICTORIAN ENGLAND (3)
Williams, Cohen
Study of the relationships between gender representations in political and literary writing and female experience in Victorian England.

16:352:613. EMERSON AND AMERICAN LITERATURE (3)
Poirier
Studies of the recurrence in American literature of Emerson's theories, images, and problems of expression.

16:352:667. SEMINAR: COLONIAL AND EARLY NINETEENTH-CENTURY AMERICAN LITERATURE (3)
Jehlen, Warner, Dowling, McGill
Study of selected works and related scholarship.

16:352:670. SEMINAR: MELVILLE (3)
Guetti
The rhetoric of self and culture in the writings of Melville; chronological reading of the works.

16:352:672. SEMINAR: NINETEENTH-CENTURY AMERICAN FICTION (3)
Gibson, Jehlen, McGill
Critical problems and cultural contexts: Irving, Cooper, Poe, Hawthorne, Stowe, Melville, Davis, Alcott, Twain, Howell, James. Consideration of American romance, of gothic and Puritan influences, of influence of English fiction.

16:352:677. SEMINAR: WHITMAN AND DICKINSON (3)
Crozier, Gibson, McGill
Form and vision in "Leaves of Grass"; Whitman's influence on modern poets of the "open form." Technical brilliance and eccentricity in Dickinson's poems; conflicts between self and culture.

16:352:681. AMERICAN LITERARY WOMEN: CATHER, GLASGOW, WHARTON, STEIN (3)
Crozier
A study of the achievement of four women writers in the context of the literary and social environment in which they worked.

16:352:689. SEMINAR: HENRY JAMES (3)
Poirier, Ian
A study of the novels and criticism.

16:352:690. SEMINAR: T.S. ELIOT (3)
Harris, Keams, Smith, Davidson
A study of the poetry, prose, and plays.

16:352:692. SEMINAR: AMERICAN WRITERS (3)
Poirier, Warner, Jehlen
Intensive study of selected American author(s) with attention to primary texts, literary contexts, biography.

16:352:695. SEMINAR: MODERN AMERICAN POETRY (3)
Smith, Ostriker, Davidson
Study of poets who have particularly influenced contemporary American poets; readings of poets since 1945.

16:352:699. SEMINAR: WALLACE STEVENS (3)
Poirier
A thorough examination of Stevens's poetry, with some attention to his prose and letters.

ENGLISH AS A SECOND LANGUAGE 356

Director of the English as a Second Language Program: Dr. Kathleen Lynch-Cutchin, 107 Tillett Hall, Livingston Campus (732/445-7422)

Members of the Full-time Faculty

Gwendolyn Cooper, M.A.
Ajunta Dutt, Ed.D.
Marian Eberly, M.A.
Kathleen Lynch-Cutchin, Ph.D.
Eva-Maria Morin, M.A.
William Roney, M.A.
Gail Rottweiler, Ed.D.
Virginia Schirripa, M.A.
Paul Sprachman, Ph.D.
Michael Wherrity, M.A.

Program

The English as a Second Language program provides instruction in English as a Second Language (ESL) to graduate students who are in need of improving their English language proficiency. Placement in all courses is by proficiency test or by subsequent assessment. All courses carry institutional credit toward full-time status for visa and financial aid requirements; however, these course credits cannot be applied toward degree requirements.

Graduate Courses

16:356:512. ESL INDEPENDENT STUDY (EBA)

16:356:531. ESL ACADEMIC WRITING I (E3)
Writing course emphasizing the composing and revising process and addressing selected grammatical problems through error analysis.

16:356:532. ESL ACADEMIC WRITING II (E3)
Advanced writing course culminating in coherent and cohesive research paper.

16:356:539. ESL WRITING CENTER (EBA)
Weekly writing tutorial focusing on improving academic writing and addressing grammatical errors.

16:356:541. ESL SPEECH CENTER (EBA)
Weekly listening/speaking tutorial focusing on improving listening, pronunciation, and speaking skills.

16:356:551. ESL SPEECH WORKSHOP I (IN)
Focuses on improving listening, pronunciation, and speaking skills through classroom and language laboratory practice.

16:356:552. ESL SPEECH WORKSHOP II (IN)
Concentrates on refining listening, speaking, and pronunciation skills through classroom and language laboratory practice.

16:356:557. ESL EFFECTIVE ORAL COMMUNICATION (E3)
Develops verbal and nonverbal communication knowledge and skills.

16:356:558. ESL EFFECTIVE PRESENTATION (E3)
Develops communicative competence through the experience of presenting before a group.

16:356:560. ESL INTERNATIONAL TA PHONOLOGY (E3)
Focuses on distinguishing essential sounds, developing appropriate stress and intonation patterns, and improving listening skills.

16:356:561. ESL INTERNATIONAL TA LANGUAGE SKILLS (E3)
Introduces international teaching assistants to teaching methodology, as well as the linguistic, discourse, and cultural components of effective communication; provides practice by teaching to peers.

ENTOMOLOGY 370

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Donald F. Caccamise,
Room 202, J.B. Smith Hall, Cook Campus (732/932-9774)

Members of the Graduate Faculty

Lena B. Brattsten, Professor of Entomology, CC; Ph.D., Illinois
Insect biochemistry and toxicology; molecular aspects of insect-plant associations
Donald F. Caccamise, Chairperson of Department and Professor of Entomology, CC; Ph.D., New Mexico State
Ecology, behavior
Timothy M. Casey, Professor of Ecology and Evolution, CC; Ph.D., California (Los Angeles)
Physiological ecology; energetics and thermoregulation
Wayne J. Crans, Professor of Entomology, CC; Ph.D., Rutgers
Mosquito biology; medical and veterinary entomology; epidemiology of disease transmission
Randy Gaugler, Professor of Entomology, CC; Ph.D., Wisconsin
Invertebrate pathology; parasitology; biological control
Gerald M. Ghidui, Extension Entomologist, CC; Ph.D., Iowa State
Vegetable insect pests
Ayodhya P. Gupta, Professor of Entomology, CC; Ph.D., Idaho
Hemocytic and humoral immunity; morphology; physiology
Karl Kjer, Assistant Professor of Entomology, CC; Ph.D., Minnesota
Taxonomy, insect molecular systematics, molecular phylogenetics, aquatic insects
James H. Lashomb, Professor of Entomology, CC; Ph.D., Maryland
Applied insect ecology; parasitic insect population dynamics; plant-herbivore interactions
Karl Maramorosch, Robert L. Starkey Professor, CC; Ph.D., Columbia
Insect pathology; virology; cell culture
Michael L. May, Associate Professor of Entomology, CC; Ph.D., Florida
Physiological and behavioral ecology of insects
Sridhar Polavarapu, Assistant Extension Specialist, CC; Ph.D., New Brunswick (Canada)
Blueberry and cranberry insect management

Associate Members of the Graduate Faculty

George C. Hamilton, Assistant Extension Specialist in Pesticides, CC; Ph.D., Rutgers
Applied insect ecology; parasitic insect population dynamics; plant-herbivore interactions; pesticide applicator training; pesticide impact assessment
Farida Mahmood, Research Associate, Entomology, CC; Ph.D., Florida
Physiology, ecology, and genetics of insects of medical and veterinary importance
Peter W. Shearer, Assistant Extension Specialist, CC; Ph.D., Hawaii
Integrated pest management for tree fruits, insect ecology, natural enemies, and alternative pest management options
Paula Shrewsbury, Assistant Extension Specialist, CC; Ph.D., Maryland
Integrated pest management and ecology of ornamental and turf insects pests

Adjunct Members of the Graduate Faculty

Richard K. Jansson, Senior Research Fellow, Merck and Co., Inc.; Ph.D., Pennsylvania State
Insect pest management
Joan A. LaSota, Manager, Merck and Co., Inc.; Ph.D., Virginia Polytechnic Institute
Insect pest management

Programs

The doctoral program normally requires 48 credits of course work and 24 credits of research. No foreign language is required. Ordinarily, two full research terms in residence are required, but this requirement may be waived by petition to the program faculty. The master's with thesis degree requires 24 credits of course work and 6 credits of research. The master's nonthesis degree may be awarded with the substitution of classes and essay in the place of the thesis on recommendation by the student's adviser and the advisory committee. The graduate program in entomology also publishes an Academic Guide for Graduate Students, which explains requirements and is available on request.

Graduate Courses

16:370:504. (S) MOSQUITO BIOLOGY (3)
Crans. Lec. 2 hrs., lab. 3 hrs. Prerequisite: Permission of instructor.
The biology, physiology, and behavior of mosquitoes on a world-wide basis; emphasis on current techniques used in field and laboratory investigations.

16:370:506. (S) INTEGRATED PEST MANAGEMENT (3)
Lashomb. Prerequisite: A background in entomology or other pest sciences and ecology. Recommended: Statistics. Students who lack background in these areas must obtain permission from the instructor.

A systems approach for measuring major ecological processes, such as development, mortality, and dispersal, presented as a means for evaluating pheromones, biocontrol, and cultural and pesticidal strategies in major crops.

16:370:507. (S) BIOLOGICAL CONTROL OF INSECT PESTS (3)
Gaugler. Prerequisite: General ecology.
The concepts and methods involved in the control of harmful insects and mites through the use of parasites, predators, and pathogens.

16:370:511. (F) PRINCIPLES OF SYSTEMATIC ENTOMOLOGY (3)
Kjer. Lec. 2 hrs., lab. 3 hrs.
Taxonomy, species concepts, methods of contemporary systematic research, and zoogeographic analysis.

16:370:515. (F) INSECT STRUCTURE AND FUNCTION (4)
Brattsten. May. Lec. 3 hrs., lab. 3 hrs. Prerequisite: 11:370:381 or equivalent. Required core course.
Physiology and functional morphology, including response systems, sensory systems, energy utilization, transport and secretion, and renewal systems.

16:370:517. (S) INSECT-PLANT BIOCHEMICAL INTERACTIONS (3)
Brattsten. See also 16:215:595. Prerequisites: Organic chemistry, biochemistry.
Biochemical aspects of interactions between herbivorous insects and their host plants, in particular those that involve adaptations to toxic plant allelochemicals. This includes metabolic and physiological defense mechanisms and mode of action and fate of phytochemicals.

16:370:519. (F) INSECT BEHAVIOR (3)
May. Prerequisite: Background in entomology and/or animal behavior.
Insect behavior from a functional standpoint: stimuli and responses; adaptive significance and evolutionary context; underlying physiological mechanisms.

16:370:522. (S) TOXICOLOGY OF PESTICIDES (3)
Brattsten. Lec. 2 hrs. Prerequisite: Advanced undergraduate biochemistry.
Mode of action, metabolism, and side effects of pesticides; their use in IPM, resistance mechanisms and development; health, registration, and legal aspects.

16:370:524. (S) INSECT TAXONOMY (4)
Kjer. Lec. 2 hrs., lab. 6 hrs. Required core course.
Insect systematics, identification, natural history, and evolution. Emphasizes North American insects at the family level.

16:370:525. (S) INSECT ECOLOGY (3)
Lashomb. Prerequisite: General ecology.
The relationship between insect populations and elements of the physical and biotic environment. Emphasis on principles governing population size, quality, and spatial and temporal variation.

16:370:601,602. SPECIAL TOPICS IN ENTOMOLOGY (BA,BA)
Each term, faculty members arrange a series of topics in specialized fields of entomology.

16:370:603,604. SEMINAR IN ENTOMOLOGY (1,1)
Required core course (2 terms for M.S.; 3 terms for Ph.D.).
Discussion and critique of presentations by guest speakers.

16:370:701,702. RESEARCH IN ENTOMOLOGY (BA,BA)

ENVIRONMENTAL SCIENCES 375

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Alan Appleby,
Environmental Science Building, Cook Campus (732/932-9081)

Members of the Graduate Faculty

Alan Appleby, Professor of Radiation Science, CC; Ph.D., Durham
Radiation chemistry; radiation interactions at the molecular level
Roni Avissar, Professor of Meteorology, CC; Ph.D., Hebrew
Micrometeorology; boundary layer meteorology, air-sea interactions,
numerical modeling
Richard Bartha, Professor of Microbiology, CC; Ph.D., Georg August (Göttingen)
Biodegradation of xenobiotic pollutants; microbial ecology
Baruch Boxer, Professor of Human Ecology, CC; Ph.D., Chicago
Problems of integrating scientific information and knowledge with policy
and regulation
Joanna Burger, Professor of Biology, FAS-NB, and of Ecology, Evolution, and
Natural Resources, CC; Ph.D., Minnesota
Behavioral ecology, ecotoxicology, ecological risk
Marcos Cheney, Assistant Professor of Environmental Science, CC; Ph.D.,
California (Davis)
Degradation of xenobiotic organic compounds on mineral surfaces and
in soil environments
Keith R. Cooper, Associate Professor of Toxicology, CC; Ph.D., Rhode Island
Xenobiotic metabolism and diseases of aquatic animals; animal models
Robert M. Cowan, Assistant Professor of Environmental Science, CC;
Ph.D., SUNY (Buffalo)
Environmental engineering; biological treatment; bioremediation;
process modeling
Joan G. Ehrenfeld, Associate Professor of Ecology, Evolution, and Natural
Resources, CC; Ph.D., CUNY
Wetland ecology, soil ecology, ecosystems ecology, pollution impacts
on ecosystems
Steven J. Eisenreich, Professor of Environmental Science, CC; Ph.D.,
Wisconsin (Madison)
Environmental organic chemistry of surface and subsurface aquatic systems
Karen Erstfeld, Assistant Professor of Environmental Science, CC;
Ph.D., Michigan
Public health; risk assessment; environmental chemistry
Melvin S. Fainstein, Professor of Environmental Science, CC; Ph.D.,
California (Berkeley)
Pollution microbiology; waste treatment composting as a controlled system
Susan E. Ford, Assistant Research Professor of Oyster Culture, CC; Ph.D., Duke
Invertebrate pathology/parasitology; genetics and mechanisms of resistance to
pathogens; physiological ecology of estuarine organisms
Michael A. Gallo, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., Albany Medical College
Food additives; phototoxins; dermatotoxicology
Emil J. Genetelli, Professor of Environmental Science, CC; Ph.D., Rutgers
Biological wastewater treatment processes
Scott M. Glenn, Associate Professor of Marine and Coastal Sciences, CC;
Sc.D., Massachusetts Institute of Technology
Marine remote sensing; wave, current, and sediment transport modeling
Fred Grassle, Director, Institute of Marine and Coastal Sciences, CC; Ph.D., Duke
Ecology of marine bottom-dwelling organisms
Max M. Haggblom, Research Assistant Professor, Center for Agricultural
Molecular Biology, CC; Ph.D., Helsinki
Environmental and applied microbiology; biodegradation and bioremediation
Robert P. Harnack, Professor of Meteorology, CC; Ph.D., Maryland
Synoptic and climatic aspects of meteorology
Sidney A. Katz, Professor of Chemistry, FAS-C; Ph.D., Pennsylvania
Environmental, nutritional, and toxicological aspects of trace elements
Stanley E. Katz, Research Professor of Microbiology, CC; Ph.D., Rutgers
Antibiotic residues in tissues and soils
Kathleen I. Keating, Professor of Environmental Science, CC; Ph.D., Yale
Trace element nutrition, plankton community structure and defined media for
zooplankton and phytoplankton culture
David S. Kosson, Associate Professor of Chemical and Biochemical Engineering,
CE; Ph.D., Rutgers
Microbial degradation of hazardous wastes and remediation
Uta Krogmann, Assistant Professor of Environmental Science, CC; Ph.D.,
Hamburg-Harburg
Solid waste management and engineering, biosolids, recycling, waste
minimization, anaerobic digestion, composting
Paul J. Lioy, Professor of Environmental and Community Medicine, UMDNJ-
RWJMS; Ph.D., Rutgers
Human exposure to pollutants; air pollution; industrial hygiene; risk assessment
James R. Miller, Associate Professor of Marine and Coastal Sciences, CC;
Ph.D., Maryland
Meteorology; atmospheric modeling

George H. Nieswand, Professor of Environmental Systems Engineering, CC;
Ph.D., Rutgers
Environmental systems analysis
Claire E. Reimers, Associate Professor of Marine and Coastal Sciences, CC; Ph.D.,
Oregon State
Marine carbon cycle; sedimentary geochemistry
John R. Reinfeld, Assistant Professor of Environmental Sciences, CC; Ph.D.,
SUNY (Stony Brook)
Trace metal biogeochemistry of aquatic systems; phytoplankton ecology
Nathan M. Reiss, Associate Professor of Meteorology, CC; Ph.D., New York
Air pollution meteorology; physical meteorology
David A. Robinson, Professor of Geography, FAS-NB; Ph.D., Columbia
Climate and climate change
Robert M. Sherrell, Assistant Professor of Marine and Coastal Sciences, CC; Ph.D.,
Massachusetts Institute of Technology
Marine geochemistry of trace metals and natural radionuclides
Peter F. Strom, Associate Professor of Environmental Science, CC; Ph.D., Rutgers
Biological treatment; hazardous wastes
Gary L. Taghon, Associate Professor of Marine and Coastal Sciences, CC;
Ph.D., Washington
Marine ecology
Robert L. Tate III, Professor of Soils and Crops, CC; Ph.D., Wisconsin
Soil microbiology
Barbara J. Turpin, Assistant Professor of Environmental Science, CC; Ph.D.,
Oregon Graduate Institute
Air pollution; the chemistry and physics of atmospheric aerosols
Christopher G. Uchirin, Professor of Environmental Science, CC; Ph.D., Michigan
Math modeling of contamination transport in surface and groundwaters
Judith S. Weis, Professor of Zoology, FAS-N; Ph.D., New York
Effects of environmental factors, including pollutants on development and growth
of estuarine organisms
Clifford P. Weisel, Assistant Professor of Environmental and Community
Medicine, UMDNJ-RWJMS; Ph.D., Rhode Island
Measurement of environmental constituents to assess human exposure
Lily Y. Young, Professor of Environmental Sciences, CC; Ph.D., Harvard
Anaerobic microbial metabolism of environmental contaminants; microbial ecology
Junfeng Zhang, Assistant Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., Rutgers/University of Medicine and Dentistry
of New Jersey
Air pollution, exposure assessment, atmospheric chemistry and greenhouse gases
Gerben J. Zylstra, Assistant Professor of Biochemistry and Microbiology, CAMB;
Ph.D., Michigan
Genetics and physiology of microbial aromatic hydrocarbon degradation

Associate Members of the Graduate Faculty

John W. Baum, *Senior Scientist, Brookhaven National Laboratory; Ph.D., Michigan*
Radiological physics; bioeffects and risks of ionizing and nonionizing radiations
Edward A. Christman, Director of Environmental Health and Safety, Columbia
University; Ph.D., Rutgers
Radiation safety; health physics
Nancy L. Fiedler, Associate Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., Bowling Green State
Neurobehavioral and health effects in human exposure to hazardous substances
Natalie Freeman, Adjunct Assistant Professor of Environmental and Community
Medicine, UMDNJ-RWJMS; Ph.D., Rutgers
Non-occupational exposure of adults/children; questionnaire development
Elan J. Gandsman, Director of Health and Safety, Yale University; Ph.D.,
Tel Aviv
Medical imaging; health physics; radiation safety; occupational health
Panos Georgopoulos, Assistant Professor of Environmental and Community
Health, UMDNJ-RWJMS; Ph.D., California Institute of Technology
Environmental modeling
William Goldfarb, Professor of Environmental Science, CC; Ph.D., Columbia
Environmental water resources; hazardous substances law and policy
Francis J. Haughey, Professor Emeritus of Radiation Science, CC; Ph.D., Rutgers
Radiation, aerosol, and health physics; environmental radioactivity
Joseph V. Hunter, Professor Emeritus of Environmental Science, CC;
Ph.D., Rutgers
Source, fate, and detection of water and soil pollutants
Howard Kipen, Assistant Professor of Environmental and Community
Medicine, UMDNJ-RWJMS; M.D., California (San Francisco)
Occupational health
Richard Lathrop, Associate Professor of Environmental Resources, CC; Ph.D.,
Wisconsin (Madison)
Remote sensing and spatial modeling of terrestrial aquatic ecosystems
Thomas S.S. Mao, Visiting Professor of Environmental Sciences, CC;
Ph.D., Rutgers
Radiopharmaceutical applications; immuno-radiopharmaceutical tests
Harry L. Motto, Associate Research Professor Emeritus of Soil Chemistry, CC;
Ph.D., Illinois
Soil chemistry

Theodore B. Shelton, Specialist of Agriculture and Resource Management, CC; Ph.D., Rutgers
Water resources planning and management

Benjamin P. Sonnenblick, Professor Emeritus of Radiation Science, CC; Ph.D., New York
Biology of cytogenetics; low-level radiation; human radiation protection

K. David Steidley, Chief Physicist, St. Barnabas Medical Center; Ph.D., Rutgers
Medical physics; biophysics; health physics; computers in medicine

Wesley R. Van Pelt, President, Wesley R. Van Pelt Associates, Inc.; Ph.D., New York
Health physics; industrial hygiene; radiation dosimetry; environmental radioactivity

Sam C. Wainwright, Assistant Professor of Marine and Coastal Sciences, CC; Ph.D., Georgia
Ecology of marine organisms

Stephen M. Waldow, Clinical Assistant Professor, UMDNJ, and Director, Division of Radiation Research, Cooper Hospital; Ph.D., SUNY (Buffalo)
Radiation biology; radiation therapy; models of tumor treatment

Max M. Weiss, Physicist and Health Physicist, Bell Laboratories; Ph.D., New York
Radiation and nuclear physics; standards and regulations; radiation facility design

Adjunct Member of the Graduate Faculty

Jennifer Francis, Assistant Research Professor of Marine and Coastal Sciences, CC; Ph.D., Washington
Polar meteorology, remote sensing, air-sea-ice energy transfer

Norberto J. Palleroni, Research Professor of Agricultural Molecular Biology, CC/CAMB; Ph.D., Buenos Aires
Taxonomic and phylogenetic studies of environmentally important bacteria

Mark Robson, Clinical Assistant Professor of Community Medicine, UMDNJ-RWJMS; Ph.D., Rutgers
Public health; risk assessment; exposure to pesticides

Arthur C. Upton, Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Michigan
Biological effects and risks of ionizing radiation

Programs

The M.S. and Ph.D. degrees are offered with concentrations in pollution prevention and remediation; aquatic and soil sciences; radiation sciences; exposure assessment; atmospheric science; and environmental toxicology. A Ph.D. option in exposure assessment is also offered jointly with the graduate program in public health, in conjunction with the Department of Environmental and Community Medicine, UMDNJ-RWJMS. Within these options, the following areas of specialization are offered: air pollution and resources; aquatic biology; aquatic chemistry; aquatic toxicology; chemistry and physics of aerosol and hydrosol systems; environmental chemistry; environmental microbiology; ground and surface water pollution modeling; human exposure; industrial hygiene; occupational health; pesticide residue chemistry; radiation biology; radiation chemistry; radiation physics; risk assessment; soil mineralogy and micromorphology; soil chemistry; soil microbiology; soil physics; solid and hazardous wastes; water and wastewater treatment; and water resources.

The backgrounds of successful applicants vary greatly. All are expected to have earned an undergraduate degree in a science or engineering discipline with appropriate background in biology, chemistry, mathematics, and physics. Accepted applicants who are deficient in any of the above will be required to correct their deficiency.

The M.S. program offers two plans: (1) 24 credits of course work, 6 credits of research, and a comprehensive oral examination that includes defense of thesis; or (2) 30 credits of course work, submission of an acceptable critical essay, and a comprehensive oral examination. All M.S. students must complete the two core courses 16:375:513,514 Fundamental Concepts of Environmental Science I,II as well as 1 credit in a seminar.

The Ph.D. requires a minimum of 72 credits beyond the bachelor's degree, of which 48 must be course credits and 24 must be research credits, and the successful completion and defense of a research dissertation. The qualifying exam is oral. A written exam may also be required. A formal research proposal is required following admission to candidacy, to be submitted to the candidate's dissertation committee. One year's residence, defined as full-time status for one academic year consisting of two consecutive terms, is normally required. There is no foreign language requirement. All

Ph.D. students must complete the two core courses 16:375:513,514 Fundamental Concepts of Environmental Science I,II as well as 2 credits in seminars.

Graduate Courses

- 16:375:501. (F) ENVIRONMENTAL SCIENCE ANALYSIS (3)
Uchrin
Physical, chemical, and biochemical processes utilized to treat municipal wastewaters. Process mechanisms, treatment efficiencies, and their relationship to wastewater quality; techniques utilized to obtain maximum efficiency.
- 16:375:502. (S) STREAM SANITATION (3)
Principles of biological stabilization of pollution materials in streams; factors influencing atmosphere reaeration; changes in biological populations in polluted waters.
- 16:375:503. (F) ANALYTICAL TECHNIQUES IN ENVIRONMENTAL CHEMISTRY (3)
Prerequisite: 11:375:405 or permission of instructor.
Theory and techniques of analytical procedures applicable to research in environmental science.
- 16:375:504. (S) WASTE TREATMENT II: WATER TREATMENT (3)
Uchrin
Chemical, physical, and biological factors affecting development of water supplies; water quality; municipal and industrial water treatment processes consisting of removal of particulate matter, softening, disinfection, corrosion control, iron and manganese removal, aeration, deaeration, and taste and odor removal.
- 16:375:505. (S) WASTE TREATMENT II: WATER TREATMENT LABORATORY (1)
Uchrin. Lab. 3 hrs. Corequisite: 16:375:504.
Experiments demonstrating water treatment processes.
- 16:375:506. (S) WASTE TREATMENT III: INDUSTRIAL WASTES (2)
Prerequisite: 16:375:501.
Industrial waters; industrial processes and sources of wastes; composition, characteristics, and effects; methods of treatment, disposal, and recovery.
- 16:375:507. (F) ENVIRONMENTAL CHEMISTRY (3)
Equilibria: acid-base, dissolution and precipitation, multi-phase; oxidation-reduction in aquatic systems; elements of chemical thermodynamics.
- 16:375:509. (F) GROUNDWATER POLLUTION (3)
Uchrin. Prerequisites: 16:375:504 and 541, or permission of instructor.
Principles of groundwater hydrology and pollution. Development of mathematical formulations for describing pollutant movement in groundwater systems. Examination of control measures. Discussion of case studies.
- 16:375:510. (S) POLLUTION MICROBIOLOGY (3)
Finsten. Prerequisite: Permission of instructor.
Bacteria as indicators of sanitary conditions; cycles of carbon, nitrogen, sulfur, and iron in polluted waters; microbiology of activated sludge, anaerobic digestion, composting, and other liquid and solid waste treatment processes.
- 16:375:512. (F) POLLUTION MICROBIOLOGY LABORATORY (2)
Finsten. Lab. 6 hrs. Corequisite: 16:375:510.
Laboratory exercises paralleling 16:375:510.
- 16:375:513. (F) FUNDAMENTAL CONCEPTS OF ENVIRONMENTAL SCIENCE I (3)
Definition of environmental science emphasizing its interdisciplinary and systems aspects: matter and energy, biosphere, atmosphere, hydrosphere, lithosphere; mathematical, physical, chemical, and biological principles.

16:375:514. (S) FUNDAMENTAL CONCEPTS OF ENVIRONMENTAL SCIENCE II (3)

Environmental contamination: how discharges into one "sphere" affect other "spheres." Topics include environmental management, wastes, air and water pollution, soil management, physical "pollution," risk, human health, policy, regulation, analysis, modeling.

16:375:516. (S) ULTIMATE DISPOSAL AND RESOURCE RECOVERY OF SLUDGES AND SOLID WASTE (3)

Description and application of advanced technology for treatment, resource recovery, and ultimate disposal of sludges and solid wastes from municipal, industrial, and agricultural sources; techniques of theory of operation, process design, application, and performance; environmental and socioeconomic implications.

16:375:517. APPLICATIONS OF AQUATIC CHEMISTRY (3)

Prerequisite: 16:375:507 or permission of instructor.

A detailed examination of the thermodynamics and principles of absorption at air-water interfaces, carbon-water interfaces, colloid-water interfaces, etc. Some consideration is also given to coagulation and flocculation and to complex metal ions in aqueous solutions.

16:375:518. (S) PRINCIPLES OF ENVIRONMENTAL SCIENCE (3)

Keating

Principles and interaction associated with air environment, water environment, and environmental health, including air resources management, water resources management, and their impact on man. Related fundamentals of environmental chemistry, biology, and physics.

16:375:519. (F) WETLAND ECOLOGY (3)

Ehrenfeld. Prerequisites: 11:704:351 or equivalent, and permission of instructor.

Survey of the ecology, management, and utilization of wetlands. Topics include the hydrology, soils, biogeochemistry, flora, fauna, and ecosystem dynamics of the major types of wetlands. Wastewater application, wetland creation, wildlife management, wetland assessment and delineation, and conservation also discussed.

16:375:520. (S) TECHNIQUES FOR BIOMONITORING IN AQUATIC ECOSYSTEMS (3)

Prerequisite: 16:375:519 or permission of instructor.

Discussion of techniques used to monitor for the presence of trace contaminants in aquatic ecosystems and to assess the effects of contaminants on the structure and function of these ecosystems.

16:375:522. (S) ENVIRONMENTAL ORGANIC CHEMISTRY (3)

Eisenreich. Prerequisite: Graduate standing or permission of instructor.

Transport and transformations of anthropogenic organic chemicals in the environment; chemical-physical properties of organic chemicals, air-water and air-land exchange, atmospheric processes and deposition, sorption processes, bioaccumulation, chemical transformation, photochemical transformations, modeling concepts, case studies.

16:375:523. (F) ENVIRONMENTAL FATE AND TRANSPORT (3)

Eisenreich, Uchrin. Corequisites: 11:375:444 or 451 or equivalent; Calc 1, Calc 2. The fate and transport of chemicals, chemical exposures in aquatic systems, and prediction of future conditions. Water quality problems introduced by addition of nutrients and oxygen-demanding material, metals and toxic organic chemicals to water, soil, and air. Models to assess environmental mobility and predict scenarios. Emphasis on the new paradigm of "environmental indicators" to assess environmental quality.

16:375:524. (F) SOURCE CONTROL OF ATMOSPHERIC POLLUTION (3)

Turpin. Prerequisite: Permission of instructor.

Principles, operation, performance, and application of methods and devices to control aerosol and gaseous emissions.

16:375:525. (F) PRINCIPLES OF SOLID WASTE MANAGEMENT AND TREATMENT (3)

Finstein. Prerequisite: Permission of instructor.

Solid waste problems in the municipal, industrial, and agricultural areas. Interrelationships with other environmental problems; socioeconomic aspects; present state-of-the-art techniques. Quality and quantity variations, treatment and management systems; recycling, source control.

16:375:526. (S) LIMNOLOGY OF URBAN AND SUBURBAN WATERS (3)

Keating. Prerequisite: Permission of instructor.

Study of waters stressed by population, development, wastes; emphasis on biological characterization of urban and suburban waters.

16:375:530. (S) HAZARDOUS WASTE MANAGEMENT (3)

Strom. Prerequisite: 16:375:525 or permission of instructor.

Overview of hazardous waste management. Case histories; legislation and regulations; treatment, disposal, and cleanup technologies; sampling and analysis methodologies; persistence and fate in the environment; emergency response procedures.

16:375:531. (F) BIOLOGICAL WASTE TREATMENT (3)

Strom. Prerequisites: 16:375:501 and 510, or permission of instructor.

Advanced topics in biological waste treatment, particularly activated sludge, focusing on microbial ecosystems.

16:375:533. (F) WATER LAW (3)

Goldfarb. Prerequisites: 16:375:501, 507, and 518, or permission of instructor.

An examination of the water law doctrines and institutions that affect water resources management. Topics include water rights, water resources development, instream uses, and water pollution control.

16:375:537. (F) LARGE-SCALE WEATHER SYSTEMS (3)

Harnack. Prerequisites: 11:670:201, 202; 11:670:323, 324 or equivalent.

Applied dynamics of the atmosphere including the theory and observations of cyclone development, vertical motion, jet streams, fronts, and synoptic-scale circulation systems.

16:375:538. (S) MESOSCALE WEATHER SYSTEMS (3)

Harnack. Prerequisites: 11:670:323, 324 or equivalent.

Description, dynamics, and prediction of moist convective weather systems such as supercells, mesoscale convective complexes, squall lines, and other multicellular storms.

16:375:540. (S) ATMOSPHERIC CHEMISTRY (3)

Zhang. Prerequisite: 11:375:421 or permission of instructor.

Air pollutants, trace gases, and aerosols discussed in terms of their observed distribution in time and space; sources and sinks in the atmosphere and its boundaries; budgets and cycles. Emphasis on tropospheric chemical reactions.

16:375:541. (S) ENVIRONMENTAL MODELS (3)

Uchrin. Prerequisites: Linear algebra and permission of instructor.

The development and applications of environmental models discussed in terms of their ability to simulate and predict the workings of environmental systems and to communicate information and trade-offs between economic and conservation goals.

16:375:542. (S) AEROSOL SCIENCES (3)

Lioy. Prerequisite: Calculus. Recommended: Differential equations.

16:375:543. (S) MICROMETEOROLOGY (3)

Avissar. Prerequisite: 11:670:324 or equivalent.

Theory of energy fluxes near and on both sides of the earth's surface, including sensible and latent heat transfer in the atmospheric boundary layer and soil heat transfer; temperature, wind, and humidity structure of the boundary layer and the temperature structure of soil; experimental methods and equipment in micrometeorology.

- 16:375:544. (S) MODELING OF CLIMATIC CHANGE (3)
Avisar, Miller
Principles of numerical modeling of regional and global climate. Sensitivity of parameterizations of land-ocean-atmosphere interactions including the effects of vegetation and human activities on climatic change.
- 16:375:545. (F) PHYSICAL CLIMATOLOGY (3)
Prerequisite: 11:670:201.
Atmospheric composition; trends and possible long-range effects on the global radiation budget; optical phenomena of the atmosphere; circulation of the stratosphere and lower mesosphere; cloud physics and weather modification; climatic fluctuations and probable causes.
- 16:375:546. (S) AIR POLLUTION METEOROLOGY (3)
Reiss. Prerequisites: 11:670:323,324, or equivalent.
Theory and applications of air pollution dispersion modeling. Meteorological effects on and by cooling towers. Effects of pollutants on meteorological parameters.
- 16:375:547. (F) ATMOSPHERIC BOUNDARY LAYER DYNAMICS (3)
Avisar. Prerequisite: 11:670:324 or equivalent.
Basic governing equations in the atmospheric boundary layer and their application to turbulent flow, including turbulent kinetic energy, turbulence closure techniques, forcing, and stability.
- 16:375:548. (S) ATMOSPHERIC NUMERICAL MODELING (3)
Avisar. Prerequisite: 16:375:547 or equivalent.
Basic governing equations in the atmosphere, simplification, and scaling; parameterization of turbulence, radiation, and clouds; numerical methods for the solution of the mathematical system; boundary and initial conditions; evaluations of atmospheric models.
- 16:375:549. (F) APPLIED CLIMATOLOGY (3)
Prerequisites: 11:670:323,324 or equivalent, one term of statistics, or permission of instructor.
Critical use of statistics as applied to climatology; analysis of meteorological time series. Application of various statistical distributions to regional climate diagnostics. Dynamic air mass analysis.
- 16:375:550. (S) LARGE-SCALE CLIMATE DIAGNOSTICS (3)
Harnack. Prerequisite: 16:375:549.
Observed characteristics of the general circulation of the atmosphere and surface layer of the oceans; atmospheric energetics; empirical studies of large-scale, air-sea interactions, tropical-midlatitude interactions, and recent climatic fluctuations; empirical methods of short-range climate prediction.
- 16:375:551. (S) REMOTE SENSING OF THE OCEAN AND ATMOSPHERE (3)
Miller. Prerequisite: 11:670:323 or equivalent.
Theoretical basis of remote sensing. Methods, instruments, and their application to observations of ocean and atmosphere. Remote sensing of oceanic parameters such as temperature, salinity, currents, sea state, turbidity and pollutants, and atmospheric parameters such as temperature, water vapor, cloud cover, wind speeds, and pollutants.
- 16:375:552. (F) SOIL GENESIS AND MORPHOLOGY (3)
Soil-forming processes in various climatic regions as evidenced by chemical, physical, and mineralogical characteristics of the profile. System of classification and literature review.
- 16:375:554. (S) SOIL AND PLANT RELATIONSHIPS (3)
Prerequisite: 11:375:452.
Selected topics related to factors affecting the chemical environment of the plant.
- 16:375:555. (S) FLOW THROUGH POROUS MEDIA (4)
Lec. 3 hrs., lab. 3 hrs. Prerequisites: Introductory computer programming, numerical analysis, and partial differential equations.
The derivation and solution of the flow equation that combines Darcy's law and the conservation of mass. Uses finite difference methods as these apply to flow through a porous medium.
- 16:375:559. (S) SOIL MANAGEMENT AND CROP PRODUCTION (3)
Influence of land management systems and cultural practices on soil productivity and environmental quality.
- 16:375:561. (F) SOIL CHEMISTRY (3)
Lec. 2 hrs., lab. 3 hrs.
Structural chemistry, formation mechanisms, chemical properties, weathering, and surface reactions of major soil components: silicates, aluminum hydroxides, and iron oxides.
- 16:375:568. (S) TOPICS IN SOIL CHEMISTRY (3)
Chemistry of phosphate, potassium, and carbonate in soils; soil acidity and amendments; oxidation-reduction; ion exchange equilibria; pollution of the soils environment.
- 16:375:573. (S) TOPICS IN SOIL ORGANIC MATTER (3)
Tate
Role of organic matter in soil, extraction and analysis of soil organic matter, biodegradation and synthesis of humic and fulvic acids; biological and ecological aspects.
- 16:375:580. (S) RADIATION CHEMISTRY (3)
Appleby. Prerequisite: 16:375:591 or 11:375:491 or equivalent.
The interaction of all types of ionizing radiation with matter and the resulting radiation-induced chemical reactions; excitation, ionization, free radical formation, and recombination; relationship of radiation chemistry to photochemistry, radiochemistry, hot atom chemistry.
- 16:375:581. (F) RADIATION BIOPHYSICS (3)
Appleby. Prerequisite: 16:375:580. Intended for students in the radiation science program, particularly those interested in medical physics.
A study of biophysical processes induced by very high energy electromagnetic and particulate radiation. Major areas of emphasis: the biophysical basis of radiation biology, consequences to therapeutic radiology, and applications to nuclear medicine.
- 16:375:584. (S) TOPICS IN RADIATION BIOLOGY (3)
The current literature of radiation biology.
- 16:375:589,590. SEMINAR IN RADIATION SCIENCE (1,1)
Topics of current interest.
- 16:375:591. (F) RADIATION AND RADIOACTIVITY (4)
Lec. 3 hrs., lab. 3 hrs.
Atomic theory, nuclear structure, nuclear radiation, lasers, radioactivity, interactions of radiation with matter, detection methods, counting statistics, nuclear reactions, neutron activation analysis, machine and isotope sources of radiation, shielding.
- 16:375:592. (F) NUCLEAR ENERGY TECHNOLOGY (3)
Prerequisite: 16:375:591.
The theory and practice of commercial nuclear power. Nuclear physics, reactor physics, reactor kinetics and control, fission products, reactor energy removal, the nuclear fuel cycle and fuel cycle wastes, nuclear reactor systems, and reactor safety and safeguards.
- 16:375:593. (S) NONIONIZING RADIATION (3)
Prerequisite: 16:375:591.
Basic physical phenomena and quantities of electromagnetic radiation in the nonionizing range, e.g., RF, microwave, visible, interaction mechanisms, biological effects, instruments, measurement of field quantities, and current protection standards.
- 16:375:595. (F) FUNDAMENTALS OF RADIATION INSTRUMENTATION (3)
Gandsman
The principles of electronics as they pertain to the analytical, research, and professional instrumentation in radiation science and radiological health. The principles of operation and applications of all important types of radiation detectors.

16:375:596. (S) RADIATION INSTRUMENTATION AND DOSIMETRY (3)

Gandsman. Prerequisite: 16:375:595.

Fundamentals and general theory of ionizing radiation dosimetry including microdosimetry. Dose measurement; external and internal human dose estimates by computational methods.

16:375:598. (S) SPECIAL TOPICS IN RADIOLOGICAL HEALTH (3)

Prerequisite: 16:375:591.

Advanced topics of current interest, background radiation levels, radiation exposure standards, external and internal radiation exposure limits, medical radiation exposure and protection, space radiation problems, environmental radioactivity.

16:375:601. EXPERIMENTAL PROBLEMS IN RADIOLOGICAL HEALTH (2)

Appleby. Prerequisite: Completion of all other courses in the radiological health or health physics program. Offered in summer session only.

A series of problems requiring literature search, field and laboratory exercises, and written reports. Typical problems: reactor radiation survey, X-ray installation survey, environmental sample analysis. Laboratory and fieldwork.

16:375:603,604. INDEPENDENT STUDY IN METEOROLOGY (BA,BA)

Reiss. Prerequisite: Permission of instructor.

The student conducts an independent comprehensive literature review and investigation of meteorological areas of interest other than the thesis topic. Regular reports of progress made in conference.

16:375:605,606. SPECIAL TOPICS IN METEOROLOGY (3,3)

Reiss. Prerequisite: Permission of instructor.

Selected topics in meteorology. Current literature and recent advances.

16:375:612,613. SEMINAR IN ENVIRONMENTAL SCIENCE (0,0)

16:375:625,626. ADVANCED SPECIAL PROBLEMS (BA,BA)

16:375:635. EXPERIMENTAL PROBLEMS IN ENVIRONMENTAL SCIENCE (BA)

16:375:651,652. SEMINAR IN SOIL SCIENCE (1,1)

16:375:671,672. SEMINAR IN METEOROLOGY (1,1)

Prerequisite: 11:670:323,324, or equivalent.

Review of recent advances in meteorology.

16:375:701,702. RESEARCH IN ENVIRONMENTAL SCIENCE (BA,BA)

Research in water pollution, water and wastewater treatment, air pollution, and aquatic microbiology.

ENVIRONMENTAL CHANGE, HUMAN DIMENSIONS OF 390

Program Offered: Certificate Program in the Human Dimensions of Environmental Change

Director of the Certificate Program in Human Dimensions of Environmental Change: David A. Robinson, Department of Geography, Lucy Stone Hall 230, Livingston Campus (732/445-4103)

Participating Faculty

The following members and associate members of the graduate faculty, identified more fully under their respective programs, are among those who participate in the certificate program in human dimensions of environmental change.

T. Airola, *Geography*
B. Boxer, *Geography*
C. Clarke, *Sociology*
D. Ehrenfeld, *Ecology and Evolution*
J. Ehrenfeld, *Ecology and Evolution*
J. Friedman, *Sociology*

B. Grandin, *Anthropology*
M. Greenberg, *Geography/Public Health*
B. Hallman, *Psychology*
M. Hamm, *Nutritional Sciences*
B. Holcomb, *Geography*
R. Lathrop, *Geography*
B. McCay, *Anthropology/Ecology and Evolution*
J. Miller, *Oceanography*
K. Mitchell, *Geography*
G. Morren, *Anthropology/Ecology and Evolution*
G. Nieswand, *Geography*
K. Nordstrom, *Geography*
P. Parks, *Agricultural Economics*
S. Pickett, *Ecology and Evolution*
F. Popper, *Geography*
N. Psuty, *Geography/Geological Sciences*
D. Robinson, *Geography/Environmental Sciences*
T. Rudel, *Geography/Sociology*
S. Schrepfer, *History*
R. Schroeder, *Geography*
L. Small, *Agricultural Economics*
P. Strom, *Environmental Sciences*
A. Vayda, *Anthropology/Ecology and Evolution*
N. Weinstein, *Psychology*

Certificate Program

Students with an interest in human-induced environmental changes may pursue, in addition to their regular program of studies, a special concentration in the human dimensions of environmental change. Two competing foci define research on these human dimensions of environmental change. One strand of research, ecological and institutional in emphasis, addresses questions of changes in natural resources, land cover, and industrial metabolism. A second strand of research, more perceptual and behavioral in emphasis, focuses on risks, hazards, and disasters. In both fields, research accomplishment requires competence in the methods of several different disciplines. Students who fulfill the following requirements will receive a Certificate in the Human Dimensions of Environmental Change, signifying special achievement in the field. To receive the certificate, students must complete, in addition to the requirements in their major disciplines, one course in one of the other participating programs that focus on the human dimensions of environmental change. All students must also complete a two-term sequence of courses in the human dimensions of environmental change.

Graduate Courses

16:390:501. SEMINAR ON THE HUMAN DIMENSIONS OF ENVIRONMENTAL CHANGE (3)

Multidisciplinary survey of the human dimensions of environmental problems and the full range of disciplinary approaches used to study these problems.

16:390:502. TOPICS SEMINAR: THE HUMAN DIMENSIONS OF ENVIRONMENTAL CHANGE (3)

Focus on a particular human dimension of environmental problems, such as commons problems/institutions, or on a particular environmental problem.

FOOD SCIENCE 400

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Joseph D. Rosen, 107 Food Science Building, Cook Campus (732/932-9611, ext. 215)

Members of the Graduate Faculty

George M. Carman, Professor of Food Science, CC; Ph.D., Massachusetts Biochemistry; membranes, phospholipids, and enzymes
Henryk Daun, Professor of Food Science, CC; Ph.D., Politechnika Gdanska Chemistry of food colors; thermal degradation of foods
Chaim Frenkel, Professor of Horticulture, CC; Ph.D. Washington State Postharvest biology; senescence science, fruit ripening, and stress

Michael Gallo, Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Albany Medical College
Food additives; phototoxins; dermatotoxicology

Thomas G. Hartman, Mass Spectrometry Lab Manager, CAFT; CC; Ph.D., Rutgers
Advanced instrumental analytical techniques as applied to food chemistry, mass spectrometry, chromatography, infrared spectroscopy, toxicology

Kan-Ichi Hayakawa, Professor of Food Science, CC; Ph.D., Rutgers
Heat and mass transfer in foods, head sterilization

Chi-Tang Ho, Professor of Food Science, CC; Ph.D., Washington University
Flavor and lipid chemistry

Mukand V. Karwe, Assistant Research Professor of Food Science, CC; Ph.D., Rutgers
Numerical simulation of thermal transport in extrusion processes; instrumentation of extruders, laser Doppler anemometry

Jozef Kokini, Professor of Food Science, CC; Ph.D., Carnegie Mellon
Food rheology; biophysical properties, extrusion

Paul A. Lachance, Professor of Food Science, CC; Ph.D., Ottawa
Nutrition; nutritional aspects of food processing

Tung-Ching Lee, Professor of Food Science, CC; Ph.D., California (Davis)
Food chemistry and biochemistry; biotechnological applications in food processing; seafood technology; nutritional and safety aspects of food processing

Thomas Leustek, Assistant Professor of Biochemistry and Microbiology, CC; Ph.D., Rutgers
Nutritional value of plant crops, sulfur metabolism; molecular genetics and biochemistry

Richard D. Ludescher, Associate Professor of Food Science, CC; Ph.D., Oregon
Protein structure and dynamics; time-resolved fluorescence and phosphorescence

Karl Matthews, Assistant Professor of Food Science, CC; Ph.D., Kentucky
Pathogenesis and reservoirs of foodborne pathogens

Thomas J. Montville, Professor of Food Science, CC; Ph.D., Massachusetts Institute of Technology
Microbial food safety; fermentations; biotechnology

Joseph D. Rosen, Professor of Food Science, CC; Ph.D., Rutgers
Food chemistry; toxicology; mass spectrometry

Robert T. Rosen, Associate Director, CAFT; Ph.D., Rutgers
Analytical and food chemistry; mass spectrometry; instrumental analysis; natural products; chromatography

Donald W. Schaffner, Associate Extension Specialist in Food Science, CC; Ph.D., Georgia
Predictive food microbiology; modeling microbial growth; applied food microbiology

Karen M. Schaich, Associate Professor of Food Science, CC; Sc.D., Massachusetts Institute of Technology
EPR studies of free radicals; lipid oxidation; co-oxidation of macromolecules; chemistry of antioxidants

Myron Solberg, Professor of Food Science, CC; Director of the Center for Advanced Food Technology; Ph.D., Massachusetts Institute of Technology
Synthesis and regulating mechanisms of microbes

Beverly J. Tepper, Associate Professor of Food Science, CC; Ph.D., Tufts
Nutrition; food intake regulation; sensory evaluation; taste in disease

Woody C.H. Tong, Assistant Professor of Food Science, CC; Ph.D., Wisconsin (Madison)
Microwave heating applications; measurements of thermophysical properties and drying kinetics

Shaw S. Wang, Professor of Chemical and Biochemical Engineering, CE; Ph.D., Rutgers
Biochemical engineering; food science and technology

Bruce P. Wasserman, Professor of Food Science, CC; Ph.D., Massachusetts
Enzyme technology and molecular biology; biopolymers synthesis, structure, and function

Robert R. Wolfe, Professor of Bioresource Engineering, CC; Ph.D., Purdue
Food quality inspection; applied machine vision; unit operations

Kit L. Yam, Associate Professor of Food Science, CC; Ph.D., Michigan State
Food packaging engineering, polymeric material

Associate Member of the Graduate Faculty

Jack L. Rossen, Senior Associate Director, CAFT; Ph.D., Rutgers
Food engineering / process design; heat / mass transfer in foods

Adjunct Members of the Graduate Faculty

Gail V. Civile, President, Sensory Spectrum, Inc.; B.S., College of Mount Saint Vincent
Sensory evaluation of foods; methodology

A. Rali Ramalingam, Group Engineering Manager, McNeil Specialty Products Company; Ph.D., Cornell
Process development; process control; computer-integrated manufacturing; separations

Israel Saguy, Adjunct Professor of Food Science, CC; D.Sc., Technion
Food processing; frying; kinetics modeling; shelf-life simulation optimization

Programs

The following areas of specialization are offered: basic studies in physical, chemical, or biological changes in foods; chemistry of fats and oils; flavor chemistry, including isolation and identification of food flavors; chemistry of food proteins; nutritional aspects of food products; food enzymology and biochemistry; food microbiology; food toxicology; heat and mass transfer in foods, energy conservation in processing; food packaging, theoretical aspects, functionality, and properties; food colors; food emulsions; sensory attributes of foods; biotechnology. The program is suitable for part-time study.

Applicants are expected to have completed one year each of calculus, physics, and organic chemistry, and to have some foundation in the biological sciences; biochemistry, microbiology, and/or nutrition are recommended, as is statistics. Some undergraduate food science courses may be taken for graduate credit. The Graduate Record Examination must be taken.

Food science offers a Master of Science degree with options for a thesis or nonthesis program. In the thesis option, the student must take a minimum of 6 research credits and 24 course credits. The student must carry out a research problem and write a thesis. For the nonthesis option, the student must have a minimum of 30 course credits and must present an essay. A nonthesis M.S. normally is considered a terminal degree. However, the student with the support of his or her major adviser may petition the faculty for permission to continue with the Ph.D. program.

The student should demonstrate proficiency in food science by satisfactory completion of course work in the following areas: food science fundamentals, food science seminar (1 credit), food biochemistry, food engineering, nutrition, food analysis or quantitative analysis, food microbiology. Any of the above requirements may be waived, except seminars, if the student has had courses that satisfy the core requirements.

Students must demonstrate proficiency in food biology, food chemistry, and food engineering early in their academic careers by completing 16:400:507 and 16:400:513,514 with an average grade of B or better. In some cases, with permission of the graduate program director, proficiency may be demonstrated through a written comprehensive examination.

The Ph.D. requires a minimum of 72 credits beyond the bachelor's degree, of which 45 must be course credits. Candidates who have any deficiencies upon admission are required to make up these deficiencies prior to receiving the degree.

Qualifying examinations for the doctorate include both written and oral examinations. A student must take a written qualifying examination in one of the following areas: food biology, food chemistry, food physics/engineering. After passing the written qualifying examination, the student takes the oral qualifying examination, which normally includes approval of the research proposal for the dissertation. Should a student fail all or part of the written qualifying examination, with the concurrence of the faculty and his or her adviser, those portions that were failed may be retaken, once. Likewise, a student who does not pass the oral qualifying examination may retake the examination, once, with the dissertation committee's concurrence. After passing both the written and oral components of the qualifying examination, the student is recommended as a candidate for the Ph.D. There is no language or residence requirement for the Ph.D. degree.

The Master of Philosophy degree is available to doctoral candidates. Graduate assistantships, teaching assistantships, and fellowships are available to qualified students.

Academic and research training in the area of packaging science and engineering as applicable to food is available in this program. For further information concerning this option, refer to the listing under Packaging Science and Engineering in this chapter.

Graduate Courses

15:400:501. (F) FLAVOR CHEMISTRY (3)

Ho. Prerequisite: One year of organic chemistry or equivalent. Isolation, fractionation, and identification of the desirable and objectionable flavor constituents in food; chemical mechanisms for the formation of flavor components in food; methods for the measuring of flavor and flavor stability of food and food components; manufacture of food flavors.

16:400:502. (S) FOOD SCIENCE INSTRUMENTATION (3)

R. Rosen, Hartman. Prerequisite: Organic chemistry. Theory, methodology, and application of chromatographic methods including high-performance liquid, thin-layer, and gas chromatography. Theory, methodology, and application of spectrometry, including visible color, ultraviolet, infrared, NMR, and mass spectrometry.

16:400:503. (S) FOOD SCIENCE INSTRUMENTATION LABORATORY (1)

Ho. Prerequisite: 16:400:502 and permission of instructor. Investigation of the macromolecular and trace components in food systems. Topics include separation techniques (gas chromatography, TLC, HPLC), spectroscopic techniques (UV/Vis, IR), and investigation of research problems in food chemistry.

16:400:504. (F) CARBOHYDRATES IN FOODS (3)

J. Rosen. Prerequisite: Organic chemistry. The basic chemistry and technology of carbohydrates in food products. The functional properties of carbohydrates related to their use in food systems.

16:400:505. (F) LIPID CHEMISTRY (3)

Schaich. Prerequisite: Organic chemistry; 16:400:513 or equivalent. Structure and composition of lipids and their chemical and physical properties; processing of fats and oils and their application in foods; fractionation, purification, and analysis of lipids; chemistry of autoxidation, antioxidants, and emulsifiers; emulsions; membranes; and health effects of lipids.

16:400:506. (S) CHEMISTRY OF FOOD PROTEINS (3)

Ludescher. Prerequisite: Organic chemistry. Study of the molecular structure, physical chemical properties, and functions of proteins and their constituents. Special emphasis on the relationship between molecular structure and function in food proteins.

16:400:507. (S) FOOD ENGINEERING FUNDAMENTALS AND PROCESSES (4)

Karwe. Prerequisites: Physics, calculus. Principles of material and energy balance, thermodynamics, fluid flow, and heat and mass transfer. Review of unit operations: thermal processing, refrigeration, freezing, evaporation, dehydration and extraction. Filtration and membrane processes.

16:400:509. (F) NUTRITIONAL ASPECTS OF FOOD PRODUCT DEVELOPMENT (3)

Lachance. Prerequisites: Food science fundamentals; general biochemistry; nutrition. Study of the application of basic and applied principles of nutrition to the formulation, fabrication, processing, and marketing of food products.

16:400:510. (S) FOOD RHEOLOGY (3)

Kokini. Prerequisite: 16:400:517 and permission of instructor. Concepts of flow and deformation behavior and their application in food materials. Rheological properties for liquid and solid materials. Methods of measurement of rheological properties in food systems. Rheology stability and rheology texture relationships used to illustrate applications of rheology in product quality. Basic equations of fluid flow and their application in selected flow processes such as extrusion and spinning.

16:400:511. (S) FOOD ENZYMOLOGY (3)

Carman, Wasserman. Prerequisite: General biochemistry. The study of enzymes important to food systems, including methods of isolation and characterization. Regulation of enzyme synthesis and enzyme activity. Traditional and emerging applications of enzyme technology in food processing and ingredient production with focus on selected topics such as thermostability, immobilization, catalysis under extreme conditions, enzyme mimics, and control of endogenous enzyme activities.

16:400:512. (F) BIOREGULATION AND BIOTECHNOLOGY IN FOOD FERMENTATION (3)

Montville. Prerequisites: 16:115:503,504 and 16:680:501, or equivalent. Utilization and physiology of microorganisms in the food industry. Metabolic regulation of fermentation products. Fermentors as laboratory tools, new microbial technologies, and approaches to the use of microorganisms in foods.

16:400:513. FOOD SCIENCE FUNDAMENTALS I (3)

Lee, et al. Prerequisite: Organic chemistry. The basic chemistry of carbohydrates, proteins, lipids, vitamins, and water independent of and in relation to interaction during processing.

16:400:514. FOOD SCIENCE FUNDAMENTALS II (3)

Montville, Matthews. Prerequisites: 16:400:513 or equivalent; general microbiology or biochemistry. Mechanistic examinations of foodborne microbes, enzymology, biotechnology, postharvest physiology, nutrition, and current concepts in food safety as related to food composition and processing.

16:400:515,516. PRINCIPLES OF FOOD PROCESS ENGINEERING I, II (3,3)

Hayakawa. Prerequisites: 11:400:401,402 and a year of calculus, or equivalent. Classical thermodynamics; chemical, biochemical, and microbial reaction kinetics; industrial heat sterilization operations; estimating process lethality and food quality. Industrial food refrigeration and freezing; influence of low temperature processing on food quality; quality and stability of frozen food; industrial drying processes; isothermal and nonisothermal moisture sorption and transfer in foods; influence of drying on food quality; quality stability of dried foods.

16:400:517. (F) APPLIED MATHEMATICS IN FOOD SCIENCE (3)

Hayakawa. Prerequisite: A year of calculus, or equivalent. Elementary numerical analyses (vectors, matrices, tensors, roots, optimization numerical calculus), special functions, analytical and numerical solutions of linear and nonlinear ordinary differential equations, analytical and finite difference solutions of linear and nonlinear partial differential equations, especially heat conduction equations.

16:400:518. (S) PRINCIPLES OF HEAT TRANSFER IN FOODS (3)

Hayakawa. Prerequisites: 11:400:401,402 or equivalent; 16:400:517. Irreversible thermodynamics, empirical formulae for estimation of heat and mass transfer in food, heat conduction in fresh or processed food with or without internal generation of heat, heat transfer in biological material undergoing phase transition, convective heat transfer in liquid food, heat exchanges, problems of dehydration.

16:400:519. (S) FOOD SAFETY (3)

J. Rosen. Prerequisite: Organic chemistry. Chemistry and toxicology of food additives, pesticides, mycotoxins, and materials naturally present in food. Chemical carcinogenesis. Role of diet in both cancer causation and cancer inhibition.

16:400:521. (F) CHEMISTRY OF FOOD COLORS (3)

Daun. Prerequisites: Organic chemistry, physics. Occurrence, structure, and physical and chemical properties of synthetic and natural food colors. Interactions between color substances and other food components during processing and storage. Analytical aspects of food colors.

16:400:523,524. TECHNOLOGY OF PACKAGING I,II (3,3)

Yam. Prerequisite: Organic chemistry. Formulation of materials, basic uses of packaging materials and packaging design; limitations of various materials.

16:400:525. (F) PACKAGING: ANALYTICAL ASPECTS (3)

Yam. Prerequisites: 16:400:523,524; quantitative analysis. Physical and chemical properties of packaging materials as related to their function in various packaging systems. Test methods.

16:400:526. (S) PREDICTING SHELF LIFE OF FOODS (3)
Yam. Prerequisites: 16:400:523,524.
Deteriorative kinetics of foods. The relationships between transport properties of packaging material and storage life of the packaged food. Techniques for measuring transport properties; computer simulations of shelf life.

16:400:527. FOOD PROCESS DESIGN (4)
Rossen, Ramalingam. Prerequisite: B.S. in food science or engineering.
Principles of food process design; applications of engineering, food science, and economics, using a case study approach based on food industry problems.

16:400:530. (S) ADVANCED FOOD SENSORY SCIENCE (3)
Tepper. Prerequisite: 01:960:401 or equivalent; basic physiology; nutrition.
In-depth study of the principles of sensory physiology, taste psychophysics, and sensory evaluation with emphasis on food and food constituents and the various methods of product testing. Includes laboratory exercises.

16:400:601,602. SEMINAR IN FOOD SCIENCE (1,1)
Required of all students.
Student and guest speakers. Topics presented contribute to some facet of food science. Student participation is focused on providing experience in preparing, presenting, and defending scholarly research.

16:400:603. SPECIAL TOPICS IN FOOD SCIENCE (BA)
Conference 3hrs.
Designed to permit a student to work on a relatively short-term library or laboratory project and prepare a final annotated paper, or to elect a specially arranged course of a visiting investigator.

16:400:701,702. RESEARCH IN FOOD SCIENCE (BA,BA)

FRENCH 420

Degree Programs Offered: Master of Arts, Master of Arts for Teachers, Doctor of Philosophy
Director of Graduate Program: Professor François Cornilliat,
103 Ruth Adams Building, Douglass Campus
(732/932-8223/3750)

Members of the Graduate Faculty

Marie-Denise Boros-Azzi, Professor of French, FAS-NB; Ph.D., California (Los Angeles)
Twentieth-century literature
François Cornilliat, Professor of French, FAS-NB; Doctorat, Paris VIII
Sixteenth-century literature; rhetoric and poetics
Viviane M. Deprez, Associate Professor of French and Linguistics, FAS-NB; Ph.D., Massachusetts Institute of Technology
Linguistics; phonetics
M. Josephine Diamond, Associate Professor of French, FAS-NB; Ph.D., Cornell
Nineteenth- and twentieth-century literature; critical theory
Uri A. Eisenzweig, Professor of French, FAS-NB; Doctorat, Paris VIII
Nineteenth- and twentieth-century literature; critical theory
Jerry Aline Flieger, Professor of French, FAS-NB; Ph.D., California (Berkeley)
Twentieth-century literature; critical theory; women's studies and feminist theory
Josephine Grieder, Professor of French, FAS-N; Ph.D., New York
Eighteenth-century literature; social history
Louise K. Horowitz, Professor of French, FAS-C; Ph.D., CUNY
Seventeenth-century literature
Christophe P.J. Lamiot, Assistant Professor of French, FAS-NB; Ph.D., California (Berkeley)
Twentieth-century French and Francophone literatures, dictionaries, poetry
Renée B. LARRIER, Associate Professor of French, FAS-NB; Ph.D., Columbia
African and Caribbean literature in French
Francis L. Lawrence, Professor of French, FAS-NB; President of the University; Ph.D., Tulane
Seventeenth-century literature
Richard D. Lockwood, Chairperson and Associate Professor of French, FAS-NB; Ph.D., Johns Hopkins
Seventeenth-century literature; rhetoric; critical theory
Ana Pairet, Assistant Professor of French, FAS-NB; Ph.D., Pennsylvania
Late medieval literature

Mary Lewis Shaw, Associate Professor of French, FAS-NB; Ph.D., Columbia
Nineteenth- and twentieth-century literature; performance arts
English Showalter, Professor of French, FAS-C; Ph.D., Yale
Seventeenth- and eighteenth-century literature
Mary B. Speer, Professor of French, FAS-NB; Ph.D., Princeton
Medieval language and literature; theory and practice of editing
James Swenson, Assistant Professor of French, FAS-NB; Ph.D., Yale
Eighteenth-century literature; critical theory
Jack Undank, Professor of French, FAS-NB; Ph.D., Harvard
Eighteenth-century literature; stylistics; visual arts
Alan L. Williams, Professor of French, FAS-NB; Ph.D., SUNY (Buffalo)
Film history; film theory; literary theory; contemporary French literature

Programs

The M.A. and Ph.D. programs deal with all important aspects of French literature and some related fields through a variety of critical approaches. These programs are open to candidates whose academic records and Graduate Record Examinations give evidence of distinguished accomplishment and promise of successful graduate work. The M.A.T. program in French studies is designed primarily for persons already involved in teaching French or using their knowledge of French and French civilization in some professional capacity; persons seeking to complement and refresh their awareness of current literary, cultural, and linguistic trends. Candidates for the M.A.T. are admitted on the basis of formal background and professional activity and need not submit Graduate Record Examination scores. Nonmatriculated students may take these courses. For all three programs, applications for September admission should be submitted by February 1 in order to receive full consideration for financial aid.

Candidates for the M.A. must satisfactorily complete 30 credits of course work (6 of which may be devoted to a research problem if the candidate elects to write a thesis), and pass an examination based on course work and a reading list. Those who wish to continue toward the Ph.D. are screened for that program at the time of the M.A. examination. Candidates for the M.A.T. also take ten term courses, chosen from among offerings in French and Francophone civilization, language, literature, and film. Students may take 6 credits of work in France. The degree is awarded after the student has taken a final written and oral examination based on course work.

Doctoral candidates are required to complete 48 credits of course work beyond the bachelor's degree. Credit for graduate work taken at other institutions may be accepted in partial fulfillment of the course requirement, but in no case will the doctoral candidate do less than one full year of course work (24 credits) at Rutgers.

Prospective candidates for the Ph.D. degree fulfill the residence requirement through full-time commitment to course work and/or research during two consecutive terms, excluding summer session. Doctoral candidates must demonstrate by examination a reading knowledge of two foreign languages in addition to French. These languages usually include a Romance language and either German or Latin, but substitution of a different language on the basis of relevance to projected research is possible. Greater proficiency in one language, proven by the successful completion of 6 credits of graduate course work in the literature of that language, may replace the second language requirement. Any of the above substitutions may be made only after receiving the approval of the graduate director. The language requirement must be satisfied before the candidate is admitted to the qualifying examination in a field of concentration. This examination is based on a reading list reflecting the research interests of the candidate. Once a student fulfills the course and language requirements and passes the qualifying examination, the student is admitted to candidacy for the Ph.D. degree and may then proceed with the preparation of the dissertation.

Reading lists upon which the examinations are based, as well as a Guide for Graduate Students in French, are available in the department office.

Graduate Courses

16:420:500. INTRODUCTION TO RHETORICAL AND STYLISTIC ANALYSIS (3)

Eisenzweig, Undank, Cornilliat

The techniques of literary interpretation of prose fiction, theater, and poetry. Critical readings and analyses of selected texts.

16:420:501. INTRODUCTION TO THE THEORY OF LITERATURE (3)

Eisenzweig, Flieger, Undank

The structure and range of such literary value judgments and critical analyses as the historical, thematic, phenomenological, Marxist, psychoanalytic, structuralist, poststructuralist, and gender-related approaches to literature.

16:420:502. PHONETICS (3)

Deprez

The theory and practice of French phonetics with emphasis on pedagogical approaches. Special attention to regional, social, and cultural influences on the production of speech.

16:420:503. ADVANCED GRAMMAR, STYLISTICS, AND THEORY OF LANGUAGE (3)

Deprez

Advanced French grammar and theory of language with special attention to typical problems of idiomatic expression; themes, oral presentations, and translation exercises.

16:420:504. TRANSLATION (3)

Translation as a linguistic, cultural, and creative exchange of signs from one language into another. Intensive practice in oral and written translation from literary, journalistic, and official sources.

16:420:505. STUDIES IN CONTEMPORARY FRENCH CULTURE (3)

Aspects of French society, history, geography, economy, intellectual and artistic life; institutions, codes of behavior, and patterns of thought; Franco-American relations and influences.

16:420:508. STUDIES IN FRANCOPHONE CULTURE (3)

Larrier, Diamond

Civilization and literatures of French-speaking Africa and America. Overviews and close examinations of the society, language, and literature of places as diverse as Sénégal, Haïti, and Québec.

16:420:512. TEACHING APPRENTICESHIP IN FRENCH (N1.5)

Observation of elementary and intermediate language classes; supervised practice teaching.

16:420:513. HISTORY OF THE FRENCH LANGUAGE (3)

Speer, Pairet

The development of the French language from its origins to the present. Consideration of the cultural forces that have influenced linguistic evolution in France.

16:420:601,602. INDIVIDUAL STUDIES IN FRENCH LITERATURE AND THEORY (3,3)

Available only by special arrangement with permission of the graduate adviser. An independent study course of directed readings in areas of particular interest, such as linguistics, critical theory, cinema studies, and studies of individual genres or issues.

16:420:611,612. OLD FRENCH LANGUAGE AND LITERATURE (3,3)

Speer, Pairet

Readings of selections from the various forms and periods of medieval French literature, with an introductory study of French philology.

16:420:613,614. STUDIES IN OLD FRENCH LANGUAGE AND LITERATURE (3,3)

Speer, Pairet

Intensive study of a medieval genre, theme, author, or major work such as *La Chanson de Roland*, *Tristan et Isolt*, *Le Roman de la Rose*; *Chrétien de Troyes*, *Villon*; literary and linguistic analysis; problems of textual criticism.

16:420:622. FRENCH LITERATURE OF THE RENAISSANCE (3)

Cornilliat

An introduction to the principal ideological and aesthetic currents of the sixteenth century through selected texts by the major poets (Marot, Scève, Labé, DuBellay, Ronsard, and D'Aubigné) and prose writers (Rabelais, Marguerite de Navarre, and Montaigne).

16:420:623. RABELAIS (3)

Cornilliat

Rabelais as humanist and storyteller; problems of language and the narrative in the early French Renaissance.

16:420:624. POETRY OF THE FRENCH RENAISSANCE (3)

Cornilliat

Jean Lemaire, Clément Marot; the School of Lyons; the *Pléiade*; scientific and satirical poets of the century's end.

16:420:625. MONTAIGNE (3)

Cornilliat

Critical reading of the *Essais* with attention to the dynamics of form and meaning.

16:420:631,632. FRENCH LITERATURE OF THE SEVENTEENTH CENTURY (3,3)

Horowitz, Lockwood, Showalter

Against the background of the age, a study of the main literary currents and an analysis of some of the significant works of the major writers.

16:420:633. THE CLASSICAL THEATER (3)

Horowitz, Lockwood

Intensive study of the forms, rhetoric, and meaning of the plays of Corneille, Racine, and Molière.

16:420:634. LA FONTAINE AND THE MORALISTES (3)

Horowitz, Lockwood

Study of La Rochefoucauld, La Fontaine, Pascal, Sévigné, La Fayette, Boileau, Perrault, or other selected writers whose work addresses moral, social, or political issues, with particular attention to rhetoric and subjectivity.

16:420:636. PASCAL (3)

Lockwood, Undank

Intensive study of problems in Pascal and Pascal criticism.

16:420:637,638. STUDIES IN FRENCH LITERATURE OF THE SEVENTEENTH CENTURY (3,3)

Lockwood, Horowitz

Intensive study of a major figure, theme, movement, or single work.

16:420:641,642. FRENCH LITERATURE OF THE EIGHTEENTH CENTURY (3,3)

Grieder, Showalter, Swenson, Undank

The rise and development of new literary forms and their relationship to intellectual and social changes of the Enlightenment.

16:420:643,644. STUDIES IN EIGHTEENTH-CENTURY FRENCH LITERATURE (3,3)

Grieder, Showalter, Swenson, Undank

Intensive study of a theme, period concept (rococo, "bourgeois" sentimentality, neoclassicism), stylistic practice, or major figure (Marivaux, Voltaire, Diderot, Rousseau).

16:420:651,652. FRENCH LITERATURE OF THE NINETEENTH CENTURY (3,3)

Diamond, Eisenzweig, Shaw

A study of the romantic movement in France with emphasis on the evolution of cultural history and art forms.

16:420:655. FLAUBERT (3)

Diamond

The development of the technique; his views on art, society, and man; his place in the history of the modern novel.

16:420:657. STUDIES IN NINETEENTH-CENTURY FRENCH

POETRY (3)

Diamond, Shaw

Ideologies and aesthetics of the romantic, Parnassian, or symbolist schools; or close examination of one major figure: Hugo, Baudelaire, Rimbaud, Mallarmé.

16:420:659. THE WRITER AND SOCIETY (3)

Eisenzweig

The interaction of historical, sociological, and political forces with writers and their aesthetics. Special attention to methodology.

16:420:661,662. FRENCH LITERATURE OF THE TWENTIETH CENTURY (3,3)

Boros-Azzi, Eisenzweig, Flieger, Lamiot, Shaw

Major contemporary French authors from surrealism to the anti-roman and the theater of the absurd, with special attention to the evolution of each genre.

16:420:663. FRENCH THEATER OF THE TWENTIETH CENTURY (3)

Boros-Azzi, Flieger, Lamiot, Shaw

Study of the modern theater as exemplified in the plays of Beckett, Ionesco, and Genêt.

16:420:664. SARTRE AND EXISTENTIALISM (3)

Boros-Azzi

The ideas and literary achievements of Sartre and Simone de Beauvoir; Camus's relation to the group.

16:420:667,668. STUDIES IN FRENCH LITERATURE OF THE TWENTIETH CENTURY (3,3)

Boros-Azzi, Flieger, Lamiot, Larrier, Shaw

Intensive study of a major figure, movement, or theme.

16:420:671. STUDIES IN FRANCOPHONE LITERATURE (3)

Lamiot, Larrier

Intensive study of major works of African, Caribbean, or Canadian literature in French. Emphasis on selected authors, genres, themes, or literary movements.

16:420:673,674. THE NOVEL IN FRANCE (3,3)

Diamond, Eisenzweig, Showalter, Undank

Forms of the French novel from L'Astrée to the "nouveau roman." The relationship of rhetoric to meaning; contemporary approaches. LaFayette, Diderot, Laclos, Sade, Stendhal, Gautier, Balzac, Flaubert, Gide, Colette, Proust, Sartre, Robbe-Grillet, Sarraute.

16:420:675. (F) STUDIES IN FILM AND FILM THEORY (3)

Williams

The history of French cinema from Lumière and Méliès to the New Wave. Examination of contemporary critics and critical approaches.

16:420:681. FRENCH RHETORIC AND POETICS (3)

Cornilliat, Lockwood

The evolution of rhetoric and poetics and their application to literature from the Renaissance to modern times.

16:420:682. PERSPECTIVES OF CONTEMPORARY CRITICISM (3)

Diamond, Eisenzweig, Flieger, Swenson, Undank

The New French Criticism: theory and models of the phenomenological, structuralist, generative, or poststructural enterprise.

16:420:687. TOPICS IN FRENCH LITERATURE (3)

Analysis of special problems, such as "Ideas and Ideologies 1930-1980."

16:420:691,692,693,694. HALF-TERM PROJECTS (1.5,1.5,1.5,1.5)

Half-term courses devoted to an aspect of critical theory, a single literary work, a scholarly or textual problem, or a theme spanning more than one literary period.

16:420:701,702. RESEARCH IN FRENCH (BA,BA)

Interdisciplinary Graduate Course

15:617:510. INTRODUCTION TO LITERARY THEORY (3)

Flieger, Marsh, Eisenzweig, Edmunds, Lockwood, Persin, Galperin, Davidson, Swenson, et al. Prerequisite: Open to second-term graduate students; priority given to students from programs participating in the Council of Languages and Literature.

An introduction to contemporary literary theory, including formalism, structuralism, poststructuralism, feminism, psychoanalysis, cultural studies, and other approaches. Readings of theoretical texts and applications to short literary texts from a variety of literatures.

GEOGRAPHY 450

Degree Programs Offered: Master of Arts, Master of Science, Doctor of Philosophy

Director of Graduate Program: Professor David A. Robinson, Lucy Stone Hall, Livingston Campus (732/445-4106)

Members of the Graduate Faculty

Gail M. Ashley, Professor of Geological Sciences, FAS-NB; Ph.D., British Columbia

Sedimentology; geomorphology; environmental geology; modern processes

Baruch Boxer, Professor of Geography and Human Ecology, CC; Ph.D., Chicago
Comparative environmental science and policy; marine affairs; twentieth-century China

Michael R. Greenberg, Professor of Urban Studies and Public Health, EJBSPPP; Ph.D., Columbia

Environment and health; mathematical methods

Briavel Holcomb, Professor of Urban Studies, EJBSPPP; Ph.D., Colorado
Urban revitalization; social and behavioral; women

Robert M. Hordon, Associate Professor of Geography, FAS-NB; Ph.D., Columbia
Water resources; physical geography

Robert W. Lake, Professor of Urban Planning and Policy Development, EJBSPPP; Ph.D., Chicago

Urban restructuring; social and environmental policy analysis; political

Richard G. Lathrop, Jr., Associate Professor of Environmental Resources, CC; Ph.D., Wisconsin (Madison)

Remote sensing and spatial modeling of terrestrial/aquatic ecosystems

Scott Madry, Senior Associate Director of Remote Sensing Center, CC; Ph.D. North Carolina (Chapel Hill)

Remote sensing; geographic information systems; natural resource assessment; prehistory; GPS

J. Kenneth Mitchell, Professor of Geography, FAS-NB; Ph.D., Chicago

Environment and public policy; coastal and marine; human response to hazards

George H. Nieswand, Professor of Environmental Resources, CC; Ph.D., Rutgers
Land, water, and agricultural resources; environmental systems

Karl F. Nordstrom, Professor, IMCS; Ph.D., Rutgers
Coastal geomorphology

Frank Popper, Professor of Urban Studies, EJBSPPP; Ph.D., Harvard

Land use, environmental and regional policy; natural resources management

Norbert P. Psuty, Professor of Geography and Geology and Associate Director of the Institute for Marine and Coastal Studies, IMCS/CC; Ph.D., Louisiana State

Coastal geomorphology; process-response models; coastal management

Joanna M. Regulska, Associate Professor of Geography, FAS-NB; Ph.D., Colorado
Urban policy; planned-market economy; geography of women

David A. Robinson, Professor of Geography, FAS-NB; Ph.D., Columbia
Climatology; cryosphere; solar radiation; physical geography

Thomas Rudel, Professor of Sociology, CC; Ph.D., Yale

Latin America; environment; development

Richard Schroeder, Assistant Professor, FAS-NB; Ph.D., California (Berkeley)
Development; gender; Africa; agriculture; social theory and environment

Neil Smith, Professor of Geography, FAS-NB; Ph.D., Johns Hopkins
Urban geography; gentrification; regional restructuring; uneven development; history of geography; social theory

Andrew P. Vayda, Professor of Anthropology and Ecology, CC; Ph.D., Columbia

Human ecology; methodology and explanation; human impact in tropical areas; agro-ecological knowledge transmission and use

Peter O. Wacker, Professor of Geography, FAS-NB; Ph.D., Louisiana State
Historical; cultural

Lyna Wiggins, Associate Professor of Urban Planning and Policy Development, EJBSPPP; Ph.D., California (Berkeley)

Planning methods; computer applications in planning

Elvin K. Wyly, Assistant Professor of Geography and Urban Planning and Policy Development, EJBSPPP; Ph.D., Minnesota

Urban restructuring; gentrification; labor markets; gender

Associate Members of the Graduate Faculty

Tuvo M. Airola, Professor of Environmental Resources, CC; Ph.D., Duke

Applied ecology; remote sensing; environmental planning

Ann R. Markusen, Professor of Urban Planning and Policy Development,

EJBSPPP; Ph.D., Michigan State

Regional economics; political economy; industrial organizations

Dona Schneider, Associate Professor of Urban Studies and Community Health,

EJBSPPP; Ph.D., Rutgers

Medical geography; epidemiology; minority health

Programs

The graduate program provides students with a thorough understanding of the theory, principles, and research skills of geographical inquiry. For the Ph.D. degree, students pursue course work and submit a dissertation on the basis of original research in a specific subfield of geography. The program has particular strengths in three areas: urban geography and social theory, environmental geography, and physical geography. For the master's degree, course work, a thesis (6 credit hours), and a comprehensive written and oral examination comprise the major requirements; a shorter research paper, a written and oral examination, and an additional 6 credits of course work may be substituted for the thesis requirement.

A broad range of disciplinary subfields is represented among the graduate faculty. Ongoing research includes various collaborative international as well as local projects and focuses on the following specific topics:

Urban Geography and Social Theory. Political economy of urban development, comparative urbanization, women and the urban environment, urban restructuring, housing and spatial segregation, gentrification, East European urban policy, regional development and decline, uneven global development, cultural historical geography of New Jersey, political geography, space and social theory, history of geography.

Environmental Geography. Global environmental change, perception of and policy responses to natural and technological hazards, geography of technological hazards, environmental health risks and planning, medical geography, toxic waste siting, remote sensing of resources and hazards, GIS applications, resource management, land use, political economy of nature, gender and environment; development and environment.

Physical Geography. Glacial and periglacial geomorphology, permafrost, sedimentology, quaternary studies, global and regional climate change, cryospheric dynamics, surface radiative dynamics, coastal geomorphology, coastal process-response modeling, coastal management, ground water and water supply, urban hydrology.

Valuable interdisciplinary links connect the geography department with various research institutes, programs, and other departments in the university, and in addition to core course work in geography, graduate students are encouraged to enroll in courses relevant to their research interests in other units of the university.

For the Ph.D. a minimum of 72 credits is required, at least 48 in nondissertation course work beyond the bachelor's degree and at least 24 credits in dissertation research. In consultation with their advisers, students select a faculty committee; upon the completion of course work students submit a dissertation proposal and take the qualifying examination. For the master's degree (the M.S. is awarded to students in physical geography, the M.A. to those in human geography), 30 credit hours (not less than 24 in course work) are required beyond the bachelor's degree. The Research Proseminar (16:450:603) is required for all new graduate students pursuing a degree through the graduate program in geography.

Applicants for the graduate program in geography should hold an appropriate, accredited undergraduate degree, although this need not be in geography. Four criteria guide the admissions process: (1) a cumulative grade-point average of 3.25 or better (or equivalent for international students); (2) competitive Graduate Record Examination general test scores; (3) strong letters of recommendation from at least three references; (4) a persuasive and well-focused personal statement describing academic goals and research interests. Financial support in the form of teaching assistantships, graduate assistantships, and university fellowships

is available on a competitive basis to students with excellent qualifications. Applicants seeking financial aid should submit applications by February 1 at the latest.

Further information can be obtained from the current edition of the booklet *Graduate Study in Geography at Rutgers University*, available from the department office and from the department's worldwide web homepage at <<http://madagascar.rutgers.edu>>.

Graduate Courses

16:450:501. (F) INTRODUCTION TO NATURAL RESOURCES MANAGEMENT (3)

Review of recent literature on natural resources management, with emphasis on identifying and analyzing research themes and methodologies employed by contemporary geographers.

16:450:502. (S) RESOURCE MANAGEMENT DECISION MAKING (3)

Prerequisite: 16:450:501 or equivalent.
Individual and collective behavior theories applied to the analysis of private decisions and public natural resource policy, from a human ecological perspective.

16:450:503. (S) ENVIRONMENTAL MANAGEMENT (3)

Prerequisite: 16:450:502 or equivalent.
Contemporary resource management issues in the United States, including resource evaluation, environmental impact assessment, and planning procedures. Emphasis on conflict resolution, public participation, and the role of science in decision making.

16:450:504. (F) COASTAL GEOMORPHOLOGY (3)

Prerequisite: 01:450:403 or 404 or equivalent.
Erosional and depositional processes in the coastal environment. Process-response models and problem-solving methods in coastal research.

16:450:505. (F) ADVANCED PHYSICAL GEOGRAPHY (3)

Prerequisite: 01:450:403 or 404 or equivalent.
Selected topics within the general field of earth science.

16:450:507. (S) APPLIED GEOMORPHOLOGY (3)

Prerequisite: 01:450:403 or 404 or equivalent.
Applications of modern geomorphological research to environmental management including geomorphological constraints to human activity and human effects on landform processes.

16:450:508. (S) ENVIRONMENTAL PROBLEMS IN DEVELOPING COUNTRIES (3)

Similarities and differences among developing countries in their environmental problems, their definitions of them, and their policies about them. The role of economic development in either solving or causing environmental problems. Environmental considerations in development planning.

16:450:509. (F) HUMAN GEOGRAPHICAL PROBLEMS OF DEVELOPING COUNTRIES (3)

Human underpinnings to problems of development as seen from the perspectives of historical, political, demographic, economic, and social geography. Case studies and examples from the third world.

16:450:510. (S) URBAN WATER RESOURCES MANAGEMENT (3)

Problems in the management of water use in metropolitan environments. The effects of urbanization on the hydrologic regime. The influence of geohydrologic factors on water use decisions.

16:450:511. (S) LAND USE SYSTEMS (3)

Environmental factors in land use planning. Land use data systems including storage and retrieval, "third dimension" planning; water and ground below the surface soil. Multivariate analysis of land variables. Land use and water quality.

16:450:513. (S) SETTLEMENT GEOGRAPHY (3)

Fieldtripsrequired.
Evolution and morphology of selected rural settlement landscapes interpreted in terms of natural conditions, institutional factors, and economic functions.

16:450:515. (S) POPULATION MIGRATION AND MOBILITY (3)

Analysis of population mobility at the international (immigration, guest workers, refugees), interregional, and intraurban levels through examination of spatial patterns of migration, locational decisions, impact of migrants in places, and population redistribution policies.

16:450:516. (S) URBAN GEOGRAPHY (3)

Geographic aspects of urbanization, theories of contemporary urban geography, and their application to existing urban patterns.

16:450:517,518. DIRECTED STUDY IN GEOGRAPHY (3,3)

Prerequisite: Permission of graduate director.
Directed readings and individual study supplementary to formal courses.

16:450:519. (F) PROBLEMS IN POLITICAL GEOGRAPHY (3)

Geographic implications of state theory, locational conflict, public policy, and national-local government relations.

16:450:520. WOMEN IN THE URBAN ENVIRONMENT (3)

Documentation of the spatial constraints faced by women in the urban environment; examination of women's roots in the context of the interrelation between the activities of production and reproduction.

16:450:525. RESTRUCTURING OF CENTRAL AND EASTERN EUROPE AFTER 1989 (3)

Examination of the roots of the collapse of totalitarian regimes in Central and Eastern Europe. Analyzes spatial implications of the transition for urban development, gender relations, economic restructuring, and environmental change.

16:450:530. DATA STRUCTURES AND ALGORITHMS FOR SPATIAL PROBLEMS (3)

Prerequisites: 01:450:420 or 11:372:415.
Discussion and hands-on programming of data structures and algorithms used in geographic information systems.

16:450:601,602. FIELD AND RESEARCH METHODS IN GEOGRAPHY (3,3)

Research procedures and methods, survey of past and current literature, data collection and analysis, preparation of reports, papers, and theses; colloquia on analytical problems.

16:450:603. (F) RESEARCH PROSEMINAR (3)

Required for graduate degrees.
Evolution and status of main disciplinary subfields, contemporary paradigms, transdisciplinary relationships, professional employment trends, introduction to geographical bibliography, and basic research skills.

16:450:605,606. GEOGRAPHY SEMINAR (3,3)

Lectures and special problems in current issues. Course content varies according to student and faculty interest.

16:450:607. (S) SEMINAR IN HISTORICAL CULTURAL GEOGRAPHY (3)

Origins and diffusions of selected material and nonmaterial culture traits in North America from the seventeenth through the nineteenth centuries.

16:450:608. (F) FOUNDATIONS OF MODERN GEOGRAPHY (3)

Philosophical and methodological issues in the study of geography.

16:450:611. (S) PERCEPTION OF THE URBAN ENVIRONMENT (3)

Spatial images, residential preferences, urban hazards, neighborhood identification, designs for legibility and safety, urban environmental quality.

16:450:612. NATURAL HAZARDS MANAGEMENT (3)

Analysis of human and environmental contributions to the generation and management of natural hazards, including, among others, earthquakes, hurricanes, floods, and droughts. Contemporary public policy issues at national and international levels of government. Theoretical emphasis on decision making in the face of uncertainty.

16:450:613. (F) SEMINAR IN COASTAL RESOURCES GEOGRAPHY (3)

Analysis of contemporary maritime management issues, including ecosystem preservation, energy facilities siting, ocean dumping, storm disaster mitigation, port development, waterfront revitalization, and beach recreation. Focus on U.S. and international public policy.

16:450:614. (F) SEMINAR IN MEDICAL GEOGRAPHY (3)

Advanced topics of medical geography. Student research and analysis of specific problems.

16:450:615. (S) SEMINAR IN REMOTE SENSING (3)

Remote sensors and their research capabilities. Research design for remote sensing studies.

16:450:616. SEMINAR IN TECHNOLOGICAL HAZARDS (3)

Human strategies for managing technological hazards. Development and application of public approaches to technological hazards management in a global context.

16:450:617. SEMINAR IN REMOTE SENSING OF THE BIOSPHERE (3)

Lathrop. Prerequisites: 16:450:615 or equivalent or permission of instructor.
The application of satellite remote sensing and geographic information system technology to monitor and model the earth's biosphere, including terrestrial/aquatic primary production, biogeochemical cycling, and climate dynamics.

16:450:625. SEMINAR IN GEOGRAPHIC INFORMATION SYSTEMS (3)

Prerequisites: 01:450:420 or 11:372:415.
Advanced topics in geographic information systems: raster/vector data structures, GIS modeling. Requires literature review and hands-on computer analysis.

16:450:632. (S) SEMINAR IN REGIONAL GEOGRAPHY (3)

Selected world regional and interregional problems associated with environmental constraints, natural resource use, and other public policy issues. Varying foreign area focus.

16:450:650,651. MASTER'S PAPER IN GEOGRAPHY (3,3)

16:450:701,702. RESEARCH IN GEOGRAPHY (BA,BA)

GEOLOGICAL SCIENCES 460

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Michael J. Carr, Wright-Rieman Laboratories, Busch Campus (732/445-2044)

Members of the Graduate Faculty

Gail M. Ashley, Professor of Geological Sciences, FAS-NB; Ph.D., British Columbia
Sedimentology; geomorphology; quaternary geology; modern processes
Michael J. Carr, Chairperson and Professor of Geological Sciences, FAS-NB;
Ph.D., Dartmouth
Convergent plate margins; volcanology, tectonics, igneous petrology
Jeremy S. Delaney, Research Scientist, Geological Sciences, FAS-NB; Ph.D.,
Queens (Belfast)
Microbeam analysis of terrestrial and extraterrestrial materials
Mark D. Feigenson, Professor of Geological Sciences, FAS-NB; Ph.D., Princeton
Geochemistry of igneous rocks and other geologic samples
Claude T. Herzberg, Professor of Geological Sciences, FAS-NB; Ph.D., Edinburgh
Solid and liquid silicate solutions; applications to planetary interiors
Gregory F. Herzog, Professor of Chemistry, FAS-NB; Ph.D., Columbia
Meteoritics; radiometric dating and cosmic ray exposure; trace elements
Roger H. Hewins, Professor of Geological Sciences, FAS-NB; Ph.D., Toronto
Petrology of meteorites, mafic and ultramafic rocks; mineral chemistry
Richard A. Lutz, Professor of Marine and Coastal Sciences, IMCS; Ph.D., Maine
Marine ecology and paleoecology; malacology; invertebrate paleontology;
ecology of deep-sea hydrothermal vents

George R. McGhee, Professor of Geological Sciences, FAS-NB; Ph.D., Rochester
Evolutionary theory; mass extinction; community paleoecology and evolution;
functional and theoretical morphology; Paleozoic stratigraphy

Kenneth G. Miller, Sr., Professor of Geological Sciences, FAS-NB; Ph.D.,
Massachusetts Institute of Technology/Woods Hole Oceanographic Institution
Joint Program in Oceanography
Cenozoic sea-level and paleoceanographic changes; integration of isotope, bio-,
magneto-, and seismic stratigraphy

Richard K. Olsson, Professor of Geological Sciences, FAS-NB; Ph.D., Princeton
Micropaleontology; stratigraphy; paleoecology; paleobathymetry of Cretaceous and
Cenozoic foraminifera

Norbert P. Psuty, Professor of Geography and Geology and Associate Director
of the Institute for Marine and Coastal Studies, IMCS, CC; Ph.D., Louisiana State
Beach morphodynamics, coastal dunes; general coastal geomorphology
and sedimentology

David A. Robinson, Professor of Geography, FAS-NB; Ph.D., Columbia
Climatology; cryosphere; solar radiation; physical geography

Peter A. Rona, Professor of Geological Sciences and Marine and Coastal Sciences,
FAS-NB/IMCS; Ph.D., Yale
Oceanic ridge crest processes; sea floor hydrothermal processes; marine geology
and geophysics

Roy W. Schlische, Associate Professor of Geological Sciences, FAS-NB;
Ph.D., Columbia
Extensional tectonics; structural and stratigraphic development of rift basins;
growth of faults

Michele A. Seidl, Assistant Professor of Geological Sciences, FAS-NB; Ph.D.,
California (Berkeley)
Geomorphology; hydrogeology

Robert E. Sheridan, Professor of Geology and Geophysics, FAS-NB;
Ph.D., Columbia
Seismic reflection and refraction; seismic stratigraphy; general geophysics;
geology of the Atlantic continental margin

Robert M. Sherrell, Assistant Professor of Geological Sciences and Marine and
Coastal Sciences, FAS-NB/IMCS; Ph.D., Massachusetts Institute of Technology/
Woods Hole Oceanographic Institution
Geochemistry of marine and fresh waters; paleochemical records in ice cores

Associate Members of the Graduate Faculty

Lloyd Burckle, Adjunct Professor of Geological Sciences, FAS-NB; Ph.D., New York
Micropaleontology (diatoms), paleoceanography, ice volume history

Alexander E. Gates, Associate Professor of Geology, FAS-N; Ph.D., Virginia
Polytechnic Institute and State University
Tectonics; structural geology; deformational-chemical interactions
in orogenic belts

Michael J. Kennish, Supervising Research Scientist, IMCS; Ph.D., Rutgers
Biology and geology of deep-sea hydrothermal vents; anthropogenic impacts on
coastal and estuarine waters

Kathleen M. Scott, Associate Professor of Zoology, FAS-NB; Ph.D., Yale
Functional morphology; paleoecology of ungulates; mammalian evolution

Adjunct Members of the Graduate Faculty

Yang Yu, Research Associate in Geological Sciences, FAS-NB;
Ph.D., Massachusetts
Petrology and geochemistry of meteorites and mafic igneous complexes;
geochronology

Brigitte M. Zanda, Maitre de Conférences des Universités II, Muséum National
d'Histoire Naturelle, Paris; Ph.D., Paris
Meteoritics; chondrule formation, evolution and metamorphism; cosmic
ray exposure

Programs

The research activities of the program concentrate in the areas of stratigraphy, sedimentology, paleontology, paleoecology, biostratigraphy, structural geology, tectonics, geochemistry, geophysics, volcanology, igneous petrology, and geomorphology. A broad background in chemistry, physics, and mathematics as well as geology is stressed. The graduate committee sets forth the curricular program of each new student and encourages each student to outline a research program in consultation with a faculty member who then becomes the student's adviser.

A written thesis, 24 credits of course work, and 6 credits of research are required for the master's degree. A minimum of 36 credits of course work out of a total 72 credits is required for the doctorate. A candidate for the Ph.D. must pass an examination in one foreign language, demonstrate satisfactory capability in computers, and pass a qualifying examination that includes a comprehensive written examination and an oral defense of the proposed dissertation research. One year of full-time graduate work satisfies the residency requirement. The Master of Philosophy degree is available to doctoral candidates.

All applicants should submit three letters of recommendation and the results of the Graduate Record Examination including the subject test. Part-time students are encouraged to apply to the program.

Graduate Courses

- 16:460:501. (S) ECONOMIC GEOLOGY (3)
Feigenson. Prerequisite: 01:460:401 or 402 or equivalent.
Geochemistry of hydrothermal ore deposits, including studies of alteration, ore mineral solubility, fluid inclusions, mass transfer, and stable and radiogenic isotopes.
- 16:460:503. (F) STUDIES IN PALEONTOLOGY (3)
Prerequisites: 01:460:303, 304, or equivalent.
Topics include methods and case studies in systematics, evolution and extinction, paleogeography, paleoclimate, and other topics of current interest. Emphasis on the relationship between geological and biological processes.
- 16:460:505. (F) SEDIMENTARY GEOLOGY (3)
Ashley, Miller, Olsson. Prerequisites: 01:460:307, 341.
Topics of current interdisciplinary research in sedimentary geology. Sequence stratigraphy, facies models, sea-level change, unconformities/hiatuses, tectonics, climate change, evolution, mass extinctions.
- 16:460:506. (S) STRUCTURE AND FORMATION OF THE EARTH (3)
Feigenson, Herzberg, Hewins. Prerequisites: 01:460:302, 307, 401, or permission of instructor.
Topics of current research on the internal structure of the earth. Mantle structure, phase changes, seismic discontinuities, trace element/isotopic properties, mineral physics, core formation, meteorites, moons, asteroids.
- 16:460:507. (S) GEODYNAMICS (3)
Carr, Schlische, Sheridan. Prerequisites: 01:460:307, 312.
Topics of current research in structural geology, geophysics, and tectonics. Deformation of the crust and mantle; convection in the mantle and core; the gravity and magnetic field of the earth; plate tectonics and the origin of earthquakes and volcanoes.
- 16:460:508. (F) MINERAL PHASE RELATIONS (3)
Hewins. Prerequisite: 01:460:308.
Free-energy diagrams and phase diagrams, equilibrium and kinetics, nucleation theory, undercooling, diffusion. Major groups of rock-forming minerals; comparison of laboratory data and theoretical models with assemblages, compositions, and morphologies actually observed in slowly cooled and rapidly cooled rocks.
- 16:460:509. (F) METEORITICS (3)
Hewins. Prerequisite: 01:460:302.
Petrology and geochemistry of meteorites, origin of solar system, thermal history of asteroids.

- 16:460:511. (S) PETROLOGY (3)
Herzberg. Prerequisites: 01:460:301, 302 or equivalent.
Basic principles of thermodynamics applied to solid-solid and solid-liquid equilibria in silicate systems; igneous and metamorphic processes that structured the petrology of the earth's crust and mantle through time.
- 16:460:512. (S) METAMORPHIC PETROLOGY (3)
Herzberg. Prerequisites: 01:460:301, 302 or equivalent.
Principles of thermodynamics applied to the stabilities of mineral assemblages in meta-igneous and meta-sedimentary rocks of the earth's crust; fluids in the crust; metamorphism and plate tectonics.
- 16:460:513. (S) VOLCANOLOGY (3)
Carr. Prerequisite: 01:460:302 or equivalent.
Geologic settings of volcanoes; geophysical and geochemical constraints on the origin of magmas; energetics and periodicity; volcanoes and earthquakes; eruption mechanisms; volcanic hazards and prediction; geothermal power and volcanogenic ore deposits.

16:460:514. (S) DEPOSITIONAL ENVIRONMENTS (3)
Ashley. Prerequisite: 01:460:340 or equivalent.
Examination of clastic depositional environments, with emphasis on sedimentary processes. Sediment sampling and analyzing; sedimentary structures; grain characteristics; facies models.

16:460:515. (F) ADVANCED TECTONICS (3)
Schlische. Prerequisites: Structural geology; two terms of calculus.
Plate tectonic theory; quantitative analysis of plate motions on a sphere; use of paleomagnetism and seismology in tectonics; causes of plate motion.

16:460:516. (F) ADVANCED STRUCTURAL GEOLOGY (3)
Schlische. Lec. 2 hrs., lab. 3 hrs. Prerequisites: Structural geology, two terms of calculus, linear algebra.
Advanced topics in structural geology including: tensor analysis of stress and strain; practical strain measurement; geometric, kinematic, and dynamic analysis of folds and fractures; seismic expression of structural styles.

16:460:519. (F) MESOZOIC-CENOZOIC STRATIGRAPHY (3)
Miller. Prerequisite: 01:460:304.
Study of the Mesozoic-Cenozoic stratigraphic sequences in different basinal settings and relationship to tectonic history.

16:460:525. (S) MARINE SEDIMENTOLOGY (3)
Ashley. Prerequisite: 01:460:340 or equivalent.
Examination of the physical processes of sedimentation on the continental shelf and continental slope environments. The interrelationship between organisms and sediment as well as environmental problems.

16:460:526. (F) PALEOCEANOGRAPHY (3)
Miller, Olsson. Prerequisite: Paleontology.
Paleoecology, paleoclimatology, and paleogeography of marine microfossils; study of major paleoceanographic events and their relationships to stratigraphy and sedimentary facies.

16:460:538. (S) EVOLUTIONARY PALEOECOLOGY (3)
McGhee. Prerequisite: 01:460:303 or equivalent.
Seminar on the evolution of ecological systems in geologic time; application of evolutionary theory to paleoecological patterns and processes.

16:460:541. (F) MARINE GEOLOGY (3)
Miller. Prerequisite: 01:460:341 or equivalent; or permission of instructor.
Structure and evolution of ocean basins, continental margins, and marine sediments.

16:460:551. (S) ISOTOPE GEOCHEMISTRY (3)
Feigenson. Prerequisite: 01:460:401 or equivalent.
Studies of stable and radiogenic isotopes in the earth's mantle and crust. The use of isotopes in age dating, source tracing, and geothermometry.

16:460:555. (F) GEOPHYSICS I (3)
Sheridan. Prerequisites: 01:460:307, 01:640:252, 01:750:204, or permission of instructor.
Theory and application of seismic refraction, seismic reflection, deep earth seismology, surface waves, and heat flow. Collection and interpretation of seismic data.

16:460:556. (S) GEOPHYSICS II (3)
Sheridan. Prerequisites: 01:460:307, 01:640:252, 01:750:204, or permission of instructor.
Theory and application of gravity, magnetics, paleomagnetism, and electrical prospecting. Measurement and interpretation of potential field anomalies.

16:460:560. (S) NUMERICAL METHODS IN PALEOECOLOGY (3)
McGhee. Prerequisite: Calculus and statistics, or permission of instructor.
Digital computational methods for paleoecologists and paleontologists; measurement systems and data transformation; statistics; discrete association and gradient analytic techniques for paleoecological research. Emphasis on applied data analysis.

16:460:561. (F) STUDIES IN MICROPALAEONTOLOGY (3)
Olsson. Prerequisites: 01:460:303, 341.
Paleoecology and biostratigraphy of foraminifera; identification and interpretation of microscopic organic remains in rocks and sediments.

16:460:601,602. ADVANCED STUDIES IN GEOLOGY (BA,BA)

16:460:611. SEMINAR IN GEOLOGY (BA)
Course may be taken more than once.
Special topics chosen each term.

16:460:701,702. RESEARCH IN GEOLOGY (BA,BA)

GERMAN 470

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Director of Graduate Program: Professor Marlene Ciklamini,
302 German House, 64 College Avenue, College Avenue Campus
(732/932-7201/7379)

Members of the Graduate Faculty

Marlene Ciklamini, Professor of German, FAS-NB; Ph.D., Yale
History of the German language; Old Norse literature; Medieval studies
Christine Cosentino-Dougherty, Professor of German, FAS-C; Ph.D., Columbia
Literature before and after German unification; expressionism
William C. Donahue, Assistant Professor of German, FAS-NB; Ph.D., Harvard
Nineteenth- and twentieth-century literature; German-Jewish studies
Hildburg Herbst, Associate Professor of German, FAS-NB; Ph.D., Princeton
Eighteenth-century romanticism; German literature; German cinema
Erna K. Neuse, Professor Emerita of German, FAS-NB; Ph.D., Vienna
Modern German and Austrian literature; methodology
Joanna M. Ratyck, Professor Emerita of German; FAS-NB; Ph.D., Munich
Contemporary German literature; stylistics
James A. Rushing, Associate Professor of German, FAS-C; Ph.D., Princeton
Medieval studies, nineteenth- and twentieth-century narrative
Otto J. Zitzelsberger, Professor of German, FAS-N; Ph.D., Columbia
German philology and literature prior to 1500

Programs

The areas of specialization available include philology, older German literature prior to the baroque period, and German literature of the seventeenth, eighteenth, nineteenth, or twentieth century. Requirements for the master's degree are 30 credits of course work beyond the bachelor's degree (or 24 credits and a thesis), and an examination covering the general field of German literature, as well as history of the German language (including a knowledge of Middle-High German).

Requirements for the doctorate are a minimum of 48 credits of course work beyond the bachelor's degree, one additional language as deemed most appropriate by the candidate's advisers, a comprehensive written examination based on a core reading list, an oral examination in the candidate's areas of specialization, and a dissertation. The Ph.D. qualifying examination may be taken in parts spaced over six months. No more than 3 credits for the master's degree and no more than 6 credits for the doctorate may be taken in independent study courses. A Master of Philosophy degree can be obtained by candidates who complete their course work and qualifying examination within four years. Although there is no formal residence requirement, the candidates accepted must be available for close supervision and consultation.

Courses at the 500 and 600 level are open to all graduate students and constitute the major portion of the program. As part of their graduate training, doctoral students are given the opportunity to assume certain teaching obligations under faculty supervision. Further details concerning the program, including additional information on the qualifying examination and the dissertation, as well as information on teaching assistantships, can be found in Graduate Programs in German and in Guidelines for Graduate Students in German. These pamphlets are available on request from the office of the graduate director.

Graduate Courses

Three to four courses from the following list are normally offered each term.

16:470:501. THE TEACHING OF COLLEGE GERMAN (3)

Neuse

Introduction to the nature of language acquisition; critical examination of instructional materials; principles of cultural analysis; theory and practice of teaching literature. Patterned to the practice of college instruction.

16:470:502. TEACHING APPRENTICESHIP IN GERMAN (N1.5)

Weekly workshops for teaching, testing, and evaluation techniques in elementary and intermediate language courses. Observation of language classes.

16:470:510. LITERARY THEORY AND METHODOLOGY (3)

Ciklamini, Rushing, Recommended during the first year.

Study and practice of scholarly techniques, the use of secondary literature for research, the writing of papers, and an overview of literary theories.

16:470:511. ADVANCED GRAMMAR (3)

Ciklamini

Comparison of syntactic and semantic differences between source and target languages.

16:470:512. ADVANCED STYLISTICS (3)

Ratych

Studies in the nature and development of literary styles and nonfiction prose from the sixteenth century to the present, with emphasis on the expressive possibilities of various syntactic modes.

16:470:513. ANALYSIS OF LITERARY TEXTS (3)

A study of selected works of poetry, drama, and prose with a view to increasing a teacher's faculties of literary interpretation and aesthetic judgment.

16:470:515. HISTORY OF THE GERMAN LANGUAGE (3)

Ciklamini, Zitzelsberger

Survey of linguistic changes and phenomena from the Indo-European era to the present.

16:470:516. INTRODUCTION TO MIDDLE-HIGH GERMAN (3)

Ciklamini, Zitzelsberger

Phonology and grammar. Reading of representative texts from the Middle-High German period A.D. 1050 to A.D. 1350, with special emphasis on the popular epic, court epic, and "Minnesänger."

16:470:517. INTRODUCTION TO OLD HIGH GERMAN (3)

Zitzelsberger

A survey of the morphology of Old High German with readings and discussions of representative literary texts as recorded in the various dialects.

16:470:520. LITERATURE OF THE MIDDLE AGES (3)

Ciklamini, Zitzelsberger

Analysis of the folk epic (Nibelungenlied) and its sources, the courtly romances of Hartmann von Aue, Wolfram von Eschenbach, and Gottfried von Strassburg, the saint's legend, and of poems by prominent "Minnesänger."

16:470:521. LITERATURE OF THE RENAISSANCE, REFORMATION, AND BAROQUE (3)

Zitzelsberger

Sociohistorical overview of German literature of the sixteenth and seventeenth centuries.

16:470:522. FROM ROCOCO TO CLASSICISM (3)

Herbst

Literature of the eighteenth century with emphasis on "Anakreontik," "Sturm und Drang," and the "Weimarer Klassik," focusing mainly on contemporaries of Goethe and Schiller.

16:470:523. GERMAN ROMANTICISM (3)

Ciklamini, Herbst

The aims and characteristics of the romantic movement as reflected in the works of Hölderlin, Novalis, Kleist, Brentano, Eichendorff, and Hoffmann.

16:470:524. NINETEENTH-CENTURY REALISM (3)

Rushing, Donahue

Studies in the theory, themes, and styles of German literary realism in the nineteenth century, focusing on the works by Büchner, Hebbel, Stifter, Keller, Meyer, Storm, and Fontane.

16:470:525. LITERATURE OF THE TWENTIETH CENTURY BEFORE 1945 (3)

Donahue, Neuse

A study of significant literary works and trends against the background of late Wilhelminian Germany, the Weimar Republic, and the Nazi era.

16:470:526. LITERATURE OF THE TWENTIETH CENTURY AFTER 1945 (3)

Consentino-Dougherty, Donahue, Neuse

A study of German writers after World War II, including Bernhard, Borchert, Böll, Dürrenmatt, Frisch, Grass, Handke, Hochhuth, Johnson, Lenz, Botho Strauss, Walser, and Weiss.

16:470:601,602. INDEPENDENT STUDY IN GERMANIC LANGUAGES AND LITERATURES (3,3)

Prerequisites: Permission of instructor and approval of graduate director.

Independent study or directed research. Intended for exploring areas not covered in depth by regularly scheduled courses.

16:470:610. OLD NORSE LITERATURE (3)

Ciklamini, Zitzelsberger. Conducted in English.

The principal genres of saga literature; Eddic and Scaldic poetry.

16:470:611. COURTLY POETRY AND MEDIEVAL DRAMA (3)

Ciklamini, Rushing, Zitzelsberger

Major lyrics of the "Minnesang" and its later developments. The Latin and romance origins of German lyric poetry. Selected dramas from the thirteenth to the late fifteenth centuries.

16:470:615. LITERATURE OF THE BAROQUE (3)

Zitzelsberger

Study of lyric, dramatic, and prose works as an expression of religious, historical, and cultural currents of the seventeenth century.

16:470:622. THE GERMAN ENLIGHTENMENT (3)

Herbst

The concept and question of German Enlightenment, especially as it relates to modernity. Readings by Leibniz, Kant, Mendelssohn, Gottsched, Bodmer, Lessing, Klopstock, Wieland, and Gellert.

16:470:625. GOETHE (3)

Herbst

A study of Goethe's poetry, drama, and prose, focusing on three major areas: works of the Storm and Stress, works of Goethe's classical period, and the "Alterswerk," including Faust.

16:470:626. FAUST IN GERMAN LITERATURE (3)

Herbst

The Faust tradition from biblical days to contemporary German literature. Emphasis on the Volksbuch, the Faust theme in the Storm and Stress period, Goethe's Faust, and Faust works of the twentieth century.

16:470:627. SCHILLER (3)

Herbst

Schiller's development as an author through detailed study of his prose, poetry, and plays, including Die Räuber, Kabale und Liebe, Don Carlos, and Wallenstein.

16:470:632. HEINE AND HIS CONTEMPORARIES (3)
The development of German literature of the nineteenth century in the context of social and political change brought about by the end of feudalism and the rise of industrialism in the period 1813 to 1849.

16:470:642. THE EXPRESSIONIST MOVEMENT (3)
Cosentino-Dougherty
German expressionism from its early prewar phase to the mid-1920s, with emphasis on its philosophical foundations, sociopolitical aims, and poetic styles. The poets Benn, Heym, Stadler, Stramm, and Werfel; the dramatists Goering, Hasenclever, Kaiser, Sorge, Sternheim, and Toller.

16:470:645. CONTEMPORARY GERMANY (3)
Cosentino-Dougherty, Donahue
A study of modern Germany with consideration of pertinent cultural, historical, political, geographical, and sociological factors and their impact on contemporary literary life.

16:470:650. LYRICAL POETRY FROM THE MIDDLE AGES TO THE PRESENT (3)
Neuse, Ratych
A study of significant poets with special emphasis on the development of literary movements and the intellectual background of the times.

16:470:651. GERMAN DRAMA FROM THE BAROQUE TO THE PRESENT (3)
Ratych
Readings of selected plays with background studies in the theory and historical development of the drama.

16:470:652. SHORT FORMS OF GERMAN PROSE (3)
Donahue, Herbst, Neuse
Short prose forms such as the Anekdote, Skizze, Novelle, Erzählung, and Kurzgeschichte. Historical, theoretical, and analytical approaches to representative works.

16:470:653. THE GERMAN "NOVELLE" AND "NOVELLE" THEORY (3)
Donahue, Herbst
The development of the Novelle as a specific German narrative form and as an expression of social, philosophical, and metaphysical viewpoints.

16:470:654. THE GERMAN NOVEL (3)
Donahue
Development of the novel as a literary genre in German literature. Emphasis on European influences, the novel and the court, the rise of the bourgeoisie, women and writing, and theory of novel.

16:470:660. AUSTRIAN NARRATIVE OF THE NINETEENTH AND TWENTIETH CENTURIES (3)
Donahue, Neuse
Comparative study of representative works that use various narrative techniques. Special emphasis on the end of the monarchy, the emergence of national socialism, and the period after 1945.

16:470:661. FOLKLORE IN GERMAN LITERATURE (3)
Ciklamini, Neuse
Archetypal patterns, motifs, figures in folklore, Sage, folksong, hagiography, and sources in pagan and biblical tradition as a basis for study of adaptations and interpretations in literary works of various genres and periods to the present.

16:470:662. GERMAN FEMINIST WRITERS (3)
Donahue
The rise of literary feminism and a sociological analysis of women's literature.

16:470:663. LITERATURE AND IDEOLOGY (3)
Rushing
A study in the history of ideas, dealing specifically with the conflict of ideologies in varying periods of German culture as expressed in the works of such authors as Gottfried von Strassburg, Luther, Gryphius, Goethe, Büchner, Nietzsche, Wagner, and Brecht.

16:470:670,671,672,673. TOPICS IN GERMAN LITERATURE I, II, III, IV (3,3,3,3)
Special topics devoted to the investigation of a single author, text, critical or philosophical problem, theme or motif, historical period or development.

16:470:701,702. RESEARCH IN GERMAN (BA,BA)

Interdisciplinary Graduate Course

15:617:510. INTRODUCTION TO LITERARY THEORY (3)
Flieger, Marsh, Eisenzweig, Edmunds, Persin, Galperin, Davidson, et al.
Prerequisite: Open to second-term graduate students; priority given to students from programs participating in the Council of Languages and Literature.
An introduction to contemporary literary theory, including formalism, structuralism, poststructuralism, feminism, psychoanalysis, cultural studies, and other approaches. Readings of theoretical texts and applications to short literary texts from a variety of literatures.

HISTORY 510

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Director of Graduate Program: Professor John Chambers,
305D Van Dyck Hall, College Avenue Campus (732/932-8493)
Vice Chairperson for Graduate Education: Professor Phyllis Mack,
305E Van Dyck Hall, College Avenue Campus (732/932-7941)

Members of the Graduate Faculty

Michael P. Adas, Abraham Voorhees Professor of History, FAS-NB; Ph.D., Wisconsin
Comparative history; colonialism and technology
Samuel L. Baily, Professor of History, FAS-NB; Ph.D., Pennsylvania
Comparative migration; twentieth-century Latin Americans social history
Omer Bartov, Professor of History, FAS-NB; D.Phil., Oxford (St. Antony's College)
Modern Europe, Germany, France, holocaust
Norma Basch, Professor of History, FAS-N; Ph.D., New York
American legal history; U.S. antebellum politics and culture
Mia Elisabeth Bay, Assistant Professor of History, FAS-NB; Ph.D., Yale
African-American history; American intellectual and cultural history
Seymour Becker, Professor of History, FAS-NB; Ph.D., Harvard
History of modern Russia (nineteenth and early twentieth centuries)
Rudolph M. Bell, Professor of History, FAS-NB; Ph.D., CUNY
Europe; quantitative history
Alastair Bellany, Assistant Professor of History, FAS-NB; Ph.D., Princeton
Early modern Britain
Herman L. Bennett, Assistant Professor of History, FAS-NB; Ph.D., Duke
Colonial Latin American history; early modern Iberian history
Carolyn Brown, Assistant Professor of History, FAS-NB; Ph.D., Columbia
African history; labor history
Jack L. Cargill, Professor of History, FAS-NB; Ph.D., California (Berkeley)
Ancient Greek history and epigraphy; ancient Rome
John W. Chambers, Professor of History, FAS-NB; Ph.D., Columbia
Twentieth-century U.S. history; especially war and peace studies, film and history, political history, U.S. foreign relations
Paul G.E. Clemens, Professor of History, FAS-NB; Ph.D., Wisconsin
Early American history and history of the South
William J. Connell, Assistant Professor of History, FAS-NB; Ph.D., California (Berkeley)
Early modern European history
Belinda Davis, Assistant Professor of History, FAS-NB; Ph.D., Michigan (Ann Arbor)
Modern European history; Germany; Women's history
Robert L. Fishman, Professor of History, FAS-C; Ph.D., Harvard
Urban history

- David Foglesong, Associate Professor of History, FAS-NB; Ph.D., California (Berkeley)
History of American foreign relations
- Ziva Galili, Professor of History, FAS-NB, and Vice Dean of the Graduate School–New Brunswick; Ph.D., Columbia
Social, economic, political history of modern Russia; Eastern Europe
- Lloyd C. Gardner, Charles and Mary Beard Professor of History, FAS-NB; Ph.D., Wisconsin
American diplomatic history
- Lora D. Garrison, Professor of History, FAS-NB; Ph.D., California (Irvine)
Women and reform movements; recent United States history
- Michael Gasster, Professor of History, FAS-NB; Ph.D., Washington
Nineteenth- and twentieth-century China
- William Gillette, Professor of History, FAS-NB; Ph.D., Princeton
Civil war and reconstruction
- John R. Gillis, Professor of History, FAS-NB; Ph.D., Stanford
Modern European social history and British history
- Peter B. Golden, Professor of History, FAS-N; Ph.D., Columbia
Medieval Eurasia
- Ann D. Gordon, Associate Research Professor, FAS-NB; Ph.D., Wisconsin (Madison)
Papers of Elizabeth Cady Stanton and Susan B. Anthony
- Phillip J. Greven, Jr., Professor of History, FAS-NB; Ph.D., Harvard
Social history; early American history
- Gerald N. Grob, Henry E. Sigerist Professor of the History of Medicine, FAS-NB; Ph.D., Northwestern
United States social history; history of medicine
- Mary S. Hartman, University Professor of History, FAS-NB; Ph.D., Columbia
Nineteenth-century France; women's history
- Joseph Held, Associate Professor of History, FAS-C; Ph.D., Rutgers
Eastern Europe
- Allen M. Howard, Associate Professor of History, FAS-NB; Ph.D., Wisconsin
African history; world history
- Reese V. Jenkins, Professor of History, FAS-NB; Ph.D., Wisconsin
Modern science and technology
- Jennifer M. Jones, Associate Professor of History, FAS-NB; Ph.D., Princeton
Early modern European; France, old regime and revolution; European women's history
- Donald R. Kelley, James Westfall Thompson Professor of History, FAS-NB; Ph.D., Columbia
European history
- Alice Kessler-Harris, Professor of History, FAS-NB; Ph.D., Rutgers
History of women and labor in the U.S.; special interest in twentieth century social policy
- Warren F. Kimball, Professor of History, FAS-N; Ph.D., Georgetown
History of United States foreign policy and diplomacy
- Dorothy Y. Ko, Associate Professor of History, FAS-NB; Ph.D., Stanford
Late imperial China; women's history; Asian-American history
- T.J. Jackson Lears, Board of Governors Professor of History, FAS-NB; Ph.D., Yale
American cultural and intellectual history
- Dina LeGall, Assistant Professor of History, FAS-NB; Ph.D., Princeton
Ottoman history; modern Middle Eastern history
- David L. Lewis, The Martin Luther King, Jr. University Professor; Ph.D., London School of Economics and Political Science
Biography; twentieth-century Afro-American history and culture; Europe and Africa in late nineteenth century
- Jan E. Lewis, Professor of History, FAS-N; Ph.D., Michigan
U.S. family and women's history; early American history
- James Livingston, Professor of History, FAS-NB; Ph.D., Northern Illinois
Nineteenth- and twentieth-century American intellectual and economic history
- Jonathan Lurie, Professor of History, FAS-N; Ph.D., Wisconsin
Legal history
- Phyllis Mack, Professor of History, FAS-NB; Ph.D., Cornell
Early modern European history; women's history; history of religion
- Norman D. Markowitz, Associate Professor of History, FAS-NB; Ph.D., Michigan
American political and radical movements
- Luis Martínez-Fernández, *Associate Professor of History, FAS-NB; Ph.D., Duke Latin American history; Puerto Rican and Hispanic Caribbean studies*
- James P. Masschaele, Associate Professor of History, FAS-NB; Ph.D., Toronto
Medieval history; English economic history
- Matt Matsuda, Assistant Professor of History, FAS-NB; Ph.D., California (Los Angeles)
Modern European history; France; cultural history
- Gregory L. Mixon, Assistant Professor of History, FAS-NB; Ph.D., Cincinnati
African-American history; U.S. political history
- Jennifer L. Morgan, *Assistant Professor of History, FAS-NB; Ph.D., Duke Early American history; African-American history; women's history*
- Karl F. Morrison, Lessing Professor of History and Poetics, FAS-NB; Ph.D., Cornell
Humanist tradition in western Europe, chiefly aesthetics and hermeneutics, in the Middle Ages
- William L. O'Neill, Professor of History, FAS-NB; Ph.D., California (Berkeley)
Twentieth-century United States history
- David M. Oshinsky, Board of Governors Professor of History, FAS-NB; Ph.D., Brandeis
Twentieth-century American history
- Philip J. Pauly, Associate Professor of History, FAS-NB; Ph.D., Johns Hopkins
History of science
- James W. Reed, Professor of History, FAS-NB; Ph.D., Harvard
United States social and intellectual history
- Stephen W. Reinert, Associate Professor of History, FAS-NB; Ph.D., California (Los Angeles)
Byzantine, medieval Balkan, early Ottoman history
- Donald T. Roden, Associate Professor of History, FAS-NB; Ph.D., Wisconsin
Modern Japanese social and intellectual history
- Said S. Samatar, Professor of History, FAS-N; Ph.D., Northwestern
Somali; modern Africa; African nationalism; African literature and religion
- Seth M. Scheiner, Associate Professor of History, FAS-NB; Ph.D., New York
American urban history
- Susan R. Schrepfer, Associate Professor of History, FAS-NB; Ph.D., California (Riverside)
American social and environmental history
- Joan W. Scott, Professor of Social Science, Institute for Advanced Study; Ph.D., Wisconsin
Feminist history and theory
- Thomas P. Slaughter, Professor of History, FAS-NB; Ph.D., Princeton
Early American history
- Bonnie G. Smith, Professor of History, FAS-NB; Ph.D., Rochester
Modern European history; women's history
- Gail Trainer-Besosa, Assistant Professor of History, FAS-NB; Ph.D., Columbia
Latin America; Brazil
- Odoric Ying-kwong Wou, Professor of History, FAS-N; Ph.D., Columbia
Asian history (China)
- Gabor Vermes, Associate Professor of History, FAS-N; Ph.D., Stanford
The Hungarian revolution of 1918-1919; modern Hungary
- Mark Wasserman, Professor of History, FAS-NB; Ph.D., Chicago
Modern Latin American history; history of Mexico
- Carmen T. Whelan, *Assistant Professor of Puerto Rican and Hispanic Caribbean Studies, FAS-NB; Ph.D., Rutgers U.S. immigration; women's history*
- Deborah G. White, Associate Professor of History, FAS-NB; Ph.D., Illinois
Afro-American history; women's history
- Virginia Yans-McLaughlin, Professor of History, FAS-NB; Ph.D., SUNY (Buffalo)
United States cultural history; women's history; history of immigration
- Yael Zerubavel, Professor of History, FAS-NB, and Director of the Center for the Study of Jewish Life; Ph.D., Pennsylvania
Jewish social, cultural, intellectual, and literary history

Associate Members of the Graduate Faculty

- Henry W. Bowden, Professor of Religion, FAS-NB; Ph.D., Princeton
American religious history
- James Jones, Associate Professor of Religion, FAS-NB; Ph.D., Brown
United States religions

Programs

The graduate program in history is chiefly intended for students who pursue full-time work toward a Ph.D. Requirements for a Ph.D. degree include twelve courses in history or a supporting discipline, two of which must be in a minor field, and two or more of which must be research seminars; successful completion of minor and major field examinations (generally taken in the third year); reading knowledge of two foreign languages (for students in European and non-Western history); preparation of an acceptable thesis based on original research; and successful defense of the thesis in a final examination by a faculty committee. Credits for M.A. work in history done at other institutions will likely be transferred with the permission of the Graduate School–New Brunswick.

The M.A. is offered within the framework of the doctoral program. Its requirements include eight courses in history and successful completion of an examination in the student's major field. A thesis is not required. Students whose sole objective is the M.A. should consider applying to the M.A. program in American history on the Rutgers–Camden campus or to the M.A. program in history on the Rutgers–Newark campus. For further information, write to Department of History, Rutgers, The State University of New Jersey, Camden, NJ 08102; or Department of History, Rutgers, The State University of New Jersey, Newark, NJ 07102.

Applications for September admission should be submitted no later than January 15 by students seeking financial assistance; otherwise by February 15. Transcripts, Graduate Record Examination scores, three letters of recommendation, and a writing sample are required.

While the Ph.D. program offers work in most fields of American, European, Latin American, and East Asian history, there are special concentrations in early American history and women's history. The department is the center for the Thomas A. Edison papers project, the IEEE History Center, the Medieval and Early Modern Data Bank project, and the Elizabeth Cady Stanton and Susan B. Anthony papers. The department has particular strength in social, political, and cultural history, in African-American history, and in comparative and world history.

A full description of the program may be found in the brochure Graduate Study in History, available from the department. Information on fellowships (\$10,000, plus tuition remission), teaching assistantships, and other forms of financial aid can be found in this booklet.

Graduate Courses

Courses in Historiography, Theory, and Practice

16:510:501. COLLOQUIUM: HISTORY OF HISTORICAL WRITING (3)
Connell, Kelley, Morrison, Reinert
Exploration of the evolution of historical writing, in varying cultural and chronological contexts, but excluding contemporary historiographic theory and practice.

16:510:503. CONTEMPORARY HISTORIOGRAPHY—THEORY AND PRACTICE (3)
Connell, Lears, Livingston, Slaughter, Yans-McLaughlin
Impact of social and literary theories on the work of recent prominent historians, including assessments of the utility and testability of such theories in contemporary historical practice.

16:510:505. STATISTICAL METHODS IN HISTORY (3)
Bell
Analysis of secondary literature employing quantitative methods, design, implementation, and presentation of an original historical research problem involving statistical techniques and computer applications.

16:510:507. HISTORICAL EDITING (3)
Jenkins

16:510:509. TEACHING OF HISTORY (3)
Adas, Baily, Bell, Howard
Designed for second- or third-year students, including first-time teaching assistants. Offers guidance and practical experience in undergraduate instruction.

Courses with Transnational, Comparative, or Interdisciplinary Themes

16:510:511. COLLOQUIUM IN COMPARATIVE HISTORY (3)
Adas, Howard

16:510:513. COLLOQUIUM IN CULTURAL HISTORY (3)
Lears, Matsuda

16:510:515. COLLOQUIUM IN DIPLOMATIC HISTORY (3)
Foglesong, Gardner, Kimball

16:510:517. COLLOQUIUM IN ECONOMIC HISTORY (3)
Livingston, Triner-Besosa
Survey of the principal problems and methodologies in economic history.

16:510:519. COLLOQUIUM IN INTELLECTUAL HISTORY (3)
Lears, Yans-McLaughlin
An investigation of consciousness—past and present—through the writings of philosophers, moralists, and cultural critics from the seventeenth through the twentieth centuries.

16:510:521. COLLOQUIUM IN LABOR HISTORY (3)
Kessler-Harris, Livingston

16:510:523. COLLOQUIUM IN MIGRATION, COMMUNITY, AND IDENTITY (3)
Baily, Whalen, Yans-McLaughlin
Immigration, community, and identity formations among immigrants. Dynamics of assimilation and its opposites in selected cultural and chronological contexts.

16:510:525. COLLOQUIUM IN POLITICAL HISTORY (3)
Basch, O'Neill, Oshinsky

16:510:527. TOPICS IN THE HISTORY OF RELIGION (3)
Lears, Mack, Morrison, Reinert
Selected issues and relevant historiography in the history of religion. Specific cultural and historical context varies according to the interests of the instructors.

16:510:529. TOPICS IN THE HISTORY OF SEXUALITY (3)
Jones, Ko, Reinert, Scott, Smith
Problems and historiography on the history of sexuality in selected historical and cultural contexts.

16:510:531. COLLOQUIUM IN SOCIAL HISTORY (3)
Gillis, Greven, Reed
An introduction to European and American social history, with emphasis on historical demography, the family, class structure and social stratification, protest, and culture.

16:510:533. TOPICS IN SOCIAL HISTORY (3,3)
Gillis, Greven, Reed

16:510:535. COLLOQUIUM IN THE HISTORY OF TECHNOLOGY AND SCIENCE (3)
Jenkins, Pauly
Major themes in the development of technology, industrial research, natural sciences, and human sciences from the sixteenth century to the present.

16:510:537. COLLOQUIUM IN URBAN HISTORY (3)
Fishman, Scheiner, Howard
Introduction to the urbanization process, with emphasis on the city building process, social mobility and social structure, ethnicity, social and geographic mobility, political and social reform.

16:510:539. COLLOQUIUM IN THE HISTORY OF WOMEN (3)
Basch, Davis, Garrison, Jones, Kessler-Harris, Mack, Smith, Yans-McLaughlin.
Prerequisite for seminar work in women's history.
Introduction to the problems and concepts of women's history on an international scale.

16:510:541. (F) COLLOQUIUM IN WORLD HISTORY (3)
Baily, Brown, Howard, Lewis. Prerequisite: Admission to Ph.D. program.
Focuses on a specific problem or set of problems in world history using readings designed to promote an understanding of the relevant theoretical and analytical literature.

16:510:543. SEMINAR IN CULTURAL HISTORY (3)
Lears, Matsuda

16:510:547. SEMINAR IN THE HISTORY OF TECHNOLOGY AND SCIENCE (3,3)
Jenkins, Pauly

16:510:549,550. SEMINAR IN THE HISTORY OF WOMEN (3,3)
Davis, Garrison, Jones, Kessler-Harris, J. Lewis, Mack, Smith, Yans-McLaughlin.
Prerequisite: 16:510:525.

16:510:551. (S) SEMINAR IN WORLD AND COMPARATIVE HISTORY (3)
Adas, Baily, Brown, Howard, Roden. Prerequisite: Admission to Ph.D. program.
Directed research in projects related to a specific theme (e.g., immigration, imperialism, comparative gender ideologies) that are announced in advance by the instructor.

Courses in American History

16:510:553. PROBLEMS AND DIRECTED READINGS IN AMERICAN HISTORY I (3)

Clemens, Greven, K. Brown, Slaughter

Introductory survey of history and historiography. America from precontact Indian societies to the Great Awakening. European and African background to colonization; colonial society and politics.

16:510:555. PROBLEMS AND DIRECTED READINGS IN AMERICAN HISTORY II (3)

Clemens, Greven, J. Lewis, Slaughter

Introductory survey of history and historiography. America from the Great Awakening (1740s) to the early nineteenth century. The American Revolution and the Constitution; emergence of new gender roles, economic and family relationships, and social patterns.

16:510:557. PROBLEMS AND DIRECTED READINGS IN AMERICAN HISTORY III (3)

Basch, Clemens, Gillette, Grob, Lears, Lewis, White

Introductory survey of history and historiography. America from the early nineteenth- through early twentieth-centuries, covering key themes of political, military, social, and cultural development.

16:510:559. PROBLEMS AND DIRECTED READINGS IN AMERICAN HISTORY IV (3)

Chambers, Foglesong, Gardner, Garrison, Kessler-Harris, Lewis, Livingston, O'Neill, Oshinsky, Yans-McLaughlin

Introductory survey of history and historiography. America from the early twentieth century to the present, covering key themes of political, military, social, and cultural development.

16:510:561. COLLOQUIUM IN AMERICAN HISTORY (3)

Chambers, O'Neill, Schrepfer, Slaughter

16:510:563. COLLOQUIUM IN AFRICAN-AMERICAN HISTORY (3)

Lewis, White

16:510:565. COLLOQUIUM IN AMERICAN LEGAL HISTORY (3)

Basch, Clemens, Lurie, Slaughter

Focuses on the interplay between law and social change in American legal history.

16:510:567. SEMINAR IN AMERICAN COLONIAL HISTORY (3)

K. Brown, Clemens, Greven, J. Lewis, Martin, Slaughter

16:510:571. SEMINAR IN RECENT AMERICAN HISTORY (3)

Markowitz, O'Neill, Oshinsky, Yans-McLaughlin

16:510:573,574. SEMINAR IN AFRICAN-AMERICAN HISTORY (3,3)

Bay, White, D. Lewis

16:510:575,576. SEMINAR IN AMERICAN DIPLOMATIC HISTORY (3,3)

Foglesong, Gardner, Kimball

16:510:579. SEMINAR IN THE INTELLECTUAL HISTORY OF THE UNITED STATES (3)

Lears

16:510:581. SEMINAR IN AMERICAN POLITICAL HISTORY (3)

Chambers, Gillette, Oshinsky

16:510:583. SEMINAR IN AMERICAN SOCIAL HISTORY (3)

Grob, Jenkins, Martin, Reed

Courses in European History

16:510:591. ANCIENT HISTORY: TOPICS AND PROBLEMS (3)

Cargill, Lenaghan, Reinert, Figueira

Colloquium structured around important primary and secondary readings in Greek and/or Roman history.

16:510:593. PROBLEMS AND DIRECTED READINGS IN MEDIEVAL HISTORY (3)

Masschaele, Morrison, Reinert

Introduction to the major problems and readings in the field of medieval history. Designed to prepare students to become competent and informed teachers in their major field.

16:510:595. COLLOQUIUM IN MEDIEVAL HISTORY (3)

Morrison, Reinert

16:510:597. PROBLEMS AND DIRECTED READINGS IN EARLY MODERN EUROPEAN HISTORY (3)

Bartov, Connell, Davis, Gillis, Jones, Kelley, Smith

Introduction to the major problems and readings in the field of early modern European history. Designed to prepare students to become competent and informed teachers in their major field.

16:510:599. PROBLEMS AND DIRECTED READINGS IN MODERN EUROPEAN HISTORY (3)

Bartov, Connell, Davis, Gillis, Jones, Kelley, Smith

Introduction to the major problems and readings in the field of modern European history. Designed to prepare students to become competent and informed teachers in their major field.

16:510:601. COLLOQUIUM IN EUROPEAN HISTORY (3)

Bartov, Becker, Bell, Bellany, Connell, Galili, Jones, Mack, Matsuda

16:510:603. COLLOQUIUM IN BRITISH HISTORY (3)

Bellany, Gillis, Lee, Mack, Masschaele

16:510:605. COLLOQUIUM IN MODERN RUSSIAN HISTORY (3)

Becker, Galili

Introduction to the historical literature and major problems of nineteenth- and twentieth-century Russian history. Designed to complement training in modern European or American history.

16:510:611. SEMINAR: WESTERN EUROPE IN THE MIDDLE AGES (3)

Morrison, Masschaele, Reinert

16:510:615,616. SEMINAR IN EUROPEAN HISTORY (3,3)

Bartov, Connell, Davis, Mack

16:510:617. SEMINAR IN EUROPEAN INTELLECTUAL HISTORY (3)

Kelley, Morrison

16:510:619. SEMINAR IN EUROPEAN POLITICAL HISTORY (3)

Held

16:510:621. SEMINAR IN EUROPEAN SOCIAL HISTORY (3)

Bell, Gillis, Smith

Courses in African, Asian, and Latin American History

16:510:625. COLLOQUIUM IN AFRICAN HISTORY (3)

Howard

Study of development prior to colonialism. Commercial systems and religious movements analyzed in the context of culture and social organization. Background for studying carryover of culture to the Americas; recent African history.

16:510:627. PROBLEMS AND DIRECTED READINGS IN EAST ASIAN HISTORY (3)

Gasster, Ko, Roden, Wou

Basic introduction to the field of East Asian history.

16:510:629. COLLOQUIUM IN CHINESE HISTORY (3)

Gasster, Ko, Wou

Introduction to major problems and readings in the field. Designed to prepare students to become competent and informed teachers of Chinese history.

16:510:631. COLLOQUIUM IN LATIN AMERICAN HISTORY (3)

Baily, Triner-Besosa, Wasserman

16:510:635. SEMINAR IN CHINESE HISTORY (3)

Gasster, Ko, Wou

Research training in Chinese history. Topic of seminar varies depending on the instructor.

16:510:637,638. SEMINAR IN LATIN AMERICAN HISTORY (3,3)

Baily, Triner-Besosa, Wasserman

Individualized Study

16:510:677. ADVANCED TOPICS IN HISTORY (3)

16:510:678. ADVANCED TOPICS IN HISTORY (3)

16:510:679. ADVANCED TOPICS IN HISTORY (3)

16:510:701,702. RESEARCH IN HISTORY (BA,BA)

Open only to advanced students.

Designed to facilitate research work toward the doctoral dissertation.

HUMAN RESOURCE MANAGEMENT

A master's program in Human Resource Management is offered by Rutgers' School of Management and Labor Relations. Contact the director of the program, Dr. Charles Fay (732/445-5831), for more information.

INDUSTRIAL AND SYSTEMS ENGINEERING 540

Degree Program Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Susan L. Albin, Industrial Engineering Building, Busch Campus (732/445-3654);
e-mail: salbin@rci.rutgers.edu;
<<http://www.engr.rutgers.edu/~ie>>

Members of the Graduate Faculty

Susan L. Albin, Professor of Industrial and Systems Engineering, CE;

D.E.Sc., Columbia

Quality engineering; stochastic models

Tayfur Altioik, Associate Professor of Industrial and Systems Engineering, CE;

Ph.D., North Carolina State

Production lines; production/inventory systems; queueing networks; simulation

Melike Baykal-Gürsoy, Associate Professor of Industrial and Systems

Engineering, CE; Ph.D., Pennsylvania

Stochastic processes; stochastic optimization and control; applications to manufacturing and telecommunications

Thomas O. Boucher, Professor of Industrial and Systems Engineering, CE;

Ph.D., Columbia

Production analysis and control; automation and manufacturing systems; management and engineering economics

David Coit, Assistant Professor of Industrial and Systems Engineering, CE;

Ph.D., Pittsburgh

Reliability engineering; optimization

Elsayed A. Elsayed, Professor of Industrial and Systems Engineering, CE;

Ph.D., Windsor

Production analysis and control; automation and manufacturing systems; quality control and reliability engineering

Mohsen A. Jafari, Associate Professor of Industrial Engineering, CE;

Ph.D., Syracuse

Manufacturing systems controller design and analysis; simulation; quality control

Rong-Shine Lin, Assistant Professor of Industrial Engineering, CE; Ph.D., Michigan

Manufacturing control; computer-aided design; geometric modeling;

computer graphics

James T. Luxhoj, Associate Professor of Industrial and Systems Engineering, CE;

Ph.D., Virginia Polytechnic Institute

Production operations management; logistics; decision support and expert systems

Hoang Pham, Assistant Professor of Industrial and Systems Engineering, CE;

Ph.D., SUNY (Buffalo)

Reliability theory and applications; software reliability; applied probability

Fred Roberts, Professor of Mathematics, FAS-NB; Ph.D., Stanford

Discrete mathematical models; graph theory; decision making; measurement theory

Programs

Industrial and Systems Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees. Areas of study include production systems engineering, manufacturing systems engineering, quality and reliability engineering, engineering economics, and systems engineering.

The Ph.D. degree requires a minimum of 48 credit hours beyond the B.S. degree in course work and 24 credits in research. Students must successfully complete comprehensive and qualifying examinations, one year of full-time residence, and an original research dissertation. The major research strengths in the department are in manufacturing/production and quality/reliability engineering.

The M.S. degree requires a minimum of 30 course credits beyond the B.S. degree. Students may choose the thesis option or a comprehensive examination in core subjects. At least 21 of the 30 credits must be taken within the Department of Industrial and Systems Engineering. The remaining credits may be taken in other graduate programs including statistics, mathematics, mechanical and electrical engineering, computer science, economics, and operations research.

There are three options for the M.S. degree. The industrial and systems engineering option offers the most flexibility, providing students with knowledge in the major areas of the discipline. The quality and reliability engineering option, offered in cooperation with the statistics department, includes courses in process control, design of experiments, quality management, and reliability. The manufacturing systems engineering option includes courses on CAD/CAM, robotics, manufacturing processes, automation, control, and an independent laboratory project.

Extensive research facilities are available for student use. Laboratories include robotics, CNC machines, CAD facilities, microcomputers, quality and reliability engineering equipment, metal processing, and materials handling. Computing facilities include RISC 6000 workstations and a wide range of microcomputers.

Contact the graduate program director for more specific information and applications.

Graduate Courses

15:540:510. DETERMINISTIC MODELS IN INDUSTRIAL ENGINEERING (3)

Altioik, Coit, Gürsoy. Prerequisite: Introduction to linear programming.

Deterministic models of operations research. Linear programming, the simplex method, duality, sensitivity analysis, transportation assignment, min cost network flow problems.

16:540:515. STOCHASTIC MODELS IN INDUSTRIAL ENGINEERING (3)

Albin, Altioik, Coit, Gürsoy, Jafari. Prerequisite: Calculus based course in probability.

Stochastic models of operations research applied to queueing, reliability, inventory, and other problems. Markov chains, Markov processes, renewal processes.

16:540:520. DESIGN OF PHYSICAL DISTRIBUTION SYSTEMS (3)

Boucher. Prerequisites: Probability and linear programming.

Methods and techniques of analysis applied to the design of inventory and distribution systems. Topics include sales forecasting, single- and multiechelon inventory and distribution systems, and routing and scheduling of product delivery.

16:540:525. (S) APPLIED QUEUEING THEORY (3)

Albin, Altioik, Gürsoy. Prerequisite: 16:540:515.

Markovian and non-Markovian queueing models; networks of queues; numerical solutions, approximations; statistical estimation of system parameters; cost models; emphasis on queueing applications in manufacturing.

16:540:530. FORECASTING AND TIME SERIES ANALYSIS (3)

Luxhoj. Prerequisites: Advanced calculus, statistics.

Alternative time series models for purposes of prediction. Smoothing techniques, probability and regression analysis, and econometric analysis.

16:540:535. NETWORK APPLICATIONS IN INDUSTRIAL ENGINEERING (3)

Altiok. Prerequisite: 16:540:510 or 14:540:311.

Flow problems in networks. Topics include shortest-route problems, critical path, and GERT.

16:540:540. COMPUTATIONAL METHODS FOR INDUSTRIAL SYSTEMS (3)

Jafari, Altiok. Prerequisites: 16:540:510, 515.

Computational methods in modeling, planning, and control of production systems, numerical methods, artificial intelligence techniques, exact and heuristic search methods, and computational strategies.

16:540:545. APPLICATION OF HUMAN FACTORS TO DECISION SYSTEMS ENGINEERING (3)

Theisen

Introduction of human factors to engineering techniques. Decision-aiding concepts considered include prompting, expert systems, and artificial intelligence. The use of psychological scaling techniques in the development of a knowledge base for expert systems. Basic concepts in decision theory used in an analysis of decision elements of the FAA Air Traffic Control System and in the design of a panel or a keyboard.

16:540:550. SPECIAL PROBLEMS IN INDUSTRIAL ENGINEERING (BA)

Prerequisite: Permission of instructor.

Special investigations in selected areas of industrial engineering.

16:540:552. MANUFACTURING PROJECT (3)

Boucher, Elsayed, Jafari. Prerequisite: Permission of instructor.

Understanding of the state of technology in discrete, batch, and continuous manufacturing; hands-on experience.

16:540:555. SIMULATION OF PRODUCTION SYSTEMS (3)

Altiok, Elsayed, Jafari. Prerequisites: 14:540:311; 01:640:477 or 01:960:379; 01:640:481 or 01:960:381, 382, or equivalent; and FORTRAN or C.

Discrete event simulation applied to problems in manufacturing. SIMAN/ARENA simulation tools. Estimation of manufacturing systems performance measures, analysis of production system operating characteristics, comparison of alternative systems, and validation of approximate analytic models. Case studies.

16:540:560. PRODUCTION ANALYSIS (3)

Boucher, Elsayed, Luxhoj. Prerequisite: Undergraduate production planning and control.

Analysis of production engineering, with emphasis on planning and control of manufacturing and service systems.

16:540:565. FACILITIES PLANNING AND DESIGN (3)

Coit, Luxhoj, Pham. Prerequisite: Deterministic models in operations research. Operations research methodologies applied to facilities planning and design problems. Facilities layout and location problems, assembly line balancing, conveyor design, and automated warehousing problems.

16:540:568. AUTOMATION AND COMPUTER INTEGRATED MANUFACTURING I (3)

Boucher, Lin. Prerequisite: Introductory course in computer control or permission of instructor.

Design of automated and computer integrated manufacturing systems using programmable automation. Modeling of discrete and continuous control systems, design and analysis of functional and informational architectures, implementation of programmable controllers and factory information systems.

16:540:570. APPLICATIONS OF ROBOTICS IN MANUFACTURING SYSTEMS (3)

Boucher, Jafari, Lin. Prerequisites: 14:540:343, 453, or equivalent.

Integration of robots in manufacturing systems, design of robot work stations, materials handling, and interactions among manufacturing cells. Machine vision with applications in manufacturing.

16:540:572. MANUFACTURING PROCESSES AND CONTROL (3)

Lin. Prerequisite: Basic knowledge of manufacturing processes.

Overview of manufacturing processes, machine tools and machining operations, mechanism of metal cutting and tool wear, control and optimization of machining process, sensor-based and other advanced monitoring and control technology, manufacturing automation.

16:540:575. ADVANCED ENGINEERING ECONOMICS I (3)

Boucher, Luxhoj. Prerequisite: Introductory course in engineering economics or equivalent.

Economic decision models for engineers involving allocation and scheduling of resources; evaluation of factual and strategic alternatives; advanced risk and uncertainty analysis; weighing and evaluating nonmonetary factors.

16:540:580. QUALITY MANAGEMENT (3)

Albin

Quality management philosophies, Deming, Juran; quality planning, control, and improvement; quality systems, management organizations for quality assurance. Role of operations research.

16:540:585. SYSTEM RELIABILITY ENGINEERING I (3)

Coit, Elsayed, Pham. Prerequisite: Advanced probability or 16:540:515.

Methods of measuring the reliability and effectiveness of complex engineering systems, including optimization theory, preventive maintenance models, and statistical analysis.

16:540:590. DESIGN OF ENGINEERING EXPERIMENTS (3)

Albin, Boucher. Prerequisite: Statistics.

The efficient design, analysis, and interpretation of engineering experiments using statistical methods. Analysis of variance and covariance. Designs commonly used in engineering experimentation. Analysis of response surface. Computer applications.

16:540:595. SOFTWARE RELIABILITY I (3)

Pham. Prerequisite: 16:540:515 or 16:960:580.

Software reliability issues; software errors, faults, and failures; software design for reliability; data collection; formal methods for reliability; software fault tolerance; modeling growth in software reliability; cost modeling and estimation; and software quality management.

16:540:615. (S) NONLINEAR PROGRAMMING (3)

Elsayed, Gürsoy. Prerequisite: 14:540:311 or equivalent.

Some methods and applications of nonlinear programming, approximate methods; Kuhn-Tucker theory; quadratic programming; integer linear programming; gradient methods; stochastic programming; computer solutions.

16:540:650. DISCRETE EVENT DYNAMIC SYSTEMS (3)

Jafari. Prerequisite: 16:540:515.

Supervisory control of discrete event dynamic systems, process monitoring, Petri nets, functional analysis, performance analysis, control specification, control verification and validation.

16:540:655. PERFORMANCE ANALYSIS OF MANUFACTURING SYSTEMS (3)

Altiok. Prerequisites: 16:540:515, 560, or equivalent.

Modeling of manufacturing systems such as flow shops, job shops, transfer lines, and production/inventory systems. Topics include problems of failures and repairs, the role of buffer inventories, capacity allocation, decomposition, approximations, pull-type systems, and the Kanban concept.

16:540:660. INVENTORY CONTROL (3)

Altiok, Gürsoy. Prerequisites: 16:540:515, 525.

Modeling of pure inventory systems with stochastic demand and lead times. Characterization of optimal control policies and analysis of simple as well as multi-item systems with simple and multiple echelons. Computational issues emphasized.

16:540:665. THEORY OF SCHEDULING (3)

Luxhoj, Elsayed. Prerequisite: Production planning and control.
Advanced topics in sequencing and scheduling for manufacturing and service systems; flow shop, job shop—static and dynamic models; multi-processor parallel machining; preempt-resume algorithms; optimal due-date problems; probabilistic sequencing; simulation and applied operations research models.

16:540:668. AUTOMATION AND COMPUTER INTEGRATED MANUFACTURING II (3)

Boucher, Jafari. Prerequisite: 16:540:482 or permission of instructor.
Design of automated and computer-integrated manufacturing using programmable automation. Modeling, specification, and implementation of factory information systems. Reference models and control architecture for discrete parts manufacturing, batch process manufacturing, and semiconductor manufacturing industries.

16:540:675. ADVANCED ENGINEERING ECONOMICS II (3)

Boucher, Luxhoj. Prerequisite: 16:540:575 or permission of instructor.
Focuses on engineering economic decision making. Application of analytical techniques to the evaluation of industrial projects, the relationship of project selection to long-range planning, and the relationship between the economics of technical choice and industrial productivity.

16:540:680. PRODUCTION AND QUALITY ENGINEERING (3)

Albin, Elsayed. Prerequisites: Production planning and control; operations research.
Integration of research in quality and production. Topics include models that relate quality and inventory policies, scheduling, set-up costs, lot sizing, production cycles, scrap, rework, repair, location of inspection stations, process control, and electronics testing and manufacturing.

16:540:682. PROCESS MODELING AND CONTROL (3)

Gürsoy. Prerequisites: 16:540:515, 568.
Stationary (ARMA), nonstationary (AIRMA) time series models for process control, various automatic process control (APC) strategies, statistical process control (SPC) methods, integration of APC and SPC.

16:540:685. SYSTEM RELIABILITY ENGINEERING II (3)

Coit, Elsayed, Pham. Prerequisites: 16:540:515, 585.
Advanced topics in reliability theory and engineering; availability models of multistate devices; theory of preventive maintenance, replacement, and inspection. Accelerated reliability models.

16:540:690. COMPONENT RELIABILITY (3)

Coit, Elsayed, Gürsoy. Prerequisite: 16:540:585.
Emphasizes reliability estimation of components stressed through different types of stresses such as thermal, electric field, humidity, vibration, and fatigue. Burn-in testing, reliability estimation from degradation data, and relationships between accelerated stresses and normal operating conditions.

16:540:691,692. SEMINAR IN INDUSTRIAL AND SYSTEMS ENGINEERING (0,0)

Lectures by graduate students, faculty, and invited speakers on current research topics in industrial and systems engineering.

16:540:694. ADVANCED TOPICS IN INDUSTRIAL ENGINEERING (3)

Prerequisite: Permission of instructor.
Seminar for doctoral students in a selected area of industrial engineering. Based on current literature.

16:540:701,702. RESEARCH IN INDUSTRIAL ENGINEERING (BA,BA)

INDUSTRIAL RELATIONS AND HUMAN RESOURCES 545

Degree Program Offered: Doctor of Philosophy
Director of Graduate Program: Professor Jeffrey Keefe,
Janice Levin Building, Livingston Campus (732/445-5973)

Members of the Graduate Faculty

John R. Aiello, Professor of Psychology, FAS-NB; Ph.D., Michigan State
Industrial and organizational psychology; environmental stress;
nonverbal communication
Clayton P. Alderfer, Professor of Psychology, GSAPP; Ph.D., Yale
Organizational behavior and organizational change
Richard W. Beatty, Professor of Human Resource Management, SMLR;
Ph.D., Washington
Human resource systems and planning; performance appraisal; compensation
James P. Begin, Professor of Human Resource Management, SMLR; Ph.D., Purdue
Industrial relations; public sector and faculty collective bargaining, employment
systems theory; negotiations
David Bensman, Associate Professor of Labor Studies and Employment Relations,
SMLR; Ph.D., Columbia
Labor history; contemporary collective bargaining issues; schools and education
Joseph Blasi, Professor of Labor-Management Relations, SMLR; Ed.D., Harvard
Employee ownership
Philip Bobko, Professor of Management, SB-NB; Ph.D., Cornell
Research methods; psychometrics; organizational behavior / personnel
John Burton, Professor of Industrial Relations and Human Resources and Dean,
SMLR; Ph.D., Michigan
Workers compensation; public sector collective bargaining
Cary Cherniss, Professor of Psychology, GSAPP; Ph.D., Yale
Job stress and burnout; careers; organizational change; supervision
Sue Cobble, Associate Professor of Labor Studies and Employment Relations,
SMLR; Ph.D., Stanford
Women and work; labor history; union leadership
Steven M. Director, Professor of Human Resource Management, SMLR;
Ph.D., Northwestern
Human resource policy, planning, and evaluation
Adrienne E. Eaton, Associate Professor of Labor Studies and Employment
Relations, SMLR; Ph.D., Wisconsin
Employee involvement; labor and employment law; collective bargaining
Charles H. Fay, Associate Professor of Human Resource Management, SMLR;
Ph.D., Washington
Compensation, performance appraisal, human resource information systems
Charles Heckscher, Professor of Labor Studies and Employment Relations, SMLR;
Ph.D., Harvard
Workplace transformation; associational organizations
Jeffrey H. Keefe, Associate Professor of Industrial Relations and Human
Resources, SMLR; Ph.D. Cornell
Work restructuring and technology; collective bargaining; deregulation
and labor relations
Mark R. Killingsworth, Professor of Economics, FAS-NB; D.Phil., Oxford
Labor and human resources; discrimination
Douglas L. Kruse, Associate Professor of Industrial Relations and Human
Resources, SMLR; Ph.D., Harvard
Profit-sharing; employee ownership; disability and earnings
Barbara A. Lee, Professor of Human Resource Management, SMLR; Ph.D.,
Ohio State
Employment and labor law; employee relations
Charles A. Nanry, Professor of Human Resource Management, SMLR;
Ph.D., Rutgers
Social organization; training policy; general management
Carl Edward Van Horn, Professor of Public Policy, EJBSPPP; Ph.D., Ohio State
American political institutions, public policy
John D. Worrall, Professor of Economics, FAS-C; Ph.D., Rutgers
Worker's compensation; property-casualty insurance; labor economics
Associate Members of the Graduate Faculty
Paula Caligiuri, Assistant Professor of Human Resource Management, SMLR;
Ph.D., Pennsylvania State
International human resources; selection
Mark Huselid, Associate Professor of Human Resource Management, SMLR;
Ph.D., SUNY (Buffalo)
Strategic human resource management
Marlene Kim, Assistant Professor of Labor Studies and Employment Relations,
SMLR; Ph.D., California (Berkeley)
Compensation; the working poor; labor studies
Claudia G. Meer, Associate Extension Specialist, SMLR; Ed.D., Rutgers
Education in industry; training and development

Jean Phillips, Assistant Professor of Human Resource Management, SMLR; Ph.D., Michigan State
Leadership; teams

Barbara Rau, Assistant Professor of Human Resource Management, SMLR; Ph.D., Wisconsin
Employee compensation, performance, attitudes, dispute resolution

Saul Rubinstein, Assistant Professor of Labor Studies and Employment Relations, SMLR; Ph.D., Massachusetts Institute of Technology
Work systems; organizational transformation

Ryan Smith, Assistant Professor of Labor Studies and Employment Relations, SMLR; Ph.D., California (Los Angeles)
Social stratification; workplace diversity; race and ethnic relations

Kirsten Wever, Assistant Professor of Labor Studies and Employment Relations, SMLR; Ph.D., Massachusetts Institute of Technology
Comparative labor relations; workplace governance

Program

The Ph.D. in Industrial Relations and Human Resources is an interdisciplinary program committed to developing scholars who are capable of studying the dynamic and changing conditions of employment and work. The program prepares students to undertake peer-reviewed research and to publish articles in scholarly journals by providing them with training in research methods and a solid theoretical foundation in the field of industrial relations and human resources. The program is designed to qualify students for future employment as college and university faculty at peer research institutions.

The program of study requires all students to take seven courses to fulfill their interdisciplinary distributional requirements, a minimum of three statistics and research methods courses, two Ph.D. seminars, the Proseminar, and six electives. The distributional requirements are labor or employment law, labor and employment history, industrial or organizational psychology, sociological theory, labor economics, industrial relations, and human resources. Electives are chosen in the student's area of interest and must be approved by the student's committee. Master's degree courses offered through the School of Management and Labor Relations may be taken as Ph.D. electives if approved by the student's committee and if the course instructor agrees to alter the nature of class assignments to make them appropriate for Ph.D. credit. In addition, the program requires that students take a comprehensive examination at the end of their second year and a qualifying examination to be admitted to Ph.D. candidacy. The comprehensive and qualifying examinations are administered in February and July.

Graduate Courses

16:545:501. INDIVIDUAL STUDIES IN INDUSTRIAL RELATIONS (BA)
Exploration in depth of specific subjects under the direction of a faculty member.

16:545:601. INDEPENDENT STUDY IN INDUSTRIAL RELATIONS AND HUMAN RESOURCES (3)
Directed study under the supervision of a faculty member.

16:545:610. ECONOMICS FOR INDUSTRIAL RELATIONS AND HUMAN RESOURCES (3)
Prerequisite: 16:533:510 or equivalent.
Alternative theories of the firm and labor markets are explored with a focus on competing hypotheses and research evidence about wage and benefit determination, internal labor markets, discrimination, unions, and employee incentive systems.

16:545:611. SEMINAR IN INDUSTRIAL RELATIONS: A SURVEY OF THE SCHOLARLY LITERATURE (3)
Prerequisite: 16:578:560 or equivalent.
Industrial relations systems theory. Analysis of managerial capitalism and the diffusion of systematic management techniques; the development of modern craft, industrial, and professional labor organizations; and the emergence of the regulatory state and the role of law and specialized government agencies in regulating industrial conflict. Conceptual framework to assess bargaining power, negotiations processes, grievance procedures, and conflict resolution.

16:545:612. SEMINAR IN HUMAN RESOURCES: A SURVEY OF THE SCHOLARLY LITERATURE (3)
Prerequisite: 16:533:521 or equivalent.
Industrial and organizational psychological foundations of human resources developed. Critical review of the research literature on recruiting, selection, performance management, compensation, and development. Analysis of firm performance.

16:545:613. RESEARCH METHODS FOR INDUSTRIAL RELATIONS AND HUMAN RESOURCES (3)
Prerequisite: One Ph.D.-level statistics course.
Problems of research design, data collection, data management, and the selection of analytical techniques.

16:545:614. THEORY DEVELOPMENT IN INDUSTRIAL RELATIONS AND HUMAN RESOURCES (3)
Prerequisites: 16:545:610, 611, 612.
How social science theories are used to develop field specific theories and hypotheses; how research then informs theory development. The tension between logical-empirical and interpretive theoretical approaches in the social sciences and its influence on research and theory development in industrial relations and human resources.

16:545:615. PROSEMINAR IN INDUSTRIAL RELATIONS AND HUMAN RESOURCES (1)
Research, theoretical, or pedagogical presentation by SMLR faculty, outside scholars, and advanced Ph.D. students. Students must enroll for eight terms.

16:545:616. MULTIVARIATE ANALYSIS FOR INDUSTRIAL RELATIONS AND HUMAN RESOURCES (3)
Prerequisites: Two Ph.D.-level statistics courses.
Multiple regression, analysis of variance, analysis of covariance, factor analysis, canonical correlation, and cluster analysis.

16:545:701,702. RESEARCH IN INDUSTRIAL RELATIONS (3,3)
Dissertation study.

INTERDISCIPLINARY PH.D. PROGRAM 554

Special interdisciplinary Ph.D. programs may be arranged for individual students who wish to pursue subjects that cut across the boundaries of program curricula.

A student who seeks the Ph.D. in an area requiring the services of two or more programs should consult interested faculty members and then submit a formal proposal to the Dean of the Graduate School–New Brunswick, outlining a program of study. Courses, examinations, the dissertation topic, and the names of faculty members who have consented to serve as the student's committee must have the approval of the directors of the Ph.D. programs involved. Once approved by the dean, the student will be transferred into the interdisciplinary Ph.D. program code (554) for registration purposes. A member of the Graduate School–New Brunswick academic staff serves as graduate director of this program.

Contact the Office of the Graduate School–New Brunswick, 25 Bishop Place, New Brunswick, NJ 08903, for further information, or call 732/932-7275.

ITALIAN 560

Degree Programs Offered: Master of Arts, Master of Arts for Teachers, Doctor of Philosophy
Director of Graduate Program: Professor Laura S. White, 84 College Avenue, College Avenue Campus (732/932-7536)

Members of the Graduate Faculty

Andrea Baldi, Assistant Professor of Italian, FAS-NB; Dott. in Lettere, Firenze; Ph.D., California (Los Angeles)
Sixteenth- and seventeenth-century literature

Franco Ferrucci, Professor of Italian, FAS-NB; Dott. in Lettere, Pavia
Dante studies; nineteenth- and twentieth-century literature

Guido A. Guarino, Professor of Italian, FAS-NB; Ph.D., Columbia
Humanism and Renaissance literature

Umberto Mariani, Professor of Italian, FAS-NB; Dott. in Lettere, Pavia
Nineteenth- and twentieth-century literature

David R. Marsh, Associate Professor of Italian, FAS-NB; Ph.D., Harvard
Influence of classical literature in Renaissance Italy from Petrarch to Tasso

Laura S. White, Chairperson of Department and Professor of Italian, FAS-NB; Dott. in Lettere, Trieste; Ph.D., California (Los Angeles)
Seventeenth- and eighteenth-century literature; Renaissance theater; the epic; early medieval literature

Programs

The graduate faculty in Italian offers three degree programs. The M.A.T. program is intended primarily for those who are teaching, or intend to teach, at the secondary school level. The program emphasizes language, literature, and civilization. The M.A. and Ph.D. programs deal with all aspects of Italian literature and literary criticism. All three programs are open to candidates with academic records of distinction and other evidence of scholarly accomplishment. The Master of Philosophy degree is available to doctoral candidates in Italian who, in addition to meeting the other M.Phil. requirements of the Graduate School—New Brunswick, achieve grades of A in at least nine term courses.

Candidates for the M.A.T. must satisfactorily complete ten term courses (30 credits) and take an examination based on a reading list. Master of Arts candidates also take ten term courses (30 credits) and must pass a comprehensive examination based on a reading list. Six of the 30 credits required for the M.A. may be devoted to a research problem if the candidate elects to write a thesis.

Doctoral candidates are usually required to complete 48 credits of course work beyond the bachelor's degree, a minimum of 24 credits of research towards the dissertation, and residence for one year; credit for graduate work taken at other institutions may be accepted in partial fulfillment of the course requirement, but in no case may the doctoral candidate do less than a full year of course work at Rutgers. Doctoral candidates must demonstrate a reading knowledge of German, Greek, or Latin and of a second Romance language. The language requirement must be satisfied before the candidate is admitted to the qualifying examination. This examination is based on a reading list covering all periods of Italian literature. Once a student fulfills the course requirements, including the residence requirement, and passes the qualifying examination, he or she is admitted to candidacy for the Ph.D. degree and may then proceed with the preparation of a dissertation.

Reading lists on which the examinations are based, as well as a Guide for Graduate Students in Italian, are available at the office of the program director.

Graduate Courses

15:560:501,502. HISTORY OF THE ITALIAN LANGUAGE (3,3)
Marsh

The development of the Italian language from its origins to the present day, with emphasis on the phonological, morphological, syntactical, and lexical growth of the literary tongue.

16:560:503,504. ADVANCED GRAMMAR AND COMPOSITION (3,3)
Advanced grammar, with special attention to problems of idiomatic expression and literary style; themes, oral presentations, and translation.

16:560:506. (F) APPLIED LINGUISTICS IN ITALIAN (3)
A contrastive analysis of the phonology, morphology, and syntax of English and Italian, oriented toward actual teaching problems in the classroom.

16:560:507,508. INTRODUCTION TO ROMANCE PHILOLOGY (3,3)
Introduction to the typology of the Romance languages. First term: history and structure of the Romance languages. Second term: readings of parallel texts with studies of special problems.

16:560:509,510. ITALIAN CIVILIZATION (3,3)
A survey of Italian civilization, with emphasis on its expression through the arts from the thirteenth century to the present.

16:560:511,512. APPROACHES TO LITERATURE (3,3)
Poetry and prose from various periods of Italian literature, with examples of interpretive and textual scholarship and criticism, and various methods of literary study.

16:560:513,514. STYLISTICS AND LITERARY CRITICISM (3,3)
Prerequisite: 16:560:504 or permission of instructor.
Elements of style and theory of grammar; rhetoric and structure of literature; stylistic analysis and practice in literary criticism.

16:560:515,516. ITALIAN LITERATURE FROM THE THIRTEENTH TO SIXTEENTH CENTURY (3,3)
A survey of the first four centuries of Italian literature. First term: late medieval literary currents. Second term: the age of humanism and the Renaissance.

16:560:517,518. ITALIAN LITERATURE FROM THE SEVENTEENTH TO THE TWENTIETH CENTURY (3,3)
A survey of the main literary currents and major writers of modern and contemporary Italy. First term: from the baroque to romanticism. Second term: from Verismo to the present.

16:560:521. (F) PROBLEMS OF TEACHING ITALIAN (N1.5)
Objectives, teaching techniques, testing, and student evaluation in elementary and intermediate language and literature courses. Bibliographical and other professional resources. Observation of classes.

16:560:522. (S) TEACHING APPRENTICESHIP IN ITALIAN (N1.5)
Observation of elementary and intermediate language classes; supervised practice teaching.

16:560:601,602. STUDIES IN EARLY ITALIAN LITERATURE (3,3)
White
The beginnings of Italian literature in the thirteenth century; poetry and prose before Danté, the Sicilian School, and the *dolcestilnuovo*.

16:560:605,606. DANTÉ SEMINAR (3,3)
Ferrucci
Medieval thought as represented in Danté's works.

16:560:613,614. ITALIAN LITERATURE OF THE FOURTEENTH CENTURY (3,3)
Guarino, White
First term: Petrarca. Second term: Boccaccio.

16:560:615,616. ITALIAN LITERATURE OF THE FIFTEENTH CENTURY (3,3)
Guarino, Marsh
First term: the development of humanism—Bruni, Valla, Alberti, Pico della Mirandola, Ficino, and others. Second term: the poets—Lorenzo, Poliziano, Pulci, Boiardo, and others.

16:560:621,622. ITALIAN LITERATURE OF THE SIXTEENTH CENTURY (3,3)
Guarino, Baldi
The flowering of the Renaissance—the Reformation, Ariosto, Machiavelli, Guicciardini, Castiglione, Della Casa, Bembo, Aretino, Tasso, and others.

16:560:625,626. ITALIAN EPIC AND CHIVALRIC POETRY (3,3)
White
The medieval origins of the genre and its evolution during the Renaissance through Pulci's *Morgante*, Boiardo's *Orlando Innamorato*, Ariosto's *Orlando Furioso*, and Tasso's *Gerusalemme Liberata*.

16:560:631,632. ITALIAN LITERATURE OF THE SEVENTEENTH AND EIGHTEENTH CENTURIES (3,3)

White

The works of Campanella, Marino, Galileo, Goldoni, Gozzi, Vico, Parini, Alfieri, and others.

16:560:641,642. THE ROMANTIC AGE (3,3)

Ferrucci

The first half of the nineteenth century. The neoclassic school and European romantic poetics: Foscolo, Leopardi, and Manzoni. Major dialect poets: Porta, Belli. Poets, critics, and ideologues of the Risorgimento.

16:560:643,644. ITALIAN LITERATURE OF THE LATE NINETEENTH CENTURY (3,3)

Ferrucci

The Scapigliatura. The major poets: Carducci, Pascoli, and D'Annunzio and their relationship to European decadentism and symbolism. The poetics of naturalism and Verismo: Verga, D'Annunzio, Fogazzaro, and Capuana.

16:560:645,646. STUDIES IN ITALIAN LITERATURE OF THE NINETEENTH CENTURY (3,3)

Ferrucci

Each term deals in depth with one or two major literary figures or movements of nineteenth-century Italian literature.

16:560:651,652. ITALIAN POETRY OF THE TWENTIETH CENTURY (3,3)

Mariani

The poetic models of D'Annunzio and Pascoli, and the reaction of the "crepuscolari" poets. The poetic movements of futurism and La Voce, the Ronda restoration. The major figures of Ungaretti and Montale. The hermetic school and the poetry of Quasimodo. Antehermetic and posthermetic developments. The Novissimi and later trends.

16:560:653,654. ITALIAN NOVEL OF THE TWENTIETH CENTURY (3,3)

Mariani

The D'Annunzian model and the anti-D'Annunzian novels of Borgese, Svevo, Pirandello, Tozzi. Differing regional trends and the traditional novel in the twentieth century. The Novecento movement and the novels of Manzini and Buzzati. The neorealists, the postwar generation, and contemporary trends.

16:560:655,656. MODERN ITALIAN THEATER (3,3)

Mariani

The Italian naturalistic and bourgeois theater from its late nineteenth-century origins to the major works of Verga, D'Annunzio, Giacosa, and Bracco. The "grotesque" theater, Pirandello, and the contemporary theater from Betti, Fabbri, and De Filippo to Zardi, Squarzina, and Testori.

16:560:657,658. ITALIAN LITERATURE OF THE TWENTIETH CENTURY (3,3)

The reaction to the nineteenth-century models in poetry, fiction, and theater; the establishment of new models of writing in the cultural climate that followed futurism and World War I; the hermeticism of the 1930s and the neorealism of the 1940s; the major literary figures and trends of recent decades.

16:560:661,662. THE ITALIAN SHORT STORY (3,3)

The origins, development, and influence of the Italian short story from the Novellino to today.

16:560:671,672. HISTORY OF ITALIAN CRITICISM (3,3)

A survey of modern Italian critical thought, starting with the preromantic aesthetics of Vico in the early eighteenth century and concluding with the twentieth-century contributions of Croce and the post-Croceans.

16:560:673,674. PROBLEMS IN LITERARY RELATIONSHIPS (3,3)

Independent study under the supervision of a faculty member of the relationship between Italian literature and the literature of France or Spain.

16:560:701,702. RESEARCH IN ITALIAN (BA,BA)

Interdisciplinary Graduate Course

15:617:510. INTRODUCTION TO LITERARY THEORY (3)

Flieger, Marsh, Eisenzweig, Edmunds, Persin, Galperin, Davidson, et al.

Prerequisite: Open to second-term graduate students; priority given to students from programs participating in the Council of Languages and Literature.

An introduction to contemporary literary theory, including formalism, structuralism, poststructuralism, feminism, psychoanalysis, cultural studies, and other approaches. Readings of theoretical texts and applications to short literary texts from a variety of literatures.

LABOR AND INDUSTRIAL RELATIONS

A master's program in Labor and Industrial Relations is offered by the School of Management and Labor Relations. Contact the director of the program, Dr. Adrienne Eaton (732/932-8559) for further information.

LIBRARY SERVICE (See the catalog of the School of Communication, Information and Library Studies for information about programs leading to the Master of Library Service.)

LINGUISTICS 615

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Director of the Graduate Program: Professor Maria Bittner,
18 Seminary Place, College Avenue Campus (732/932-7289)

Members of the Graduate Faculty

Akinbiyi M. Akinlabi, Associate Professor of Linguistics, FAS-NB; Ph.D., Ibadan
Intonation of lexical tone languages; optimization and ATR harmony
Maria Bittner, Associate Professor of Linguistics, FAS-NB; Ph.D., Texas (Austin)
Formal semantics; syntax-semantics interface; exotic languages (including Eskimo)

Veneeta Dayal, Associate Professor of Linguistics, FAS-NB; Ph.D., Cornell
Syntax; semantics; South-Asian linguistics; cognitive studies
Viviane M. Deprez, Associate Professor of Linguistics, FAS-NB; Ph.D.,
Massachusetts Institute of Technology
Syntax; French linguistics

Jane Grimshaw, Professor of Linguistics, FAS-NB; Ph.D., Massachusetts
Syntactic theory; the lexicon; language acquisition; cognitive science

Alan S. Prince, Professor of Linguistics, FAS-NB; Ph.D., Massachusetts
Institute of Technology
Phonology; prosodic theory; constraint interaction; cognitive science

Kenneth Safir, Professor of Linguistics, FAS-NB; Ph.D., Massachusetts Institute of Technology
Syntax; Germanic linguistics; Romance linguistics; history of linguistics; learnability theory

Roger Schwarzschild, Assistant Professor of Linguistics, FAS-NB;
Ph.D., Massachusetts
Formal semantics; syntax; Hebrew language

Hubert Truckenbrodt, Assistant Professor of Linguistics, FAS-NB; Ph.D.,
Massachusetts Institute of Technology
Phonology; syntax-phonology interface; intonation

Program

The graduate program in linguistics offers a comprehensive program of study leading to the Ph.D. in the major areas of theoretical linguistics. It is structured from the start to facilitate the student's involvement in research through work undertaken in close contact with members of the faculty and is designed to prepare graduates for careers in research and teaching at the university level in linguistics or in linguistically oriented subfields within the larger enterprise of cognitive science. Students are expected to develop broad expertise in all of the core areas of phonology, syntax, and semantics before specializing.

Students do not enroll for the M.A.; a terminal master's degree is offered.

Graduate Courses

16:615:505. LINGUISTICS COLLOQUIUM (3)

Discussion and presentation of research in progress by advanced graduate students, visitors, and faculty members.

16:615:510. SYNTAX I (3)

Deprez, Grimshaw, Safir

Introduction to syntactic theorizing and analysis. Provides fundamental background in phrase structure theory, predicate argument structure, grammatical function changing, conditions on anaphora, case marking, thematic roles, and long distance dependencies.

16:615:511. SYNTAX II (3)

Deprez, Grimshaw, Safir. Prerequisite: 16:615:510.

Intermediate level discussion of major issues in syntactic theory, including theories of parametric variation, logical form and levels of grammar, components and subtheories of grammar, and many other issues.

16:615:514. TOPICS IN SYNTACTIC THEORY (3)

Deprez, Grimshaw, Safir. Prerequisite: 16:615:511.

Advanced level discussion of current issues in syntactic theory. Topics vary.

16:615:517. TOPICS IN GERMANIC SYNTAX (3)

Safir. Prerequisite: working knowledge of generative grammar.

Further study of Germanic phenomena in the construction of syntactic theory. Emphasis on construction types that are of the greatest theoretical and crosslinguistic interest.

16:615:520. PHONOLOGY I (3)

Akinlabi, Prince, Truckenbrodt

Introduction to major phonological phenomena and concepts of current theory, with emphasis on the development of analytical skills.

16:615:521. PHONOLOGY II (3)

Akinlabi, Prince, Truckenbrodt. Prerequisite: 16:615:520.

In depth investigation of leading issues in current theory, with focus on the structure of representations and the organization of the phonological component of the grammar.

16:615:524. TOPICS IN PHONOLOGY (3)

Akinlabi, Prince, Truckenbrodt. Prerequisite: 16:615:521.

Exploration of a special topic arising from current research in phonological theory.

16:615:530. SEMANTICS I (3)

Bittner, Dayal, Schwarzschild

Introduction to model-theoretic semantics. Topics include elementary set theory, predicate logic, and their applications in the analysis of major semantic phenomena.

16:615:531. SEMANTICS II (3)

Bittner, Dayal, Schwarzschild. Prerequisite: 16:615:530.

Mathematical tools for relating syntactic structure to semantic interpretation. Topics include higher-order logic, lambda calculus, intensional logic, type theory, type driven translation, type lifting, and lattices.

16:615:532. TOPICS IN SEMANTICS I (3)

Bittner, Dayal, Schwarzschild. Prerequisite: 16:615:531.

Selected topics in model-theoretic semantics. Questions, focus, presupposition, conversational implicature, context dependence, and context change.

16:615:533. TOPICS IN SEMANTICS II (3)

Bittner, Dayal. Prerequisite: 16:615:531.

Selected topics in model-theoretic semantics, modals, conditionals, indexicals, tense, aspect, and genericity.

16:615:535. SEMINAR IN SEMANTICS (3)

Bittner, Dayal, Schwarzschild. Prerequisite: 16:615:532 or 533.

Seminar concerned with current issues in semantic theory. Topics vary.

16:615:610. FORMAL METHODS FOR LINGUISTICS (3)

Bittner, Prince, Schwarzschild. Prerequisite: 16:615:531 or equivalent.

Selected topics in logic, algebra, formal languages, computation, mathematical analysis, statistics, and/or formal learning theory, with applications to linguistics.

16:615:631. FIELD METHODS FOR LINGUISTICS (3)

Prerequisites: 16:615:511, 521, 531.

Analysis of the linguistic structure of an unfamiliar language, based on in-class work with a native-speaker consultant.

16:615:660. SPECIAL TOPICS IN CURRENT LINGUISTIC THEORY (3)

Prerequisites: 16:615:511, 521, and either 532 or 533.

Topics in current linguistic research that cross disciplinary boundaries.

16:615:690,691. QUALIFYING PAPER WORKSHOP (3,3)

Students working on qualifying papers present work in progress for discussion and criticism.

LITERATURE AND LANGUAGE 617

The Council of Literatures and Languages coordinates activities of interest and benefit to graduate programs in literatures and languages. The council sponsors lectures, promotes professional preparation, and facilitates interdisciplinary activities and workshops and offers literary, linguistic, and film theory courses that are open to students in all literary disciplines.

Inquiries may be addressed to the current chair of the council, Professor Margaret Persin, Graduate Program in Spanish, Carpenter House (732/932-9323).

Graduate Courses

15:617:510. INTRODUCTION TO LITERARY THEORY (3)

Flieger, Marsh, Eisenzweig, Edmunds, Persin, Galperin, Davidson, et al.

Prerequisite: Open to second-term graduate students; priority given to students from programs participating in the Council of Languages and Literature.

An introduction to contemporary literary theory, including formalism, structuralism, poststructuralism, feminism, psychoanalysis, cultural studies, and other approaches. Readings of theoretical texts and applications to short literary texts from a variety of literatures.

16:617:512. LINGUISTIC THEORY AND THE STUDY OF LITERATURE (3)

Deprez, Safir

The major schools of linguistic theory and methods (i.e., de Saussure, American structuralism, Prague School, generative grammar) and their relevance for other fields, e.g., anthropology, literature, and cognitive science.

16:617:514. INTRODUCTION TO FILM THEORY AND ANALYSIS (3)

Surveys major film theories and methods of close analysis in the context of literary and cultural studies; includes "classical" theory, formalist analysis, feminist and psychoanalytic approaches.

LITERATURES IN ENGLISH

(see English, Literatures in 350)

MATHEMATICS 640, 642

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Peter S. Landweber,
Hill Center for the Mathematical Sciences, Busch Campus
(732/445-3864)

Members of the Graduate Faculty

- Eric W. Allender, Associate Professor of Computer Science, FAS-NB; Ph.D., Georgia Institute of Technology
Complexity theory; parallel and probabilistic computation
- Abbas Bahri, Professor of Mathematics, FAS-NB; Doctorat, École Normale Supérieure
Variational problems in nonlinear analysis and geometry
- Tadeusz Balaban, Professor of Mathematics, FAS-NB; Ph.D., Warsaw
Mathematical physics
- José Barros-Neto, Professor of Mathematics, FAS-NB; Ph.D., São Paulo
Functional analysis; partial differential equations
- R. Michael Beals, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Harmonic analysis; Fourier integral operators; partial differential equations
- Jozsef Beck, Harold H. Martin Professor of Mathematics, FAS-NB; Ph.D., Hungarian Academy of Sciences
Combinatorics, combinatorial games, number theory
- Adi Ben-Israel, Professor of Management, SB-NB; Ph.D., Northwestern
Matrix theory, numerical linear algebra, convexity and optimization operations research, mathematical economics
- Edward Boylan, Associate Professor of Mathematics, FAS-N; Ph.D., Princeton
Analysis
- Haim Brezis, Visiting Distinguished Professor of Mathematics, FAS-NB; Doctorat, Paris
Nonlinear functional analysis; partial differential equations
- Felix E. Browder, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Functional analysis and partial differential equations
- Richard T. Bumby, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Number theory
- Terence Butler, Professor of Mathematics, FAS-NB; Ph.D., Indiana
Differential equations
- Sagun Chanillo, Professor of Mathematics, FAS-NB; Ph.D., Purdue
Classical analysis; partial differential equations
- Gregory L. Cherlin, Professor of Mathematics, FAS-NB; Ph.D., Yale
Logic; model theory; model theoretic algebra
- Vasek Chvatal, Professor of Computer Science, FAS-NB; Ph.D., Waterloo
Combinatorial optimization; analysis of algorithms
- Amy Cohen, Professor of Mathematics and Dean, UC-NB; FAS-NB; Ph.D., California (Berkeley)
Partial differential equations; inverse scattering; Korteweg-de Vries equation
- Richard M. Cohn, Professor Emeritus of Mathematics, FAS-NB; Ph.D., Columbia
Differential algebra
- Bernard Coleman, J. Willard Gibbs Professor of Thermomechanics, FAS-NB; Ph.D., Yale
Continuum mechanics, analysis
- Jane Cronin, Professor Emerita of Mathematics, FAS-NB; Ph.D., Michigan
Qualitative theory of ordinary differential equations; biomathematics
- Fred Diamond, Associate Professor of Mathematics, FAS-NB; Ph.D., Princeton
Number theory
- William D. Duke, Professor of Mathematics, FAS-NB; Ph.D., New York
Analytic number theory and automorphic forms
- Joanne Elliott, Professor Emerita of Mathematics, FAS-NB; Ph.D., Cornell
Analysis; potential theory
- Carl C. Faith, Professor Emeritus of Mathematics, FAS-NB; Ph.D., Purdue
Theory of rings and modules
- Richard S. Falk, Professor of Mathematics, FAS-NB; Ph.D., Cornell
Numerical analysis; partial differential equations
- Giovanni Gallavotti, Visiting Professor of Mathematics, FAS-NB; Ph.D., Florence
Statistical mechanics; quantum field theory; dynamical systems
- Israel M. Gelfand, Professor of Mathematics, FAS-NB; Ph.D., Moscow State
Mathematics; artificial intelligence; neuroanatomy; cell biology
- Jane P. Gilman, Professor of Mathematics, FAS-N; Ph.D., Columbia
Riemann surfaces; Fuchsian groups; Teichmüller theory; geometric topology; combinatorial group theory
- Semen G. Gindikin, Professor of Mathematics, FAS-NB; Ph.D., Mathematics Institute (Leningrad)
Theory of representations; integral geometry; several complex variables; mathematical physics
- Gerald A. Goldin, Director of the Center for Mathematics, Computing and Science Education and Professor of Mathematics and Physics Education, GSE; Ph.D., Princeton
Lie theory; mathematical physics; secondary education
- Sheldon Goldstein, Professor of Mathematics, FAS-NB; Ph.D., Yeshiva
Statistical mechanics; probability theory
- Roe Goodman, Professor of Mathematics, FAS-NB; Ph.D., Massachusetts Institute of Technology
Differential operators and analysis on Lie groups
- Ronald L. Graham, University Professor of Mathematics, FAS-NB; Ph.D., California (Berkeley)
Combinatorics graph theory; theory of compatibility
- Stephen Greenfield, Associate Professor of Mathematics, FAS-NB; Ph.D., Brandeis
Linear partial differential equations; several complex variables
- Richard F. Gundy, Professor of Statistics, FAS-NB; Ph.D., Chicago
Harmonic analysis; probability theory; harmonic functions; martingales
- András Hajnal, Professor of Mathematics and Director of DIMACS; Ph.D., Bolyai Institute (Szeged)
Combinatorics; mathematical logic; set theory
- Peter Hammer, Professor of Mathematics and Director of the Center for Operations Research, RUTCOR; Ph.D., Bucharest
Boolean methods in operations research; integer programming; applications of discrete mathematics; graph theory
- William Hoyt, Associate Professor Emeritus of Mathematics, FAS-NB; Ph.D., Chicago
Algebraic geometry; elliptic surfaces; modular forms
- Henryk Iwaniec, State of New Jersey Professor of Mathematics, FAS-NB; Ph.D., Warsaw
Analytic number theory
- Howard J. Jacobowitz, Professor of Mathematics, FAS-C; Ph.D., New York
Differential geometry
- Joseph L. Johnson, Professor of Mathematics, FAS-NB; Ph.D., Columbia
Differential algebra; algebraic theory of partial differential equations
- Jeffrey N. Kahn, Professor of Mathematics, FAS-NB; Ph.D., Ohio State
Matroids; extremal problems in set theory and graph theory; finite geometries
- Johannes H.B. Kemperman, Professor of Statistics, FAS-NB; Ph.D., Amsterdam
Probability and statistics
- C. David Keys, Associate Professor of Mathematics, FAS-N; Ph.D., Chicago
Number theory; harmonic analysis and representation theory of p-adic groups
- Friedrich Knop, Professor of Mathematics, FAS-NB; Ph.D., Basel (Switzerland)
Algebraic geometry; representation theory
- János Komlós, Professor of Mathematics, FAS-NB; Ph.D., Eötvös
Combinatorics; probability; theoretical computer science
- Antoni A. Kosinski, Chairperson of Department and Professor of Mathematics, FAS-NB; Ph.D., Warsaw
Differential topology
- Martin Kruskal, David Hilbert Professor of Applied Mathematics, FAS-NB; Ph.D., New York
Applied mathematics
- Antti Kupiainen, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Mathematical physics; quantum field theory; statistical mechanics
- Peter S. Landweber, Professor of Mathematics, FAS-NB; Ph.D., Harvard
Algebraic topology; bordism theory; generalized homology theory
- Solomon Leader, Professor Emeritus of Mathematics, FAS-NB; Ph.D., Princeton
Analysis; abstract spaces
- Joel L. Lebowitz, George William Hill Professor of Mathematics and Director of the Center for Mathematical Sciences Research, FAS-NB; Ph.D., Syracuse
Mathematical physics; statistical mechanics
- James I. Lepowsky, Professor of Mathematics, FAS-NB; Ph.D., Massachusetts Institute of Technology
Lie algebras; representation theory
- Norman Levitt, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Differential and geometric topology; surgery theory; structural theory
- Yanyan Li, Professor of Mathematics, FAS-NB; Ph.D., New York
Nonlinear analysis; partial differential equations
- Richard N. Lyons, Professor of Mathematics, FAS-NB; Ph.D., Chicago
Simple groups
- Benjamin Muckenhoupt, Professor Emeritus of Mathematics, FAS-NB; Ph.D., Chicago
Harmonic analysis; orthogonal expansions; weighted norm inequalities
- Roger Nussbaum, Professor of Mathematics, FAS-NB; Ph.D., Chicago
Nonlinear functional analysis
- Daniel L. Ocone, Associate Professor of Mathematics, FAS-NB; Ph.D., Massachusetts
Stochastic processes; stochastic control; filtering
- Michael E. O’Nan, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Permutation groups; simple groups
- Barbara L. Osofsky, Professor of Mathematics, FAS-NB; Ph.D., Rutgers
Ring theory; homological algebra
- Ted Petrie, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Algebraic and differential topology; transformation groups; equivariant surgery
- Walter V. Petryshyn, Professor Emeritus of Mathematics, FAS-NB; Ph.D., Columbia
Nonlinear functional analysis; numerical functional analysis

Andras Prekopa, Professor of Operations Research and Statistics, FAS-NB; Ph.D., Budapest
Optimization of stochastic systems

John D. Randall, Associate Professor of Mathematics, FAS-N; Ph.D., Warwick
Topology; algebraic geometry

Herbert Robbins, State of New Jersey Professor of Mathematical Statistics, FAS-NB; Sc.D., Purdue
Stochastic approximation; empirical Bayes; tests of power one; design of clinical trials

Fred S. Roberts, Professor of Mathematics, FAS-NB; Ph.D., Stanford
Discrete mathematical models; graph theory; decision making; measurement theory

Xiaochun Rong, Associate Professor of Mathematics, FAS-NB; Ph.D., SUNY (Stony Brook)
Riemannian geometry

Joseph Rosenstein, Professor of Mathematics, FAS-NB; Ph.D., Cornell
Logic; linear orderings; recursive model theory

Siddhartha Sahi, Associate Professor of Mathematics, FAS-NB; Ph.D., Yale
Representations of reductive groups

Michael Saks, Professor of Mathematics, FAS-NB; Ph.D., Massachusetts Institute of Technology
Combinatorial optimization and algorithms; extremal set theory; partially ordered sets

Vladimir Scheffer, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Geometric measure theory; partial differential equations

David Shanno, Professor of Management, SB-NB; Ph.D., Carnegie-Mellon
Mathematical programming, numerical analysis

Saharon Shelah, Distinguished Visiting Professor of Mathematics, FAS-NB; Ph.D., Hebrew
Logic; model theory

Diana F. Shelstad, Professor of Mathematics, FAS-N; Ph.D., Yale
Harmonic analysis on algebraic groups related to number theory and geometry

Charles C. Sims, Professor of Mathematics, FAS-NB; Ph.D., Harvard
Computational group theory and algebraic algorithms

Avraham Soffer, Associate Professor of Mathematics, FAS-NB; Ph.D., Tel Aviv
Theory of partial differential evolution equations; Schrödinger operators and scattering theory; general mathematical physics

Eduardo D. Sontag, Professor of Mathematics, FAS-NB; Ph.D., Florida
System and control theory

Eugene R. Speer, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Mathematical physics

Hector J. Sussmann, Professor of Mathematics, FAS-NB; Ph.D., New York
System and control theory

William J. Sweeney, Professor of Mathematics, FAS-NB; Ph.D., Stanford
Linear partial differential equations; overdetermined systems

Endre Szemerédi, State of New Jersey Professor of Computer Science, FAS-NB; Ph.D., Budapest
Theoretical computer science; number theory; combinatorics

Earl J. Taft, Professor of Mathematics, FAS-NB; Ph.D., Yale
Hopf algebras

Jean E. Taylor, Professor of Mathematics, FAS-NB; Ph.D., Princeton
Geometric measure theory

Simon Thomas, Professor of Mathematics, FAS-NB; Ph.D., London
Model theory; infinite groups

Myles Tierney, Professor of Mathematics, FAS-NB; Ph.D., Columbia
Topos theory

Gabor Toth, Associate Professor of Mathematics, FAS-C; Ph.D., Eötvös Loránd
Differential geometry

J. François Trèves, Robert Adrain Professor of Mathematics, FAS-NB; Ph.D., Sorbonne
Functional analysis; linear partial differential equations; several complex variables

Jerrold B. Tunnell, Associate Professor of Mathematics, FAS-NB; Ph.D., Harvard
Number theory; automorphic forms

Wolmer V. Vasconcelos, Professor of Mathematics, FAS-NB; Ph.D., Chicago
Commutative algebra

Michael Vogelius, Professor of Mathematics, FAS-NB; Ph.D., Maryland
Numerical analysis; partial differential equations

Bertram Walsh, Professor of Mathematics, FAS-NB; Ph.D., Michigan
Analysis; functional analysis; potential theory

Charles A. Weibel, Professor of Mathematics, FAS-NB; Ph.D., Harvard
Algebraic K-theory; homological algebra; algebraic topology; category theory

Tilla K. Weinstein, Professor of Mathematics, FAS-NB; Ph.D., New York
Differential geometry; surfaces in semi-Riemannian manifolds

Richard L. Wheeden, Professor of Mathematics, FAS-NB; Ph.D., Chicago
Harmonic analysis; harmonic functions; weighted norm inequalities

Robert L. Wilson, Professor of Mathematics, FAS-NB; Ph.D., Yale
Lie algebras

Norman Zabusky, State of New Jersey Professor of Computational Fluid Dynamics, FAS-NB; Ph.D., California Institute of Technology
Vortex dynamics in two and three dimensions

Hyman J. Zimmerberg, Professor Emeritus of Mathematics, FAS-NB; Ph.D., Chicago
Boundary value problems

Associate Members of the Graduate Faculty

Martin Farach, Assistant Professor of Mathematics, FAS-NB; Ph.D., Maryland
Computational molecular biology; sequential and partial algorithms

Zheng-Chao Han, Assistant Professor of Mathematics, FAS-NB; Ph.D., Courant Institute (New York)
Nonlinear analysis; partial differential equations

Yi-Zhi Huang, Assistant Professor of Mathematics, FAS-NB; Ph.D., Rutgers
Differential geometry; conformal field theory

William F. Keigher, Associate Professor of Mathematics, FAS-N; Ph.D., Illinois
Differential and commutative algebra, category theory; algebraic geometry

Michael Kiessling, Assistant Professor of Mathematics, FAS-NB; Ph.D., Ruhr (Bochum)
Statistical mechanics

Henry W. Levinson, Associate Professor of Mathematics, FAS-NB; Ph.D., New York
Algebraic graph theory

Feng Luo, Assistant Professor of Mathematics, FAS-NB; Ph.D., California (San Diego)
Topology and geometry

Jacob Sturm, Associate Professor of Mathematics, FAS-N; Ph.D., Princeton
Number theory, automorphic forms

Programs

The graduate program in mathematics offers courses of study leading to the degrees of Master of Science and Doctor of Philosophy with options in both pure and applied mathematics. Possible areas of specialization include algebraic geometry, applied discrete mathematics and combinatorics, category theory, commutative algebra, differential geometry, functional analysis, geometric measure theory, group theory, harmonic analysis on Euclidean spaces, Lie theory, logic, mathematical physics, nonlinear analysis, number theory, numerical analysis, ordinary differential equations, operations research, partial differential equations, probability theory, ring theory, algebraic and geometric topology, topos theory, and system and control theory.

The program in mathematics is housed in the Hill Center for the Mathematical Sciences, a modern seven-story building on the Busch campus. Hill Center and the adjoining CoRE building house the departments of Computer Science, Statistics, the Center for Discrete Mathematics and Theoretical Computer Science, as well as the Mathematical Sciences Library, which contains over 27,000 volumes and subscribes to over 300 research journals in pure and applied mathematics. Office space is provided to all full-time graduate students in mathematics. The graduate programs in biology, chemistry, physics, and engineering are located nearby.

Applicants to the Ph.D. programs must have a strong undergraduate background in mathematics and must submit scores from both the general and subject tests of the Graduate Record Examination (GRE). Financial support in the form of fellowships and teaching assistantships is available to qualified doctoral students. Application for financial support should be made by February 1.

Applicants to the master's programs should have an undergraduate degree in mathematics or a related area. Preferably, they should have taken courses in linear algebra and advanced calculus. Both the general and subject tests of the GRE are required for master's applicants.

It is also possible to apply for admission as a nondegree student. The GRE is not required for these applicants. Courses taken as a nondegree student can count toward a degree if the student is subsequently admitted to a degree program.

All doctoral students must pass a two-stage qualifying examination before officially commencing work on their thesis; the exam structure is the same for pure and applied mathematics. The first examination, a written one, designed to ensure that Ph.D. graduates know certain basic material, is normally taken at the beginning of the student's second year. The second examination is oral and is normally taken by the beginning of the second term of the student's third year.

For the Ph.D. in pure mathematics, 48 credits of course work are required, normally including the following: 16:640:501, 502 (real analysis), 16:640:503 (complex analysis), 16:640:507 (functional analysis), 16:640:540-541 (topology), 16:640:551-552 (algebra),

and 16:640:616,617 (seminar in mathematics). In addition to the doctoral dissertation, 24 credits in research are required. A reading knowledge of French, German, or Russian is required. There is no residency requirement.

For the Ph.D. in applied mathematics, 48 credits of course work and 24 credits in research are required in addition to the doctoral dissertation. Courses 16:640:616,617 Seminar in Mathematics are required, and the following courses are strongly recommended: 16:640:501,502 (real analysis), 16:640:503 (complex analysis), and 16:640:551,552 (algebra). Students should also take a series of courses in an area of application, such as control and system theory, discrete mathematics, mathematical biology, mathematical physics, numerical analysis, or operations research. A reading knowledge of French, German, or Russian is required. There is no residency requirement.

For the M.S. in pure mathematics, 30 credits of course work are required. Three of the following four sequences of courses must be taken: 16:640:501,502 (real analysis), 16:640:503,504 or 16:640:503,507 (complex or complex and functional analysis), 16:640:540,541 (topology), and 16:640:551,552 (algebra). A master's essay is also required. There is no residency requirement.

For the M.S. in applied mathematics, 30 credits of course work are required. Students must take: (1) 16:642:550 (linear algebra); (2) a course in computer science, discrete mathematics, or statistics; and (3) one of the following courses in analysis: 16:640:501 (real analysis), 16:640:503 (complex analysis), 16:640:515 (ordinary differential equations), or 16:642:516 (partial differential equations). The ten courses used to fulfill the 30-credit requirement must be chosen with faculty approval. Typically, most of the courses in an approved program are organized around some coherent principle, such as applied discrete mathematics, numerical analysis, operations research, or systems and control theory. Finally, a master's essay and proficiency in a scientific programming language (such as FORTRAN or PL/I) are required. There is no residency requirement.

Not all graduate courses listed below are given every year. Each course is scheduled subject to student demand and at the discretion of the graduate faculty.

Graduate Courses (640)

16:640:501,502. THEORY OF FUNCTIONS OF A REAL VARIABLE (3,3)
Prerequisite: Advanced calculus.

The real number system, measure theory, and Lebesgue integration in Euclidean and abstract spaces, set functions, bounded variation, absolute continuity, differentiation of the indefinite integral. Radon measure, L^p spaces.

16:640:503. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE I (3)
Prerequisite: Advanced calculus.

Elementary properties of complex numbers, analytic functions, the exponential function and logarithm, conformal mapping, the Cauchy integral formula, the maximum modulus principle, Laurent series, classification of isolated singularities, the residue theorem.

16:640:504. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE II (3)
Prerequisite: 16:640:503.

Analytic continuation and the monodromy theorem, normal families and the Riemann mapping theorem, the Picard theorems, and other topics.

16:640:507,508. FUNCTIONAL ANALYSIS (3,3)
Prerequisites: 16:640:502,503,540.

First term: Introductory Hilbert space theory, including the Riesz representation theorem and the spectral theory of compact symmetric operators. Fundamental principles of linear analysis: Hahn-Banach, uniform boundedness, and closed-graph theorems. Weak topologies, Riesz theory of compact operators. Second term: Banach algebra, spectral theory of operators on Hilbert space, other selected topics and applications.

16:640:509,510,511. SELECTED TOPICS IN ANALYSIS (3,3,3)
Prerequisites: 16:640:502 and permission of instructor.

16:640:513. NUMERICAL FUNCTIONAL ANALYSIS (3)

Prerequisite: Permission of instructor.

Bases in Banach spaces. Constructive solution of equations involving symmetric and nonsymmetric linear operators and nonlinear compact, P-compact, monotone-accretive, and A-proper operators. Constructive fixed-point theory. Eigenvalue problems. Application to differential and integral equations.

16:640:515. ORDINARY DIFFERENTIAL EQUATIONS (3)

Prerequisites: Linear algebra and advanced calculus.

Theory of ordinary and functional differential equations: basic existence theorems, linear systems, stability theory, periodic and almost-periodic solutions. Applications to biology, medicine, and physics.

16:640:517,518. PARTIAL DIFFERENTIAL EQUATIONS I,II (3,3)

Pre- or corequisites: 16:640:502,503,507.

Theory of distributions, Fourier transform, fundamental solutions of the heat, wave, and Laplace equations. The Cauchy problem, the theorems of Cauchy-Kovalevskaja and Holmgren, hyperbolic equations. Elliptic boundary value problems and Sobolev spaces.

16:640:519. SELECTED TOPICS IN DIFFERENTIAL EQUATIONS (3)

Prerequisite: Permission of instructor.

Topics in ordinary and partial differential equations chosen by the instructor.

16:640:520. DISTRIBUTION THEORY (3)

Prerequisites: 16:640:501,502.

Spaces of distribution; tempered distributions; Sobolev spaces; spaces of test functions; topology and duality of these spaces. Kernel theorems. Growth conditions; the Fourier transform.

16:640:521. HARMONIC ANALYSIS ON EUCLIDEAN SPACES (3)

Pre- or corequisite: 16:640:502.

Maximal functions, fractional integrals, singular integrals, multipliers, Littlewood-Paley theory, H_p spaces, weighted norm inequalities, Fourier series, differentiation.

16:640:523,524. FUNCTIONS OF SEVERAL COMPLEX VARIABLES (3,3)

Pre- or corequisites: 16:640:502,503,507.

Elementary theorems (Hartogs, Osgood), statement of Cousin and Levi problems, complex differential geometry, complex manifolds, holomorphic convexity.

16:640:529. POTENTIAL THEORY (3)

Prerequisites: 16:640:502,504.

Harmonic and superharmonic functions in \mathbb{R}^n ; polar sets, potentials, capacities, Green's functions, balayage, thin sets, and the fine topology. Energy and the Dirichlet integral. The Dirichlet problem in $\mathbb{R}^n L_p$ boundary values and nontangential maximal functions for C^1 and $Lip 1$ boundaries. Ideal boundaries.

16:640:532. DIFFERENTIAL GEOMETRY (3)

Differentiable manifolds, connections, Riemannian manifolds.

16:640:533. INTRODUCTION TO DIFFERENTIAL GEOMETRY (3)

Riemannian manifolds, variational methods and theorems on geodesics, connections on vector and principal bundles, curvature, Euler and other characteristic numbers and classes.

16:640:534. SELECTED TOPICS IN GEOMETRY (3)

Prerequisite: Permission of instructor.

Selected topics including Lie groups, representation theory, homogeneous spaces, and semi-Riemannian manifolds.

16:640:535,536. ALGEBRAIC GEOMETRY (3,3)

Prerequisite: Permission of instructor.

Geometry of projective spaces; cohomology of coherent sheaves; schemes.

16:640:537. SELECTED TOPICS IN GEOMETRY (3)

- 16:640:540,541. INTRODUCTION TO ALGEBRAIC TOPOLOGY (3,3)
Prerequisite: Basic concepts of point set topology.
Fundamental group, homology, and cohomology theory; elements of differentiable manifolds.
- 16:640:542,543. ALGEBRAIC TOPOLOGY (3,3)
Prerequisites: 16:640:504, 541.
Further topics of algebraic and differential topology, including duality theorems, homotopy theory, vector bundles, characteristic classes, and applications to geometric problems.
- 16:640:544. TRANSFORMATION GROUPS (3)
Prerequisite: 16:640:541. Corequisite: 16:640:549.
Actions of compact Lie groups on manifolds.
- 16:640:546. TOPICS IN ALGEBRAIC TOPOLOGY (3)
K-theory, spectral sequences, cohomology operations, various other topics.
- 16:640:547. TOPOLOGY OF MANIFOLDS (3)
Prerequisite: 16:640:541.
Selected topics from the theory of topological and combinatorial manifolds.
- 16:640:548. DIFFERENTIAL TOPOLOGY (3)
Prerequisites: 16:640:540, 541.
Vector bundles, differentiable manifolds. Sard theorem and applications to imbedding problems. Tubular neighborhoods. Other selected topics.
- 16:640:549. LIE GROUPS (3)
Prerequisites: 16:640:532, 541.
Lie groups. Lie algebras, elements of representation theory.
- 16:640:550. LIE ALGEBRAS (3)
Prerequisites: Linear algebra, 16:640:551,552.
An introduction to the general structure theory of Lie algebras and to the structure theory of finite-dimensional semisimple Lie algebras over the complex numbers.
- 16:640:551,552. ABSTRACT ALGEBRA (3,3)
Introductory topics in groups, rings, modules, linear algebra, fields, Galois theory, and homological algebra.
- 16:640:553. THEORY OF GROUPS (3)
Prerequisite: 16:640:551.
Solvable groups, Nilpotent groups, p-groups, transfer and fusion, permutation groups. Topics chosen from among group representations and character theory, primitive permutation groups, local groups, theoretic analysis of simple groups, infinite groups.
- 16:640:555. SELECTED TOPICS IN ALGEBRA (3)
Prerequisite: Permission of instructor.
- 16:640:556. THEORY OF RINGS (3)
Prerequisite: 16:640:552.
Irreducible modules, representations of rings, radicals of rings. Artinian and semisimple rings, quotient rings.
- 16:640:558. THEORY OF ALGEBRAS (3)
Prerequisite: Permission of instructor.
General theory of not necessarily associative algebras and rings. Topics selected from the theory of associative, Lie, alternative, and Jordan algebras. Structure and representation theory.
- 16:640:559. COMMUTATIVE ALGEBRA (3)
Prerequisite: 16:640:552.
Ideal theory, Noetherian rings, local rings, regular local rings, valuation theory, polynomial and power series rings.
- 16:640:560. HOMOLOGICAL ALGEBRA (3)
Prerequisite: 16:640:552.
Projective and injective modules, the derived functors Ext and Tor, categories and functors. Morita theorems, homological dimension.
- 16:640:561. MATHEMATICAL LOGIC (3)
The metamathematics and first-order arithmetic and analysis, with emphasis on the questions of consistency and completeness. An introduction to model theory and its application to the study of formal systems.
- 16:640:566. AXIOMATIC SET THEORY (3)
Prerequisite: 16:640:561.
Axioms of Zermelo-Fraenkel, axioms of infinity consistency and independence of the continuum hypothesis, Dedekind-finite cardinals, large cardinals.
- 16:640:567. MODEL THEORY (3)
Prerequisite: 16:640:561.
Types of elements, prime and saturated models, methods of constructing models, the two-cardinal problem, categoricity and power.
- 16:640:569. SELECTED TOPICS IN LOGIC (3)
Prerequisite: Permission of instructor.
Topics of current interest.
- 16:640:571,572. NUMBER THEORY (3,3)
Prerequisites: 16:640:551,552.
An integrated, year-long introduction to ideas in algebraic and analytic number theory.
- 16:640:573. SPECIAL TOPICS IN NUMBER THEORY (3)
Iwaniec. Prerequisite: Permission of instructor.
- 16:640:615. SPECIAL STUDIES IN ADVANCED MATHEMATICS (BA)
- 16:640:616,617. SEMINAR IN MATHEMATICS (1,1)
Prerequisite: Two years of graduate study in mathematics.
A two-term participation in one of the seminars conducted by the department is required of all candidates for the Ph.D.
- 16:640:651. CATEGORY THEORY (3)
Prerequisite: Some background in algebra and topology.
Basic theory of categories, functors, and natural transformations. The abstract theory interpreted and illustrated through examples.
- 16:640:663. TOPICS IN MATHEMATICAL PHYSICS (3)
- 16:640:699. NONTHESIS STUDY (1)
- 16:640:701,702. RESEARCH IN MATHEMATICS (BA,BA)
- ### Graduate Courses in Applied Mathematics (642)
- 16:642:516. APPLIED PARTIAL DIFFERENTIAL EQUATIONS (3)
Prerequisites: Advanced calculus, differential equations.
Theory and applications of partial differential equations. First order equations: linear and quasi-linear. Hyperbolic systems: shocks. Classification of second-order linear equations. Hyperbolic: characteristics, wave equation. Elliptic: maximum principles, Laplace's and reduced wave equations. Parabolic: heat equation. Fourier and Laplace transforms.
- 16:642:527,528. METHODS OF APPLIED MATHEMATICS (3,3)
Prerequisite: Permission of instructor. Credit not given for these courses and 16:650:567,568.
Appropriate topics from linear algebra, linear operators in Hilbert space, linear integral equations, boundary value problems, calculus of variations, numerical solution of ordinary and partial differential equations.
- 16:642:550. LINEAR ALGEBRA AND APPLICATIONS (3)
Vector spaces, bases, and dimension. Linear operators, quadratic forms, and their matrix representations. Eigenvalues, eigenvectors, diagonalizability, Jordan, and other canonical forms. Applications to systems of linear differential equations.

16:642:551. APPLIED ALGEBRA (3)

Prerequisite: 16:642:550.

Basic algebraic structures, including groups and their representations, finite fields, and Boolean algebra. Applications to physics, counting arguments, switching circuits, and coding theory. Automata theory.

16:642:561-562. INTRODUCTION TO MATHEMATICAL PHYSICS (3,3)

Prerequisites: Linear algebra, advanced calculus.

The study of models of classical and/or quantum mechanical physical systems, with emphasis on the use of rigorous mathematical techniques.

16:642:563. (F) RIGOROUS RESULTS IN STATISTICAL MECHANICS: PART I, EQUILIBRIUM (3)

Prerequisite: Permission of instructor. Students should have either a general mathematical background equivalent to that of a second-year graduate student in mathematics or knowledge of statistical mechanics obtained from physics, chemistry, or engineering courses in the subject.

Treats the subject ab initio. Deals with general questions such as the existence of the thermodynamic limit, convergence of low-density expansions, correlation inequalities, coexistence of phases.

16:642:564. (S) RIGOROUS RESULTS IN STATISTICAL MECHANICS: PART II, NONEQUILIBRIUM (3)

Prerequisite: Permission of instructor. Students should have either a general mathematical background equivalent to that of a second-year graduate student in mathematics or knowledge of statistical mechanics obtained from physics, chemistry, or engineering courses in the subject.

Ergodic theory, time evolution of infinite systems, heat flow in random systems, stationary nonequilibrium systems, exactly soluble models systems, stochastic processes.

16:642:573,574. NUMERICAL ANALYSIS (3,3)

Prerequisites: Advanced calculus, linear algebra, and differential equations.

Ideas and techniques of numerical analysis illustrated by problems in the approximation of functions, the numerical solution of linear and nonlinear systems of equations, the approximation of matrix eigenvalues and eigenvectors, numerical quadrature, and the numerical solution of ordinary differential equations.

16:642:575. NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS (3)

Prerequisite: Partial differential equations.

Finite-difference schemes, investigating stability and convergence, other methods such as those of Ritz-Galerkin type and collocation.

16:642:577,578. SELECTED MATHEMATICAL TOPICS IN SYSTEM THEORY (3,3)

Prerequisites: Linear algebra, differential equations.

Selection of topics from mathematical system theory, e.g., realization, control, stability, optimization, and feedback, with emphasis on qualitative aspects. Algebraic techniques in linear system theory, geometrical and functional analytic techniques in the study of nonlinear control systems.

16:642:581. (S) APPLIED GRAPH THEORY (3)

Prerequisites: Linear algebra, graduate standing.

Connectedness, vertexbases, eulerian and Hamiltonian circuits, tournaments, orientability, intersection graphs, planarity, colorability, and applications to such areas as communication, transportation, archaeology, genetics, and public policy.

16:642:582. (S) COMBINATORICS I (3)

Prerequisites: Linear algebra, advanced calculus. Recommended: Probability.

Introduction to combinatorial methods and their applications. Permutations, combinations, permanents, derangements, inclusion and exclusion, recurrence relations, generating functions, Polya theory, Latin rectangles, Ramsey numbers, experimental design, and error-correcting codes.

16:642:583. (S) COMBINATORICS II (3)

Prerequisites: 01:640:350, 411 or permission of instructor. Recommended: 01:640:477.

Introduction to combinatorial theory and applications. Elementary enumeration, generating functions, matching theory, extremal set theory, partially ordered sets and lattices, Ramsey theory, block designs, error-correcting codes, probabilistic methods, and matroids.

16:642:585. MATHEMATICAL MODELS OF SOCIAL AND POLICY PROBLEMS (3)

Prerequisites: Linear algebra, elementary probability.

Mathematical models of problems in the social sciences and the public and private policy area, emphasizing discrete models. Transportation and communication networks. Energy modeling. Pollution models. Models from economics, psychology, sociology, and political science, dealing with such issues as currency movement, land development, learning, small group behavior, and power in legislatures. Development of requisite mathematical tools about graphs, signed graphs, Markov chains, and n-person games.

16:642:586. (S) THEORY OF MEASUREMENT (3)

Prerequisite: Undergraduate modern algebra or permission of instructor.

Foundations of measurement from a mathematical point of view. Homomorphisms or relational systems; scale type; uniqueness theory; ordinal, extensive, difference, and conjoint measurement; utility and expected utility; subjective probability; applications to social and physical sciences.

16:642:587. SELECTED TOPICS IN DISCRETE MATHEMATICS (3)

Prerequisite: Permission of instructor.

Topics such as combinatorics, applied graph theory, measurement theory.

16:642:588. (F) INTRODUCTION TO MATHEMATICAL TECHNIQUES IN OPERATIONS RESEARCH (3)

Prerequisite: Linear algebra.

Deterministic methods in operations research, emphasizing linear programming. Hyperplanes, duality, complementary slackness, simplex method, dual simplex method. Integer programs. Assignment, network, and transportation problems. Emphasis on theoretical underpinnings.

16:642:589. (S) TOPICS IN MATHEMATICAL TECHNIQUES IN OPERATIONS RESEARCH (3)

Prerequisites: 16:642:588 or equivalent, permission of instructor.

Special mathematical topics such as matching, matroids, dynamic programming, recent work in combinatorial optimization.

16:642:591,592. TOPICS IN PROBABILITY AND ERGODIC THEORY (3,3)

Corequisites: 16:640:501,502.

Basic probability theory and its applications. Topics include: stochastic independence, distributions and densities, Markov processes, stationary processes, the law of large numbers, and the central limit theorem. A broad range of applications to communications engineering, economics, biology, and physics.

16:642:611,612. SELECTED TOPICS IN APPLIED MATHEMATICS (3,3)

Prerequisite: Permission of instructor.

Topics of current interest.

16:642:613. SELECTED MATHEMATICAL TOPICS FROM PHYSIOLOGY AND MEDICINE (3)

Prerequisite: Permission of instructor.

Problems in the qualitative theory of nonlinear ordinary and functional differential equations that arise in such subjects as the Hodgkin-Huxley theory, hormonal control systems, and rhythms in physiology.

16:642:661,662. SELECTED TOPICS IN MATHEMATICAL PHYSICS (3,3)

Prerequisite: Permission of instructor.

Topics of current interest in areas such as classical mechanics, statistical mechanics, ergodic theory, nonrelativistic quantum mechanics, and quantum field theory.

MECHANICAL AND AEROSPACE ENGINEERING 650

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor George J. Weng,
B234 Engineering Building, Busch Campus (732/445-3514)

Members of the Graduate Faculty

Haim Baruh, Associate Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Virginia Polytechnic Institute
Structural dynamics; controls; system identification
Haym Benaroya, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Pennsylvania
Aerospace structures; structural dynamics; probabilistic mechanics
William J. Bottega, Associate Professor of Mechanical and Aerospace Engineering,
CE; Ph.D., Yale
Delamination mechanics; dynamics and stability of solids; composite materials
David G. Briggs, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Minnesota
Heat transfer; thermodynamics; numerical modeling
Yu Chen, Professor Emeritus of Mechanics, CE; Sc.D., Harvard
Numerical simulation of thermomechanical phenomena; applied mechanics
Alberto Cuitiño, Assistant Professor of Mechanical and Aerospace Engineering,
CE; Ph.D., Brown
Computational solid mechanics
Mitsunori Denda, Associate Professor of Mechanical and Aerospace Engineering,
CE; Ph.D., Harvard
Fracture mechanics; computational solid mechanics
Ellis H. Dill, Professor of Mechanical and Aerospace Engineering and Dean of the
College of Engineering, CE; Ph.D., California (Berkeley)
Continuum mechanics; computational mechanics; finite element methods
Gregory S. Elliott, Assistant Professor of Mechanical and Aerospace Engineering,
CE; Ph.D., Ohio State
Experimental fluid mechanics
Hae Chang Gea, Assistant Professor of Mechanical and Aerospace Engineering,
CE; Ph.D., Michigan
Design and structural optimization; finite element
Nick G. Glumac, Assistant Professor of Mechanical and Aerospace Engineering,
CE; Ph.D., California
Combustion; thermodynamics
Dale B. Haidvogel, Professor of Oceanography, CCES; Ph.D., Massachusetts
Institute of Technology
Areas of basin- and global-scale ocean dynamics; coastal ocean physics;
development of numerical models appropriate to these classes of problems
Yogesh Jaluria, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Cornell
Convection; numerical methods in heat transfer; materials processing
Mukund V. Karwe, Assistant Professor of Food Science, CC; Ph.D., Rutgers
Thermal processing of food materials; numerical modeling
Doyle D. Knight, Professor of Mechanical and Aerospace Engineering, CE; Ph.D.,
California Institute of Technology
Computational fluid dynamics; turbulence; aerodynamics;
supercomputer applications
Noshir A. Langrana, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Cornell
Computer-aided design; biomechanics; artificial intelligence in design
Constantinos Mavroidis, Assistant Professor of Mechanical and Aerospace
Engineering, CE; Ph.D., Paris VI
Analysis and synthesis of mechanisms; design, planning, and control
of robotics systems
Michael R. Muller, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Brown
Fluid mechanics, waves; rotating flows; fluidized beds
Andrew N. Norris, Professor of Mechanical and Aerospace
Engineering, CE; Ph.D., Northwestern
Dynamics of solids; wave propagation; mechanics of composite materials
Madara M. Ogot, Associate Professor of Mechanical and Aerospace Engineering,
CE; Ph.D., Pennsylvania State
Computer-aided design; dynamics; optimization; robotics
Kook D. Pae, Professor of Mechanical and Aerospace Engineering, CE; Ph.D.,
Pennsylvania State
Polymer mechanics; high pressure effects on properties of polymers; surface
modification of polymers
Richard B. Pelz, Associate Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Princeton
Computational fluid dynamics; turbulence; chaos; parallel processing
Richard L. Peskin, Professor Emeritus of Mechanical and Aerospace Engineering,
CE; Ph.D., Princeton
Computational fluid dynamics

Constantine E. Polymeropoulos, Professor of Mechanical and Aerospace
Engineering, CE; Ph.D., Cornell
Combustion; heat transfer
Kyung T. Rhee, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Wisconsin
Internal-combustion engines; flame propagation
Valentinas Sernas, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Toronto
Optical techniques; boiling heat transfer; experimental methods
Samuel Temkin, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Brown
Fluid mechanics; acoustics; droplet dynamics
Timothy Wei, Associate Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Michigan
Fluid mechanics and turbulence
George J. Weng, Professor of Mechanical and Aerospace Engineering, CE;
Ph.D., Yale
Micromechanics of composite materials; phase transformation
Norman J. Zabusky, State of New Jersey Professor of Computational Fluid
Dynamics, CE; Ph.D., California Institute of Technology
Fluid dynamics—computational and analytical; nonlinear dynamical systems
Abdelfattah Zebib, Chairperson and Professor of Mechanical and Aerospace
Engineering, CE; Ph.D., Colorado
Hydrodynamic stability; computational fluid mechanics
Mark C. Zimmerman, Principal Scientist/Group Leader, Johnson & Johnson;
Ph.D., Rutgers
Orthopedic biomechanics; biomaterials; bone remodeling

Programs

Mechanical and aerospace engineering offers graduate programs leading to the Master of Science and Doctor of Philosophy degrees.

Individuals wishing to enroll in the M.S. program should have received a B.S. degree in mechanical and/or aerospace engineering from an accredited institution and should have graduated with a cumulative grade-point average of 3.0 (where A = 4.0) or better. Applicants who have a B.S. degree in other engineering disciplines or in applied mathematics, geology, meteorology, or physics are also considered.

Admission into the Ph.D. program requires an M.S. in mechanical and/or aerospace engineering. Applicants having an M.S. in a closely related discipline may be admitted directly into the Ph.D. program provided their preparation has no significant deficiencies. The Master of Philosophy degree is available to doctoral candidates.

The Master of Science program is intended to extend and broaden the undergraduate preparation. It can be considered as a terminal degree or may be used as preparation for the Ph.D. program. The M.S. program requires a minimum of 30 credits and normally includes a research thesis.

The Ph.D. program is intended for those individuals primarily interested in teaching and/or research. It requires a minimum of 48 credits of course work beyond the B.S. degree and a minimum of 24 credits of research beyond the M.S. degree. The program requires successful performance in the Ph.D. qualifying examination, one year of full-time residence, and the completion of a satisfactory research dissertation. Proficiency in a foreign language is not required. While the student may be a full-time student throughout his or her studies, the one-year residence requirement is normally satisfied after the student has passed the qualifying examination and is mainly devoted to research.

Study is offered in the general areas of applied mechanics and engineering science and design. There are four major fields of study in mechanical and aerospace engineering. These are design, fluid mechanics, solid mechanics, and thermal sciences. Because of the exceptional variety and large number of courses available in these areas and because of the wide range of research activities in the program, students have a unique opportunity to acquire a broad and thorough education and training.

Facilities for research are outstanding and include modern laboratories in acoustics, biomechanics, combustion, computational fluid dynamics, computational solid mechanics, heat transfer and thermal convection, computer-aided design, experimental fluid mechanics, geophysical fluid dynamics, internal-combustion engines, optics, and high pressure mechanics. The College of Engineering operates a Supercomputer Remote Access Center that provides both high-speed network access to the U.S. National Supercomputer Centers and local computational support for code

development and data post-processing. The facility includes a Sun Sparc1000 server, several color graphics workstations, and color hardcopy. Other computational facilities available include an IBM RISC system and Sparc compute servers.

Research areas in which the faculty of the program are currently engaged include acoustics; applications of artificial intelligence; biomechanics; boiling heat transfer; combustion; composite materials; computational fluid dynamics; computational solid mechanics; convective heat transfer; delamination mechanics; droplet dynamics; energy management; fracture mechanics; gas dynamics; geophysical fluid dynamics; hydrodynamical instability; internal-combustion engines; incompressible fluid dynamics; kinematics and dynamics of mechanisms; mantle convection; material processing; mechanical design; micromechanics; nondestructive evaluation; nonlinear acoustics; numerical modeling; particulate emission; polymer mechanics; plasticity; stability of structures; structural dynamics; thermal stress analysis; turbulence; turbulent dispersion; and waves in solids.

Degree programs in mechanical or aerospace engineering may be arranged with the graduate program director. Further details may be found in Graduate Programs in Mechanical and Aerospace Engineering, available on request from the program office, and in the program's Handbook for Graduate Students, sent to applicants who have been admitted to the program.

Graduate Courses

16:650:501. (S) PRINCIPLES OF TURBULENT FLOWS (3)

Knight. Prerequisite: 16:650:540.
Physical aspects and methods of analysis of turbulent flows; scaling laws, modeling techniques, and statistical description of turbulence; application to problems in engineering science and geophysical fluid dynamics.

16:650:506. (F) COMPUTER-AIDED DESIGN (3)

Langrana. Prerequisite: Permission of instructor. Limited enrollment.
A broad introduction to computational methods in mechanical design. Theory and application of methods in mathematical programming for the solution of design problems. Applications of optimization and computer graphics methods.

16:650:507. (S) COMPUTATIONAL METHODS I: FLUID MECHANICS (3)

Knight. Prerequisite: Permission of instructor. Limited enrollment.
Development and application of computational methods for fluid mechanics, boundary layer equations, and Euler equations. Selected algorithms including finite difference, finite volume, and special techniques. Applications chosen from incompressible and compressible flows.

16:650:508. (S) COMPUTATIONAL METHODS II: HEAT TRANSFER (3)

Jaluria. Prerequisites: 16:198:510 and undergraduate heat transfer.
Computational methods for the solution of heat transfer problems, including conductive, convective, and radiative transport processes. Topics are also chosen from thermal energy systems, environmental heat transfer, and combined-mode processes.

16:650:509. (S) COMPUTATIONAL METHODS III: FINITE ELEMENT METHODS IN SOLID MECHANICS (3)

Dill. Prerequisites: 16:198:510; undergraduate thermodynamics and fluid mechanics.
General theory, application of finite element methods to the solutions of the equations of elasticity and plasticity. Two- and three-dimensional linear and nonlinear, static and dynamic problems. Working computer programs.

16:650:511. (F) ACOUSTICS (3)

Norris, Temkin. Prerequisite: Undergraduate fluid mechanics. Pre-corequisite: 16:642:527.
Basic equations. Reflection and transmission phenomena, resonators, waves in horns; sound emission; attenuation and dispersion; underwater acoustics.

16:650:512. (S) FLUID DYNAMICS OF SUSPENSIONS (3)

Temkin. Prerequisites: 16:650:540 or equivalent; and one graduate-level course in applied mathematics or consent of instructor.
Fundamental aspects of fluid mechanics and thermodynamics of suspensions of particles in fluids, including aerosols, bubbly liquids, and colloids.

16:650:513. (S) EXPERIMENTAL METHODS (3)

Wei. Prerequisites: Undergraduate fluid mechanics and heat transfer.
Survey of current measuring techniques used in mechanical and aerospace engineering research; principles of digital and analog data acquisition and reduction.

16:650:517. (F) CONDUCTION HEAT TRANSFER (3)

Polymeropoulos. Prerequisite: Undergraduate heat transfer.
Analytical methods in steady and transient heat conduction in solids; finite difference methods in heat conduction.

16:650:518. (S) CONVECTION HEAT TRANSFER (3)

Briggs, Sernas. Prerequisites: Undergraduate heat transfer; 16:650:540 or equivalent.
Forced and free convection in laminar and turbulent flows; mass transfer.

16:650:520. (S) THERMAL TRANSPORT IN MATERIALS PROCESSING (3)

Jaluria. Prerequisite: Permission of instructor. Limited enrollment.
Transport phenomena in processes such as heat treatment, bonding, extrusion, casting, injection molding, crystal growing, metal forming, and plastic processing; analysis, mathematical modeling, and numerical simulation of such processes for design and optimization of the relevant systems.

16:650:525. (S) ROBOTICS: MECHANISMS AND CONTROLS (3)

Mavroidis, Ogot. Prerequisites: Undergraduate vibrations, controls, and design of mechanisms.
Introduction to robotics, including mechanisms and control theories as well as applications; manipulator mechanics; design considerations; control fundamentals; adaptive and sensory controls; algorithm development; robotic assembly techniques.

16:650:526. (S) KINEMATIC ANALYSIS OF MECHANISMS (3)

Ogot. Prerequisite: Undergraduate kinematics of mechanisms or equivalent.
Introduction of modern kinematic analysis; analytical representation of motions; miscellaneous mechanisms; automated kinematic designs.

16:650:527. (S) SATELLITE ORBIT DETERMINATION AND CONTROL (3)

Benaroya. Prerequisites: 14:650:401, 443.
Advanced controls, rigid body dynamics, physics, propulsion, and mathematical modeling applied to basic satellite control and orbit determination.

16:650:528. (S) BIOMECHANICAL SYSTEMS (3)

Langrana. Prerequisites: Undergraduate mechanical design and solid mechanics.
Selected topics from the study of the human body as a mechanical system, with emphasis on modeling, analysis, and design. Investigation of biomechanical systems frequently encountered in orthopedic surgery and physical rehabilitation.

16:650:529. (S) RANDOM VIBRATIONS (3)

Benaroya. Prerequisites: 14:650:443 or permission of instructor.
Methods of probabilistic mechanical vibrations, with application to systems encountered in mechanical and aerospace engineering.

16:650:530. (S) MECHANICAL VIBRATIONS (3)

Benaroya, Baruh. Prerequisite: Undergraduate mechanical vibrations.
Vibration considerations in mechanical engineering, damping, frequency response; multidegree of freedom systems; lumped parameter systems; continuous systems; exact solutions, variational principles, system response, random vibrations.

- 16:650:531. (S) ADVANCED MECHANICS OF MATERIALS (3)
 Gea. Prerequisites: Undergraduate solid mechanics and mechanical design.
 Critical examination and application of the theories and methods for evaluating stresses and deformations of mechanical components and structures under static and dynamic loading.
- 16:650:532. (S) OPTIMAL DESIGN IN MECHANICAL ENGINEERING (3)
 Gea. Prerequisite: 16:650:531.
 Formulation and solution of engineering optimal design problems in mechanical engineering. Introduction to algorithms for constrained and unconstrained searching. Application to optimal design of mechanical and structural components. Use of discretization techniques; shape optimization problem.
- 16:650:533. (F) KINEMATIC SYNTHESIS OF MECHANISMS (3)
 Ogot. Prerequisite: Undergraduate kinematics of mechanisms or equivalent.
 Classification of mechanisms and type synthesis; dimensional synthesis; finite displacement theory, structural errors; approximation theory and design optimization; introduction to spatial mechanisms; design automation; current applications.
- 16:650:534. (S) ANALYTICAL DYNAMICS (3)
 Baruh. Prerequisite: Graduate standing in mechanical/aerospace engineering.
 Newtonian mechanics, rotating frames, variational principles, Lagrange's equations, Hamilton's equations, Euler angles, Euler's equations, transformation theory, Hamilton-Jacobi equation.
- 16:650:535. (F) MECHANICS OF COMPRESSIBLE FLUIDS (3)
 Pelz. Prerequisite: 16:650:541 or equivalent.
 Linear and nonlinear theory of one-dimensional inviscid unsteady motion, compression and expansion waves, shock tube and wave interactions; two-dimensional inviscid steady motions, including linearized subsonic and supersonic flows, boundary layer theory of compressible fluids.
- 16:650:540. (F) FLUID MECHANICS I (3)
 Pelz, Knight. Prerequisite: Undergraduate fluid mechanics.
 Physical properties of fluids; basic equations of motion; kinematics; exact solutions of the Navier-Stokes equations; incompressible boundary layer equations and applications; flow past bodies, jets, and wakes; introduction to turbulent flows.
- 16:650:541. (S) FLUID MECHANICS II (3)
 Zabusky. Prerequisite: 16:650:540 or equivalent.
 Low Reynolds number flows; incompressible, inviscid motions; D'Alembert's paradox; Kutta-Joukowski theorem; one- and two-dimensional compressible flows. Shock waves. Special topics.
- 16:650:542,543. INDEPENDENT STUDY (3,3)
 Prerequisites: Permission of instructor and graduate program director.
 Independent studies or investigations in a selected area of mechanical and aerospace engineering.
- 16:650:544. (S) COMPUTER-AIDED ENGINEERING FOR FLUID FLOW AND HEAT TRANSFER (3)
 Peskin. Prerequisites: First-year graduate level applied mathematics; fluid flow and/or heat transfer.
 Use of high performance computers, expert systems, and interactive graphics for rapid prototyping of fluid flow and heat transfer models. Student participation in ongoing research in this area.
- 16:650:549. (F) BOILING AND CONDENSATION HEAT TRANSFER (3)
 Sernas. Prerequisites: Undergraduate heat transfer and fluid mechanics.
 A detailed presentation of boiling and condensation heat transfer; nucleate boiling, transitional boiling, film boiling, film condensation, and dropwise condensation.
- 16:650:552. (S) RADIATION HEAT TRANSFER (3)
 Rhee. Prerequisite: Undergraduate heat transfer.
 Theory of radiant heat transfer; characteristics of ideal and real systems; radiant energy exchange with and without a participating medium; experimental techniques; gray and nongray system analysis.
- 16:650:553. (F) ADVANCED THERMODYNAMIC THEORY (3)
 Glumac. Prerequisite: Undergraduate thermodynamics.
 A critical analysis of advanced theories and methods in thermodynamics.
- 16:650:558. (S) COMBUSTION (3)
 Polymeropoulos. Prerequisites: Undergraduate thermodynamics and fluid mechanics.
 Fundamentals of combustion processes; premixed flames, diffusion flames, one-dimensional gas dynamics, thermal explosion theory.
- 16:650:560. (S) ADVANCED MECHANICAL ENGINEERING TOPICS (3)
 Topics of current interest in mechanical and aerospace engineering, such as applications of computer-aided intelligence, computer-aided manufacturing, and waves in fluids.
- 16:650:561. (F) GEOPHYSICAL FLUID DYNAMICS (3)
 Muller. Prerequisite: 16:650:540 or equivalent.
 Fundamentals of fluid mechanics pertaining to the dynamics of oceans and atmospheres; quasigeostrophic motion, the Ekman Layer, and baroclinic instability.
- 16:650:567,568. (F,S) MATHEMATICAL METHODS IN ENGINEERING (3,3)
 Baruh, Zebib. Prerequisites: Undergraduate calculus and differential equations.
 Review of matrix algebra; numerical methods for inversion; ordinary differential equations, functions of a complex variable; calculus of variations; partial differential equations and their classification; Fourier methods; asymptotic and perturbation methods.
- 16:650:571. (F) INTRODUCTION TO MECHANICS OF CONTINUA (3)
 Bottega. Prerequisites: Undergraduate mechanics and engineering mathematics.
 Introduction to the fundamental concepts of continuum mechanics, including stress and strain, kinematics, balance laws, and material symmetry. Applications to theories of elasticity, plasticity, fracture, viscoelasticity, and classical fluid dynamics.
- 16:650:572. (S) THEORY OF ELASTICITY (3)
 Cuitiño, Norris. Prerequisites: 16:650:571, 16:642:527; or equivalent.
 Corequisite: 16:642:528.
 The classical theory of linear elasticity. Equations of equilibrium; plane stress; plane strain; Airy stress function; complex variable methods; torsion; energy theorems; solutions of selected classical problems.
- 16:650:573. (S) THEORY OF PLASTICITY AND APPLICATIONS (3)
 Weng, Pae. Prerequisite: 16:650:571.
 Yield criteria and associated flow rules; hardening rules; Drucker's stability postulates; flow potential; derivation of multiaxial relations from uniaxial data; high temperature creep; visco-plasticity and strain-rate sensitivity; modern unified theories; boundary-value problems in bending, torsion, expansion, and slip-line field.
- 16:650:576. (S) POLYMER MECHANICS (3)
 Pae. Prerequisite: 16:635:511 or permission of instructor.
 Mechanical behavior, viscoelastic behavior, effects of external and internal factors on mechanical behavior, yielding and plastic deformation, fracture, fatigue, and effects of high pressure on mechanical, physical, and thermal properties of polymeric materials.
- 16:650:577. (F) MECHANICS OF COMPOSITE MATERIALS (3)
 Weng. Prerequisite: 16:650:572.
 Classification of anisotropy; engineering constants; particulate, fiber, and disc reinforcements; orthotropic plates; laminate theory; rule of mixture; Voigt and Reuss approximations; stress-strain average; energy principles; two-phase and three-phase models; mean-field theory; self-consistent method; differential scheme; bounding techniques.

16:650:579. CONTROL OF STRUCTURES (3)

Baruh, Benaroya. Prerequisite: 14:650:401.

Provide intensive and in-depth advanced introduction to the increasingly important field of structural control. Systems being designed for severe environments such as aero/space require control in order that they function according to very tight specifications. The technical challenges are significant in this discipline.

16:650:581. (S) ADVANCED ENGINEERING ANALYSIS (3)

Baruh. Prerequisites: 16:650:534 or 540; 16:642:527.

Behavior of linear and nonlinear systems, phase-plane analysis, bifurcation, stability criteria, perturbation methods. Examples from fluid mechanics, dynamics, and heat transfer.

16:650:582. (S) DYNAMICS AND STABILITY OF ELASTIC SYSTEMS (3)

Bottega. Prerequisites: 16:650:571,572; 16:642:528.

Hamilton's principle; discrete and continuous systems; dynamical theories of beams and plates; nonlinear vibrations; Liapunov stability; limit cycles; chaotic motion. Applications include the static and dynamic stability of thin-walled structures.

16:650:584. (S) THEORY OF VISCOELASTICITY AND APPLICATIONS (3)

Weng. Prerequisite: 16:650:572.

Inelastic behavior, linear theory of viscoelasticity; constitutive equations and correspondence principles. Applications to specific engineering problems; introduction to nonlinear theories of viscoelasticity and viscoplasticity.

16:650:585. (F) FRACTURE MECHANICS (3)

Denda. Prerequisites: 16:650:571,572, or permission of instructor.

Basic principles of fracture mechanics: linear elastic, dynamic, elastic-plastic, time dependent. Fracture and fatigue crack growth for metals, ceramics, polymers, and composites. Mathematical methods in fracture mechanics; weight functions (3D), Green's functions (dislocation and point force), complex variable methods (2D), integral transforms, and applications of the FEM and BEM.

16:650:586. (S) THEORY OF THERMAL STRESSES AND APPLICATIONS (3)

Cuitiño, Pae. Prerequisites: 16:650:571,572.

Formulation and solution of problems involving the effects of temperature on the elastic and inelastic behavior of materials and structures. Thermodynamics of deformation; heat transfer; thermoelasticity/thermoviscoelasticity.

16:650:587. (F) MICROMECHANICS (3)

Weng. Prerequisite: 16:650:572 or 573.

Origins of internal stress, Green's tensor function. Eshelby's solutions of ellipsoidal inclusions, stress concentration; crystal plasticity; continuous distribution of dislocations; single crystal versus polycrystal; self-consistent method; two-phase plasticity and creep; principles of micro-macro transition; fracture and fatigue.

16:650:588. (S) STRESS WAVES IN SOLIDS (3)

Norris. Prerequisites: 16:642:528, 16:650:572.

Propagation of elastic waves in solids, reflection and transmission, Rayleigh waves, waves in plates, dispersion, radiation from a point load, Fourier transforms methods; scattering; waves in anisotropic materials; propagation of discontinuities; shocks.

16:650:591. (S) ADVANCED MECHANICAL VIBRATIONS (3)

Benaroya. Prerequisites: 16:642:527 and 16:650:530.

Continuous systems, exact and approximate solutions; integral formulation; vibration under combined effects, inclusion principle, qualitative and quantitative behavior of the eigensolution, computational techniques.

16:650:615. (F) HYDRODYNAMIC STABILITY (3)

Zebib. Prerequisite: 16:650:541 or equivalent.

Thermal, centrifugal, and shear instabilities; linear, nonlinear, and energy methods.

16:650:622. (F) ADVANCED TOPICS IN TURBULENCE (3)

Peskin. Prerequisite: 16:650:501 or permission of instructor.

Advanced topics selected from ongoing research in turbulence, such as numerical simulation of turbulent flows and turbulence in the atmosphere.

16:650:691,692. SEMINAR IN MECHANICAL ENGINEERING (1,1)

Prerequisite: Ph.D. candidacy in mechanical and aerospace engineering or permission of graduate program director.

Lectures by Ph.D. students, faculty, and invited speakers on current research topics in mechanical and aerospace engineering.

16:650:699. NONTHESIS STUDY (1)

16:650:701,702. RESEARCH IN MECHANICAL AND AEROSPACE ENGINEERING (BA,BA)

MECHANICS 654

Degree Programs Offered: Master of Science, Doctor of Philosophy

Director of Graduate Program: Bernard D. Coleman,

B134 Engineering Building, Busch Campus (732/445-5558)

Members of the Graduate Faculty

Abbas Bahri, Professor of Mathematics, FAS-NB; Doctorat, École Normale Supérieure

Variational problems in nonlinear analysis and geometry

Haim Brezis, Visiting Distinguished Professor of Mathematics, FAS-NB;

Doctorat, Paris

Nonlinear functional analysis; partial differential equations

Bernard D. Coleman, J. Willard Gibbs Professor of Thermomechanics, CE;

Ph.D., Yale

Continuum physics; mathematical analysis; constitutive theory; thermodynamics; rheology; liquid crystal physics

Ellis H. Dill, Professor of Mechanics and Dean of the College of Engineering, CE;

Ph.D., California (Berkeley)

Continuum mechanics; computational mechanics; finite element methods

Richard S. Falk, Professor of Mathematics, FAS-NB; Ph.D., Cornell

Numerical analysis of problems in elasticity; partial differential equations

Michael Grinfeld, Visiting Professor of Mathematics, FAS-NB; D.S., Moscow

Material science; continuum physics; theory of phase transformations

Armen G. Khachaturyan, New Jersey Professor of Materials Science and

Engineering, CE; Ph.D., Kiev Institute

Theory of phase transformation in metal alloys and ceramics

Wilma K. Olson, *Mary I. Bunting Professor of Chemistry, FAS-NB; Ph.D., Stanford*

Theoretical studies of nucleic acid structure and properties

Jean E. Taylor, Professor of Mathematics, FAS-NB; Ph.D., Princeton

Geometric measure theory; theory of crystal growth

Irwin Tobias, Professor of Chemistry, FAS-NB; Ph.D., Princeton

Continuum models of biological macromolecules; mechanics of supercoiling in DNA

Thomas Tsakalakos, Professor of Materials Science and Engineering, CE;

Ph.D., Northwestern

Physical metallurgy; materials with modulated structure; multilayered thin films

Michael Vogelius, Professor of Mathematics, FAS-NB; Ph.D., Maryland

Numerical analysis; partial differential equations

Adjunct Member of the Graduate Faculty

Robert N. Thurston, Visiting Professor of Mechanics, CE; Ph.D., Ohio State

Continuum physics; liquid crystals; wave propagation

Programs

The graduate program in mechanics offers advanced instruction and research in theoretical mechanics. The broad areas of study are continuum mechanics, thermodynamics, and analytical dynamics. The topics of courses, seminars, and research include elasticity, viscoelasticity, the theory of non-Newtonian fluids, liquid crystal theory, the mechanics and thermodynamics of phase transformations, modern constitutive theory (e.g., invariance principles, thermodynamical relations, homogenization theory), and the mathematical theory and numerical techniques employed to understand and solve the dynamical equations of continuous media.

Excellent computational facilities are available to students, including a variety of workstations and access to supercomputers.

Students applying to the M.S. and Ph.D. programs should have a B.S. or B.A. degree in engineering, mathematics, or the physical sciences. The M.S. degree requires 30 credits and either a critical essay or a research thesis. The requirements for the Ph.D. degree include an appropriate combination of course work and research credits, a qualifying examination, and a dissertation. The qualifying examination is given in two parts, written and oral. Students are required to attend and participate in the mechanics seminar series. Candidates for the Ph.D. degree will be expected to spend at least one year in full-time residence, a requirement that will be waived only in exceptional circumstances.

A number of fellowships are available to first-year and advanced students. Students receiving fellowships are expected to devote their full time to course work and research. Teaching assistantships and research assistantships associated with specific research projects may be available. Further information on these and other matters may be found in The Graduate Program in Mechanics, available upon request from the program office.

Graduate Courses

16:654:543. (S) CONTINUUM MECHANICS (3)

Coleman. Prerequisite: 16:650:571 or permission of instructor. Algebraic and geometric methods in continuum physics; kinematical concepts, balance of momentum; introduction to the general theory of constitutive relations, material symmetry, and frame-indifference. Examples of nonlinear theories of material behavior, e.g., finite elasticity, non-Newtonian fluids, materials with memory.

16:654:545. (S) CONTINUUM THERMODYNAMICS (3)

Coleman. Prerequisite: 16:654:543 or permission of instructor. Theory of thermodynamical restrictions on the constitutive relations of viscous materials, materials with memory, and materials with internal state variables. Energy criteria for stability; thermal influences on wave propagation; thermodynamical methods in the theory of the field equations of mechanics.

16:650:575. (S) FINITE ELEMENT METHODS IN SOLID MECHANICS (3)

Dill. Prerequisites: 16:650:571 or 16:654:543 or equivalent; knowledge of linear elasticity. General theory, application of finite element methods to the solution of the equations of elasticity, viscoelasticity, and plasticity. Two- and three-dimensional linear and nonlinear, static and dynamic problems. Working computer programs for such problems studied in detail.

16:654:583. ADVANCED THEORY OF ELASTICITY (3)

Prerequisites: Elasticity, e.g., 16:650:581, and continuum mechanics, e.g., 16:654:543. Advanced topics in the linear theory of elasticity and an introduction to finite elasticity. Uniqueness and stability theorems, variational principles, theories of rods, plates, and shells.

16:654:601,602. SELECTED TOPICS IN CONTINUUM MECHANICS (3,3)

Prerequisite: Permission of instructor. Topics of current interest in such areas as constitutive theory, finite elasticity, viscoelasticity, theory of liquid crystals.

16:654:603,604. SELECTED TOPICS IN COMPUTATIONAL MECHANICS (3,3)

Prerequisite: Permission of instructor. Topics of current interest in the theory and application of numerical methods to the solution of problems in such subjects as elasticity, the mechanics of rods and shells, plasticity, the theory of materials with memory, and the theory of liquid crystal phases.

16:654:605,606. SELECTED TOPICS IN PHASE TRANSFORMATION THEORY (3,3)

Prerequisite: Permission of instructor. Topics of current interest in such subjects as heterogeneous equilibrium, the dynamics of phase transitions, spinodal decomposition, and interface motion.

16:654:611,612. SEMINAR IN MECHANICS (1,1)

Faculty, students, and invited speakers participate in presentations of contemporary topics in mechanics and related branches of mathematics and numerical analysis.

16:654:701,702. RESEARCH IN MECHANICS (BA,BA)

MEDIEVAL STUDIES 667

Program Offered: Certificate in Medieval Studies

Director of the Certificate Program in Medieval Studies:

Professor Elizabeth McLachlan, Medieval Studies Program,
43 Mine Street, Room 201, and Department of Art History,
Voorhees Hall, College Avenue Campus (732/932-7041)

Participating Faculty

The following members of the graduate faculty, identified more fully under the subject headings indicated, are among those in charge of the curricular arrangements for a certificate program in medieval studies as part of a wider advanced-degree program:

R. Barton, *English*
P. Bathory, *Political Science*
R. Bell, *History*
M. Ciklamini, *German*
W. Connell, *History*
S. Crane, *English*
S. Feldman, *Philosophy*
P. Golden, *History*
M. Gossy, *Spanish*
F. Grave, *Music*
C. Guardiola, *Spanish*
G. Guarino, *Italian*
A. Harvey, *Art History*
E. McLachlan, *Art History*
D. Marsh, *Italian*
J. Masschaele, *History*
J. Miller, *English*
K. Morrison, *History*
M. Picker, *Music*
S. Reinert, *History*
L. Scanlon, *English*
M. Speer, *French*
F. Sumner, *Music*
A. Tripolitis, *Comparative Literature*
A. Welsh, *English*
L. White, *Italian*

Certificate Program

Students with a special interest in medieval studies may pursue, in the course of their regular program of studies toward an advanced degree, a special concentration in medieval studies. Those who fulfill the requirements may be awarded a certificate in medieval studies upon completion of their degrees. The special requirements for the certificate, many of which may also be used to satisfy the student's graduate degree requirements, are as follows:

1. At least two courses in a medieval subject within the chosen discipline, with no grade lower than B.
2. At least three other courses in medieval culture in other disciplines, with no grade lower than B.
3. Demonstration of a reading knowledge of at least two languages in the forms common during the Middle Ages.
4. Completion of a master's thesis, doctoral thesis, or an expanded seminar paper on a topic in medieval civilization.

The various courses in medieval studies are offered by the participating faculty and additional faculty through their departments. A list of such courses is available from the director.

Graduate Courses

16:667:501,502. MEDIEVAL LATIN (3,3)

Bolton, Lenaghan, Wilhelm. Prerequisite: Two terms of classical Latin. An overview of Medieval Latin; grammar and syntax followed by readings in major texts, including works in theology, philosophy, and literature.

16:667:550,551. MEDIEVAL PALEOGRAPHY (3,3)
Introduction to the study of manuscripts, records, and the manuscript book.

METEOROLOGY

(see Environmental Sciences 375)

MICROBIOLOGY AND MOLECULAR GENETICS 681

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Howard C. Passmore, Jr.,
Nelson Biology Laboratories, Busch Campus (732/445-2812)

Members of the Graduate Faculty

Morad A. Abou-Sabé, Associate Professor of Biological Sciences, FAS-NB;
Ph.D., Pittsburgh
Microbial genetics; gene expression

Kurt Amsler, Assistant Professor of Physiology and Biophysics, UMDNJ-RWJMS;
Ph.D., Tennessee
Growth factor receptor tyrosine kinases and regulation of renal epithelial cell development and behavior

Alan D. Antoinette, Associate Professor of Microbiology, CC; D.Sc., Johns Hopkins
Microbial biochemistry and physiology; metabolism of nitroaromatic compounds; biochemistry of cyanobacteria

Edward Arnold, Professor of Chemistry, FAS-NB/CABM; Ph.D., Cornell
Protein and virus structure; crystallography; AIDS; polymerases; drug and vaccine design

David E. Axelrod, Associate Professor of Microbiology and Molecular Genetics, WIM; Ph.D., Tennessee
Cellular and molecular oncology; tumor cell proliferation

Richard Bartha, Professor of Microbiology, CC; Ph.D., Georg August (Göttingen)
Biodegradation of xenobiotic pollutants; microbial ecology

Helen M. Berman, Professor of Chemistry, FAS-NB; Ph.D., Pittsburgh
Nucleic acid and protein structure; crystallography; biological databases

Steven J. Brill, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB; Ph.D., SUNY (Stony Brook)
Biochemistry and genetics of DNA replication in yeast

George M. Carman, Professor of Food Science, CC; Ph.D., Massachusetts
Molecular biology of phospholipid biosynthesis in yeast

Theodore Chase, Jr., Professor and Chairperson of Biochemistry and Microbiology, CC; Ph.D., California (Berkeley)
Microbial biochemistry in the environment; plant enzymology and molecular biology of ripening and flavor

Suzie Chen, Assistant Professor of Chemical Biology, CP; Ph.D., Albert Einstein
Transgenic mice predisposed to melanoma development; molecular mechanisms of adipocyte differentiation; UV-inducible genes

Khew-Voon Chin, Assistant Professor of Medicine and Pharmacology, CINJ/UMDNJ-RWJMS; Ph.D., Rutgers
Drug resistance in cancers; regulation of gene expression

Lori Ruth Covey, Assistant Professor of Biological Sciences, FAS-NB; Ph.D., Columbia
Switch recombination in human B lymphocytes in response to T cell factors

Kiron M. Das, Professor of Medicine, Microbiology, and Molecular Genetics, UMDNJ-RWJMS; Ph.D., Edinburgh
Autoimmunity in inflammatory bowel diseases

David T. Denhardt, Professor of Cellular and Molecular Biology, FAS-NB; Ph.D., California Institute of Technology
Regulation of gene expression, cell proliferation, and metastasis

Jonathan D. Dinman, Assistant Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Johns Hopkins
Probing molecular mechanisms of ribosomal frameshifting

Hugo K. Dooner, Professor of Plant Genetics, CC/WIM; Ph.D., Wisconsin
Plant molecular genetics; transposons; meiotic recombination

Joseph P. Dougherty, Associate Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Yale
Retrovirus vectors and retrovirus replication

Monica Driscoll, Associate Professor of Molecular Biology and Biochemistry, CABM; Ph.D., Harvard
C. elegans developmental genetics; molecular mechanisms of inherited neurodegeneration

Donald T. Dubin, Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; M.D., Columbia
Sequence of HIV; antibiotic resistance in staphylococci

Richard H. Ebright, Professor of Chemistry, WIM; Ph.D., Harvard
Regulation of gene expression; protein-DNA interaction; protein engineering

Isaac Edery, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB/CABM; Ph.D., McGill
Molecular mechanism underlying biological clocks

Douglas E. Eveleigh, Professor of Microbiology, CC; Ph.D., Exeter
Applied microbiology: fermentation, organic chemicals from biomass; microbial ecology

Martin Farach, Assistant Professor of Computer Science, FAS-NB; Ph.D., Maryland
Computational biology; design and analysis of sequential and parallel algorithms

Dunne Fong, Associate Professor of Biological Sciences, FAS-NB; Ph.D., Princeton
Immunology and molecular cell biology of parasitic protozoans

David J. Foran, Adjunct Assistant Professor of Pathology, UMDNJ-RWJMS; Ph.D., Rutgers/UMDNJ
Imaging; telemedicine; animation; pattern recognition; morphometrics

Abram Gabriel, Assistant Professor of Molecular Biology and Biochemistry, FAS-NB; M.D., Johns Hopkins
Molecular mechanisms of retrotransposition

Marc R. Gartenberg, Assistant Professor of Pharmacology, UMDNJ-RWJMS; Ph.D., Yale
Nuclear organization of DNA; chromosome structure; yeast plasmid segregation

Celine Gelinis, Associate Professor of Biochemistry, CABM; Ph.D., Sherbrooke
Function of viral and cellular oncogenes

Millie M. Georgiadis, Assistant Professor of Chemistry, FAS-NB/WIM; Ph.D., California (Los Angeles)
X-ray crystallographic studies of enzyme-nucleic acid complexes

Bijan K. Ghosh, Professor of Physiology and Biophysics, UMDNJ-RWJMS; D.Sc., Calcutta
Molecular biology of microbial membrane protein receptor

Max Haggblom, Assistant Research Professor of Microbiology and Molecular Genetics, CC/CAMB; Ph.D., Helsinki
Environmental and applied microbiology; biodegradation and bioremediation

Beatrice Haimovich, Assistant Professor of Surgery, UMDNJ-RWJMS; Ph.D., Pennsylvania
Adhesion receptors mediated signals that regulate cell adhesion and spreading

Robert Herman, Professor of Biological Sciences, FAS-NB; Ph.D., Rutgers
Immunity to protozoan parasitic infections

Sarah Hitchcock-DeGregori, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Case Western Reserve
Structure-function relationships in contractile proteins; folding and design of coiled-coil proteins

Masayori Inouye, Professor of Biochemistry, UMDNJ-RWJMS; Ph.D., Osaka
Signal transduction; adaptation to stresses; protein folding

Ken Irvine, Assistant Professor of Molecular Biology and Biochemistry, CC/WIM; Ph.D., Stanford
Cell communication, patterning, and morphogenesis

Peter C. Kahn, Associate Professor of Biochemistry, CC; Ph.D., Columbia
Protein folding and assembly; modeling; hydration in biological systems

Stanley E. Katz, Professor of Microbiology, CC; Ph.D., Rutgers
Analytical and environmental microbiology; transformation of organic molecules; antibiotics in animal products

Terri Goss Kinzy, Assistant Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Case Western Reserve
Eukaryotic translation elongation and regulation of gene expression

Daniel F. Klessig, Professor of Molecular Biology, WIM; Ph.D., Harvard
Signal transduction and regulations of gene expression in plant-pathogen interactions

Robert M. Krug, Chairperson of Department and Professor of Molecular Biology and Biochemistry, CABM; Ph.D., Rockefeller
Expression and replication of the influenza virus genome; pre-mRNA splicing and nuclear export of mRNA

Casimir A. Kulikowski, Professor of Computer Science, FAS-NB; Ph.D., Hawaii
Intelligent systems and machine learning in molecular biology

Eric Lam, Associate Professor of Plant Sciences, CABM; Ph.D., California (Berkeley)
Molecular genetics of plant development with an emphasis on mechanisms of plant gene regulation

Jerome A. Langer, Associate Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Yale
Cloning and ligand interactions of the cell surface receptor for alpha interferon

Michael J. Leibowitz, Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; M.D., Ph.D., Yeshiva
Host-virus interactions in yeast; molecular epidemiology; ribozyme enzymology; HIV regulatory proteins

John Lenard, Professor of Physiology and Biophysics, UMDNJ-RWJMS; Ph.D., Cornell
RNA virus structure, fusion cellular entry, transcription and assembly

Thomas Leustek, Associate Professor of Molecular Biology, CC/CAMB; Ph.D., Rutgers
Plant biochemistry; molecular biology; cysteine and methionine biosynthesis and metabolism; sulfur assimilation; general metabolism

Ronald M. Levy, Professor of Chemistry, FAS-NB; Ph.D., Harvard
Protein structure and dynamics; computer modeling of proteins

- Alice Y.-C. Liu, Professor of Biological Sciences, FAS-NB; Ph.D., Mount Sinai
Signal transduction mechanism of the heat shock response; heat shock gene
expression and cell aging
- Peter Lobel, Associate Professor of Pharmacology, UMDNJ-RWJMS/CABM;
Ph.D., Columbia
Protein targeting, mannose 6-phosphate receptors; cancer prognosis indicators
- Kiran Madura, Assistant Professor of Molecular Biochemistry and Molecular
Biology, UMDNJ-RWJMS; Ph.D., Rochester
Ubiquitin-dependent proteolysis in signal transduction pathways in yeast
- Pal Maliga, Professor of Genetics, WIM; Ph.D., Hungarian Academy of Sciences
Plastid genetics and development; RNA editing
- Richard A. Mann, Associate Professor of Microbiology, WIM; M.D.,
Yeshiva (Einstein)
Immunopathogenesis of renal disease
- Karl Maramorosch, Robert L. Starkey Professor, CC; Ph.D., Columbia
Comparative virology; parasitology; cell culture
- Charles E. Martin, Professor of Biological Sciences, FAS-NB; Ph.D., Florida State
Genetic regulation of membrane lipid biosynthesis in *Saccharomyces*
- Kim S. McKim, Assistant Professor of Microbiology and Genetics, CC/WIM;
Ph.D., British Columbia
Regulation of meiotic recombination; homologous chromosome pairing;
DNA repair
- Joachim W. Messing, University Professor of Molecular Biology and Director of
the Waksman Institute of Microbiology; Ph.D., Munich
Molecular biology of higher plants; M13 cloning, sequencing, gene synthesis
- Richard B. Middleton, Professor of Molecular Biology, UMDNJ-SOM;
Ph.D., Harvard
Genetics of enteric bacteria
- Gaetano T. Montelione, Associate Professor of Molecular Biology and
Biochemistry, FAS-NB/CABM; Ph.D., Cornell
Protein structure and dynamics; NMR spectroscopy
- Thomas J. Montville, Professor of Food Science, CC; Ph.D., Massachusetts
Institute of Technology
Metabolic regulation of food borne microbes; novel antimicrobials
- N. Ronald Morris, Professor of Pharmacology, UMDNJ-RWJMS; M.D., Yale
Molecular biology of mitosis and microtubules
- William R. Moyle, Professor of Obstetrics and Gynecology, UMDNJ-RWJMS;
Ph.D., Harvard
Structure and function of glycoprotein hormones and their receptors
- Joseph I. Naus, Professor of Statistics, FAS-NB; Ph.D., Harvard
Significance of matching in DNA sequences; scan statistic probabilities of
clustering; data editing
- Lenore Neugeborn, Assistant Professor of Molecular Biology and Biochemistry,
WIM; Ph.D., Columbia
Genetic and molecular mechanisms governing gene regulation in yeast
- Carlos A. Neyra, Associate Professor of Plant Sciences, CC; Ph.D., Illinois
Plant-microbe interactions; biological control of plant pathogens; biological
nitrogen fixation; microbial technologies for agriculture
- Robert A. Niederman, Professor of Molecular Biology and Biochemistry,
FAS-NB; Ph.D., Illinois
Structure, function, and assembly of energy transducing membranes
- David N. Norris, Assistant Professor of Molecular Biology and Biochemistry,
FAS-NB; Ph.D., Harvard
Effect of chromatin structure and transcription and recombination in yeast
- Wilma K. Olson, Mary I. Bunting Professor of Chemistry, FAS-NB;
Ph.D., Stanford
Theoretical studies of nucleic acid structure and properties; relation of structure,
conformation, and function of nucleic acids
- Julian J. O'Rear, Adjunct Assistant Professor of Molecular Genetics and
Microbiology, UMDNJ-RWJMS; Ph.D., Wisconsin (Madison)
Retrovirus encapsidation; basement membrane structure and function
- Richard Padgett, Associate Professor of Molecular Biology and Biochemistry,
WIM/FAS-NB; Ph.D., North Carolina
Molecular genetics of signal transduction in *Drosophila* and *C. elegans*
- Howard C. Passmore, Jr., Professor of Microbiology and Molecular Genetics,
FAS-NB; Ph.D., Michigan
Regulation of meiotic recombination; mouse models for the expression of tumor
suppressor genes
- Henrik Pedersen, Professor of Chemical and Biochemical Engineering, CE;
Ph.D., Yale
Plant cell culture; biosensing
- Stuart W. Peltz, Assistant Professor of Molecular Genetics and Microbiology,
UMDNJ-RWJMS; Ph.D., Wisconsin (Madison)
Eukaryote gene expression
- Sidney Pestka, Professor and Chairperson of Molecular Genetics and Microbiology,
UMDNJ-RWJMS; M.D., Pennsylvania
Interferons and cytokine receptors; signal transductions
- Ronald D. Poretz, Professor of Biochemistry and Microbiology, CC; Ph.D.,
SUNY (Buffalo)
Inherited susceptibility to neurotoxicants; intracellular targeting of drugs;
endocytosis glycoconjugate glycans
- David Pramer, Professor Emeritus of Microbiology, CC; Ph.D., Rutgers
Biological control; biodegradation of natural and manufactured compounds;
nematode-trapping fungi
- Carl A. Price, Professor of Plant Biochemistry, WIM; Ph.D., Harvard
Plant molecular biology; regulation of gene expression in plastids
- Arnold B. Rabson, Associate Professor of Molecular Genetics and Microbiology,
UMDNJ-RWJMS; M.D., Brown
Regulation of human retroviral gene expression and lymphoragenesis
- Tariq Mahmood Rana, Assistant Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., California (Davis)
RNA-protein interactions; regulation of HIV-1 gene expression; drug design;
artificial proteolysis
- Karel Raska, Jr., Professor of Pathology, Molecular Genetics, and Microbiology,
UMDNJ-RWJMS, and Chairperson of Laboratory Medicine and Pathology,
UMDNJ-NJMS; M.D., Charles; Ph.D., Czechoslovak Academy of Sciences
DNA tumor viruses; immunopathology and molecular mechanisms
in human cancers
- Anna-Louise Reysenbach, Assistant Professor of Biochemistry and Microbiology,
CC/CTAG; Ph.D., Cape Town
Ecology and evolution of thermophilic microorganisms
- Yacov Ron, Associate Professor of Molecular Genetics and Microbiology, UMDNJ-
RWJMS; Ph.D., Weizmann Institute of Science
Autoimmunity; development of B and T cells; gene therapy
- Marilyn M. Sanders, Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Washington
DNA topoisomerases as antifungal and antiprotozoan drug targets; the heat
shock response in eukaryotic cells
- Carl P. Schaffner, Professor of Microbial Chemistry, WIM; Ph.D., Illinois
Chemical and biological properties of microbial products
- Beate Schwer, Assistant Professor of Biochemistry, UMDNJ-RWJMS;
Ph.D., Heidelberg (Germany)
Pre-mRNA splicing in yeast: the role of an RNA-dependent ATPase
- Aaron J. Shatkin, Professor of Molecular Genetics and Microbiology,
UMDNJ-RWJMS; University Professor of Molecular Biology, FAS-NB; Director
of the Center for Advanced Biotechnology and Medicine; Ph.D., Rockefeller
Eukaryotic gene expression; viral cytopathogenesis and host range restriction
- Leonard H. Sigal, Associate Professor of Medicine, UMDNJ-RWJMS;
M.D., Stanford
Immunopathogenesis of Lyme neurologic disease; cross-reactions between
human axonal protein and flagellin of *Borrelia burgdorferi*
- Lee D. Simon, Associate Professor of Molecular Genetics, WIM; Ph.D., Rochester
Molecular biology of protein degradation in prokaryotes
- Navin K. Sinha, Associate Professor of Molecular Genetics, WIM;
Ph.D., Minnesota
Mechanisms of spontaneous and induced mutations
- Peter Smouse, Professor of Marine and Coastal Studies, CC; Ph.D.,
North Carolina State
Mathematical representation of molecular phylogenics
- William Sofer, Associate Professor of Molecular Genetics, WIM; Ph.D., Miami
Genetic algorithms in protein structure prediction
- Ann C. St. John, Associate Professor of Biological Sciences, FAS-NB; Ph.D.,
Wisconsin (Madison)
Regulation of protein catabolism; stress response proteins
- Stanley Stein, Professor of Molecular Biology, CABM/UMDNJ-RWJMS;
Ph.D., CUNY
Protein analysis; synthesis of peptides and antisense DNA
- Ruth Steward, Professor of Molecular Biology and Biochemistry, FAS-NB;
Ph.D., Basel (Switzerland)
Oocyte determination, nuclear migration, and establishment of embryonic polarity
in *Drosophila*
- Victor Stollar, Professor of Molecular Genetics and Microbiology,
UMDNJ-RWJMS; M.D.C.M., Queen's (Ontario)
Viral replication in mammalian and insect cells
- Roger Strair, Associate Professor of Medicine, CINJ/UMDNJ-RWJMS;
M.D., Ph.D., Albert Einstein
Hematopoietic malignancies; stem cell transplantation
- William A. Strohl, Professor of Molecular Genetics and Microbiology,
UMDNJ-RWJMS; Ph.D., California Institute of Technology
DNA viruses; viral oncogenesis; growth regulation of eukaryotic cells
- Moti L. Tiku, Associate Professor of Medicine, UMDNJ-RWJMS; M.D., Delhi
Immunobiology of autoimmune diseases; rheumatoid and osteoarthritis;
immunology and cytokine biology; reactive oxygen radicals and aging
- Thresia Thomas, Associate Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., Indian Institute of Science (Bangalore)
Molecular biology of breast cancer; polyamines, estradiol, and cyclins
- Robert Trelstad, Professor and Chairperson of Pathology and Laboratory Medicine,
UMDNJ-RWJMS; M.D., Harvard
Matrix morphogenesis and macromolecular patterning
- Nilgun E. Tumer, Associate Professor of Plant Pathology, CABM; Ph.D., Purdue
Mechanisms of virus resistance, mechanism of antiviral action of ribosome
inactivating proteins, turfgrass transformation and improvement
- Aurea C. Vasconcelos, Professor of Biology, FAS-NB; Ph.D., Chicago
Chloroplast development, function, and regulation
- Andrew K. Vershon, Associate Professor of Molecular Biology, WIM; Ph.D.,
Massachusetts Institute of Technology
Regulation of gene expression in yeast

Robert C. Vrijenhoek, Professor of Marine and Coastal Sciences; Director of the Center for Theoretical and Applied Genetics, CC; Ph.D., Connecticut Molecular evolution; phylogeny; population genetics; conservation biology
Eileen P. White, Professor of Biological Sciences, FAS-NB; Ph.D., SUNY (Stony Brook)
Regulation of programmed cell death (apoptosis) by viral oncogenes and tumor suppressor genes

Nancy A. Woychik, Assistant Professor of Molecular Genetics and Microbiology, UMDNJ-RWJMS; Ph.D., Wisconsin (Madison)
Regulation of mRNA transcription; RNA polymerase II subunit function

Lily Y. Young, Professor of Environmental Sciences, CC; Ph.D., Harvard
Anaerobic microbial metabolism of contaminant chemicals; microbial biodegradation; bioremediation

Peter D. Yurchenco, Associate Professor of Pathology, UMDNJ-RWJMS; Ph.D., Albert Einstein College of Medicine
Basement membrane; self-assembly; three-dimensional structure; cellular interactions

Barbara A. Zilinskas, Professor of Plant Biochemistry, CC; Ph.D., Illinois (Urbana)
Molecular biology of plant response to oxidative stress; photosynthesis
Gerben Zylstra, Associate Professor of Biochemistry and Microbiology, CC; Ph.D., Michigan
Genetics and physiology of microbial aromatic hydrocarbon degradation

Associate Members of the Graduate Faculty

Hidenori Kawanishi, Professor of Medicine, UMDNJ-RWJMS; M.D., Ph.D., Kyoto
Gut mucosal molecular immunology

Debra L. Laskin, Professor of Pharmacology and Toxicology, CP; Ph.D., Medical College of Virginia
Immunology; cytokines; nitric oxide

Jeffrey D. Laskin, Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., SUNY (Buffalo)
Effects of xenobiotics on growth and differentiation of epidermal cells; mechanisms of chemical carcinogenesis; biology of nitric oxide

Michael A. Lawton, Assistant Professor of Plant Pathology, CC; Ph.D., Oxford
Fungal pathogens; signal transduction during development and disease in plant cells

Abbas Rashidbaigi, Assistant Professor and Director of Cell Biology, Interferon Sciences; Ph.D., Wisconsin (Madison)
Isolation of interferon regulated genes; interferon mechanisms

W. Steven Ward, Assistant Professor of Urology, UMDNJ-RWJMS; Ph.D., Vanderbilt
Organization of DNA in the mammalian sperm nucleus

Adjunct Member of the Graduate Faculty

Marion Man-Ying Chan, Assistant Research Professor of Biological Sciences, FAS-NB; Ph.D., Cornell Medical College
Inflammation, immunity, and chemotherapy for intracellular parasite—Leishmania

Programs

The graduate program in microbiology and molecular genetics offers advanced studies leading to the M.S. and Ph.D. degrees with specialized training and research opportunities in four central areas: Molecular genetics and microbial physiology; virology, immunology, and pathogenic microbiology; applied, environmental, and industrial microbiology; and computers in molecular biology.

Students entering the program usually participate in a selection of core courses, as described under the molecular biosciences heading in this chapter, in the chosen area of interest. Additional or alternate studies are designed to meet individual needs. Thus, graduate students have the opportunity to select additional study areas in their work. Admission is handled through the consolidated graduate programs in molecular biosciences. For further information, refer to the molecular biosciences heading within this chapter.

Graduate study in microbiology and molecular genetics at Rutgers is organized as a coordinated program and involves the participation of faculty members from six principal and numerous auxiliary units. The six major coordinating units are: (1) the Department of Biological Sciences of the Faculty of Arts and Sciences—New Brunswick, (2) the Waksman Institute of Microbiology, (3) the Department of Molecular Genetics and Microbiology of the University of Medicine and Dentistry of New Jersey—Robert Wood Johnson Medical School, (4) the Department of Biochemistry and Microbiology of Cook College, (5) the Center of Advanced Biotechnology and Medicine of the University of Medicine and Dentistry of New Jersey, and (6) the Center of Agricultural Molecular Biology.

The Master of Science degree requires the satisfactory completion of a minimum of 24 course credits, 6 research credits, and a research thesis. In the nonthesis option, the thesis requirement is waived, but additional course work is then required to qualify for the degree. Candidates for the M.S. degree are also required to complete 2 credits from courses 16:681:681–686. See further course requirements below.

Thirty-two course credits are required for the Doctor of Philosophy degree. Each Ph.D. student must pass a qualifying examination and complete a research project that culminates with the student's oral defense of his or her dissertation. Candidates for the Ph.D. degree are required to complete 4 credits from courses 16:681:681–686. See further course requirements below. Candidates for the Ph.D. degree must spend a minimum of two consecutive terms (summer included) as full-time students in residence. As part of their graduate training, doctoral students may be required to fulfill certain teaching duties under faculty supervision. There is no language requirement.

General Microbiology 16:681:501 and 16:681:502 Microbial and Molecular Genetics or 16:681:580 Fundamentals of Molecular Genetics are required courses. Exemptions may be granted for students transferring equivalent graduate credits.

The Master of Philosophy degree is available to doctoral candidates. All degrees in this program are conferred jointly between Rutgers University and the University of Medicine and Dentistry of New Jersey. For information about joint M.S. and Ph.D. degrees available in this program, see the beginning of this chapter. For more detailed description of the program faculty, degree requirements, and course offerings, refer to the Student Bulletin available from the program director.

Graduate Courses

The following courses have minimum prerequisites for undergraduate degrees in biochemistry, biology, chemistry, or microbiology with a concentration in genetics, organic chemistry, general biochemistry, or general microbiology.

16:681:501. (F) GENERAL MICROBIOLOGY (3)

Antoine, Bartha

Molecular aspects of origin of life, microbial evolution, properties and synthesis of the major biological polymers, transport phenomena, metabolic pathways and regulation, cellular control mechanisms, virology, applied immunology, pathogenic microbiology, and food and industrial microbiology.

16:681:502. (S) MOLECULAR GENETICS (3)

Dougherty. Prerequisites: 16:115:501, 502.

Prokaryotic and eukaryotic molecular genetics. Bacteria, bacteriophage, yeast, *Drosophila*, and mammals.

16:681:515. (F) PRACTICAL MICROSCOPY (4)

Ghosh, Simon. Lec. 3 hrs., lab. 3 hrs. Prerequisites: 16:681:501 and permission of instructor.

Principles and techniques of light and electron microscopy.

Application to the study of the fine structure of microorganisms.

16:681:517. (F) PROTEIN TECHNOLOGY (1)

Stein

Purifying, analyzing, and otherwise working with proteins.

16:681:520. (S) MICROBIAL BIOCHEMISTRY AND MOLECULAR BIOLOGY (3)

Antoine. Prerequisites: 16:115:511, 512, or equivalents; 16:681:521.

A survey of the biochemical activities unique to microorganisms emphasizing the similarities and differences between prokaryotic and eukaryotic organisms; consideration of the genetic regulation and practical importance of these biochemical capabilities. Topics include methanogenesis, toxins, biodegradation, microbial transformations, and secondary metabolites.

16:681:521. (S) MICROBIAL PHYSIOLOGY AND METABOLISM (3)

Antoine. Prerequisites: 16:681:501, 16:115:511, 512, or equivalents.

Microbial responses to environment with particular emphasis on nutrition and biochemistry. Enzymology and metabolic pathways of microorganisms. Metabolic diversity and regulation.

- 16:681:524. (S) INDUSTRIAL MICROBIOLOGY (3)
Eveleigh. Prerequisites: 16:681:501, one year of organic chemistry.
The industrial applications of microorganisms, including production of chemicals and antibiotics, transformations, product stability, protection from deterioration, impact on environment, continuous fermentations, and waste disposal.
- 16:681:543. (F) IMMUNOLOGY (3)
Ron. Prerequisite: 16:681:541.
Cellular basis of immunology; analysis, activation, and function of lymphoid cells; regulatory mechanisms, relevance to tumor and transplantation immunity.
- 16:681:544. (S) MEDICAL MICROBIOLOGY AND IMMUNOLOGY (4.5)
Strohl
Bacteria and human cells in culture. Biochemical correlations. Comparative cytology, metabolism, genetics, regulation of protein synthesis and enzyme function, immunology, virology, and medical microbiology. Principles governing mechanisms of human disease emphasized.
- 16:681:545. (S) MEDICAL MICROBIOLOGY AND IMMUNOLOGY LABORATORY (2.5)
Strohl. Corequisite: 16:681:544.
Experiments in the isolation, identification, and growth kinetics of bacteria; bioassay methods; organelle biogenesis; human karyotyping; diagnostic bacteriology; immunological methods; animal cell culture and virology. Concepts and techniques relevant to medical problems emphasized.
- 16:681:546. (F) INFECTIOUS DISEASES (4)
Dubin. Prerequisites: 16:681:544, 545, 561, or equivalent; permission of instructor.
Open to advanced students who can demonstrate the need for a clinically oriented course in infectious diseases. Consists of sixteen three- or four-hour sessions (60 hours total) over a period of two months. Time varies; consult instructor.
The diagnosis and management of human diseases caused by infectious agents. Principles of the epidemiology, pathogenesis, and clinical manifestations of common diseases.
- 16:681:548. CELL SURFACE RECEPTORS (3)
Langer. Prerequisites: 16:115:501, 502, or equivalent. Recommended: a course in cell biology.
Diverse prokaryotic and eukaryotic cell-surface receptors and their mechanisms of intracellular signaling are examined to illustrate a range of experimental approaches, structural motifs, and biochemical mechanisms.
- 16:681:555. (F) MOLECULAR VIROLOGY (3)
Stollar. Prerequisite: 16:681:501, 550, or equivalent.
Detailed consideration of fundamental physical-chemical properties, schemes of classification, genetics, and modes of replication of selected animal viruses.
- 16:681:560. (F) BACTERIAL PHYSIOLOGY (4)
Neiderman, St. John. Lec. 3 hrs., rec. 2 hrs. Prerequisites: 16:681:501, 16:115:511, 512.
Recent advances in regulation of growth and cell division, macromolecular synthesis, cellular responses to nutritional and environmental stress, chemotaxis, and the structure, function, and assembly of bacterial membranes.
- 16:681:572. (S) MICROBIAL ECOLOGY (4)
Bartha, Eveleigh. Lec. 3 hrs., lab. 3 hrs. Prerequisite: 16:681:501.
Qualitative and quantitative methods for the study of microbial communities. Ecological determinants. Characteristics of aquatic and terrestrial ecosystems. Biogeochemical cycles and energy flow. Microbial interactions and community structure.
- 16:681:580. (F) FUNDAMENTALS OF MOLECULAR GENETICS (3)
Champe, Sofer. Prerequisites: Genetics, 16:115:511, 512.
Basic mechanisms of information storage in and retrieval from nucleic acids; organization of prokaryotic and eukaryotic genomes; mechanisms of DNA replication; transposable genetic elements; transcriptional and translational control of gene expression. Designed to provide necessary background for advanced molecular genetics courses 16:681:581, 582, 583, 584, 585, 586, 587, and 588.
- 16:681:581. (F) MOLECULAR GENETICS OF ORGANELLES (3)
Prerequisite: 16:681:580 or permission of instructor.
Molecular analysis of genomes and of genetic and evolutionary processes in mitochondria and chloroplasts, both as unique systems and as model systems for molecular genetic studies.
- 16:681:585. (S) CANCER MOLECULAR BIOLOGY (3)
Axelrod. Prerequisite: 16:681:580 or permission of instructor.
Emphasis on the molecular, cellular, and genetic basis for cancer. Oncogenes and tumor suppressor genes. Signal transduction and cell cycle control in cancer cells. Metastasis. Diagnosis and therapy. Recent understanding of the molecular basis of selected human cancers. Lectures and critical discussion of the current literature.
- 16:681:586. (S) PLANT MOLECULAR GENETICS (3)
Price, Sinha. Prerequisite: 16:681:580 or permission of instructor.
Topics include: nuclear genomes, genetic manipulations with Ti plasmids, mitochondrial and chloroplast genomes, molecular genetics of nitrogen fixation, plant viruses, transposable elements, and plant tissue culture techniques.
- 16:681:587. (S) ADVANCED RECOMBINANT DNA TECHNIQUES (3)
Klessig. Prerequisite: 16:681:580 or permission of instructor.
Use and properties of restriction endonucleases, prokaryotic and eukaryotic cloning vectors, construction and screening of recombinant DNA libraries, characterization of cloned DNA, and site-directed mutagenesis. Current NIH and FDA regulations governing recombinant DNA research.
- 16:681:588. (F) CANCER (3)
Axelrod. Prerequisite: 16:681:580 or permission of instructor.
Broad coverage of cancer as a family of diseases of humans and experimental animals. Malignant progression and metastasis, DNA and RNA tumor viruses, cancer genes, chemical carcinogenesis, tumor immunology, therapeutic modalities, epidemiology, and medical oncology.
- 16:681:601,602,603,604. ADVANCED TOPICS IN MICROBIOLOGY AND MOLECULAR GENETICS (BA,BA,BA,BA)
Prerequisites: 16:681:501, 580. Recommended: 16:115:503, 504.
Special topics of current interest.
- 16:681:607,608. TEACHING TECHNIQUES IN MICROBIOLOGY AND MOLECULAR GENETICS (2,2)
Strohl. Prerequisite: Open only to matriculated students in the graduate program in microbiology and molecular genetics.
Guidance and practical experience in the teaching of microbiology and molecular genetics.
- 16:681:611,612,613,614. (F) LABORATORY ROTATION IN MICROBIOLOGY AND MOLECULAR GENETICS (2,2,2,2)
Prerequisite: Written approval of program director. Open only to matriculated students in the graduate program.
Half-term research projects of interest to the student in faculty laboratories.
- 16:681:641,642,643,644,645,646. INDEPENDENT STUDIES IN MICROBIOLOGY AND MOLECULAR BIOLOGY (BA,BA,BA,BA,BA,BA)
Prerequisites: Permission of faculty adviser and program director.
Library research project normally leading to the nonthesis essay for master's degree candidates.
- 16:681:681,682. SEMINAR IN MOLECULAR GENETICS AND MICROBIAL PHYSIOLOGY (1,1)
Informal critical description and discussion of current literature and concepts.
- 16:681:683,684. SEMINAR IN VIROLOGY, IMMUNOLOGY, AND PATHOGENIC MICROBIOLOGY (1,1)
Informal critical description and discussion of current literature and concepts.

16:681:685,686. SEMINAR IN APPLIED, ENVIRONMENTAL, AND INDUSTRIAL MICROBIOLOGY (1,1)
Informal critical description and discussion of current literature and concepts.

16:681:687,688. SEMINAR IN COMPUTATIONAL MOLECULAR BIOLOGY (1,1)
Recent advances in computational molecular biology selected from the following areas: genomics, bioinformatics, structural biology, image analysis, pattern formation, and molecular evolution.

16:681:701,702. RESEARCH IN MICROBIOLOGY AND MOLECULAR GENETICS (BA,BA)

MOLECULAR AND CELL BIOLOGY 695

Program Offered: Core Curriculum
Director of Interdisciplinary Core Curriculum: Professor Michael J. Leibowitz, Department of Microbiology, University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School, Piscataway, New Jersey 08854 (732/235-4795)

Core Curriculum Program

The Graduate School–New Brunswick and the Graduate School of Biomedical Sciences of the University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School offer a shared interdisciplinary core curriculum in molecular and cell biology. The core curriculum provides new course offerings and fellowship support to qualified students who want to pursue Ph.D. degrees in the Consolidated Graduate Programs in Molecular Biosciences.

Students enrolled in molecular and cell biology are expected to follow the curriculum outlined below in their first year of study. Subsequently, they are expected to proceed in one of the participating degree-granting programs. The core curriculum courses are to be integrated into the requirements of the program in which the student earns the degree. This curriculum is followed by all students in the molecular biosciences programs.

Fall Term

- 16:115:501 Biochemistry (3)
- 16:115:502 Biochemistry (Molecular Biology) (3)
- 16:115:556 Ethical Scientific Conduct (1)
- 16:695:611 Special Topics in Molecular and Cell Biology (1)
- 16:695:615 Laboratory Rotation in Molecular and Cell Biology (4)

Spring Term

- 16:681:502 Microbial and Molecular Genetics (3)
- 16:695:601 Advanced Cell Biology (3)
- 16:695:612 Special Topics in Molecular and Cell Biology II (1)
- 16:695:616 Laboratory Rotation in Molecular and Cell Biology II (2 or 4)

Graduate Courses

16:695:601. ADVANCED CELL BIOLOGY (3)
Hitchcock-DeGregori, Pintar. Prerequisite: 16:115:501,502. Corequisites: 16:681:502, 16:695:612.

Molecular analysis of eukaryotic cells, including cell structure, receptors, cell-cell interactions, cytoskeleton, growth, differentiation, and transformation.

16:695:611,612. SPECIAL TOPICS IN MOLECULAR AND CELL BIOLOGY I, II (1,1)
Leibowitz. Corequisites: 16:681:502; 16:695:601.

First term: student seminars and discussions based on assigned literature readings in biochemistry and molecular genetics, with emphasis on structure and function of macromolecules. Second term: student seminars and discussions based on assigned literature readings in molecular cell biology, with emphasis on molecular approaches to cellular structures and activities in eukaryotic cells.

16:695:615,616. LABORATORY ROTATION IN MOLECULAR AND CELL BIOLOGY I, II (4, 2 OR 4)

Leibowitz
Students participate in research projects in the laboratories of selected faculty members.

MOLECULAR BIOPHYSICS 696

Program Offered: Core Curriculum
Director of Interdisciplinary Core Curriculum: Professor Wilma K. Olson, Center for Molecular Biophysics and Biophysical Chemistry, Wright-Rieman Laboratories, Busch Campus (732/445-6376)

Participating Faculty

The following members and associate members of the graduate faculty, identified more fully under their respective programs, represent part of the faculty who participate regularly in the core curriculum in molecular biophysics.

Stephen Anderson, Biochemistry
Edward Arnold, Chemistry
Jean S. Baum, Chemistry
Helen M. Berman, Chemistry and Biochemistry
Kenneth J. Breslauer, Chemistry and Biochemistry
Barbara M. Brodsky, Biochemistry
Richard H. Ebright, Chemistry
Martin Farach, Computer Science
Marc Gartenberg, Pharmacology
Millie M. Georgiadis, Chemistry
Sarah E. Hitchcock-DeGregori, Biochemistry
Masayori Inouye, Biochemistry
Stephan S. Isied, Chemistry and Biochemistry
Roger A. Jones, Chemistry and Biochemistry
Karsten Krogh-Jespersen, Chemistry
Casimir Kulikowski, Computer Science
John Lenard, Biochemistry
Ronald M. Levy, Chemistry and Biochemistry
Richard Ludescher, Food Science
Gerald S. Manning, Chemistry
Gaetano T. Montelione, Biochemistry and Chemistry
Wilma K. Olson, Chemistry and Biochemistry
Tariq M. Rana, Biochemistry
Ann M. Stock, Biochemistry
John Taylor, Chemistry
T.J. Thomas, Biochemistry
Donald A. Winkelmann, Biochemistry

Core Curriculum Program

The aim of the molecular biophysics core curriculum is to select and educate researchers who are capable of applying the tools and concepts of the physical sciences to the solution of significant biological problems. Many important contributions in molecular biophysics are a synthesis of biology, chemistry, mathematics, and physics not found in a single traditional discipline. The molecular biophysics core curriculum therefore goes beyond the curricula of individual academic disciplines and sets its own guidelines for courses and the character of dissertation research. The requirements are, nevertheless, consistent with those of existing graduate programs at Rutgers so that the students can earn a Ph.D. in one of the major academic disciplines with a concentration in molecular biophysics.

Supplemental work for molecular biophysics is designed to enable the students to do the following: (1) receive broad exposure to the principles and methods of molecular biophysics along with rigorous training in the relevant physical sciences, (2) combine course requirements with those in existing predoctoral programs, (3) choose from a wide range of courses in molecular biophysics not specifically included in the requirements, and (4) master a curriculum that meets his or her individual needs.

Because students in the program come from a variety of backgrounds and have different interests, the course structure is flexible. Formal course requirements are limited to a core program in biophysical chemistry and a choice of two advanced courses. All students are expected to complete a sequence of laboratory rotations and to register every term for the core curriculum seminar.

The laboratory rotation is intended to provide students with broad exposure to the methods of molecular biophysics and to assist them in choosing dissertation advisers. The aim of the seminar course is to provide in-depth exposure to new developments in the field as well as to unify the molecular biophysics students and faculty. Students also work in depth with a faculty mentor on a dissertation problem. The emphasis of the research training is on the structures, interactions, and physicochemical properties of biological macromolecules. The program additionally offers wide latitude in the choice of advanced electives, allowing students and faculty to design curricula to match individual needs. Students in the program are expected to have a common minimal background in the physical and biological sciences. Courses are taken to fill gaps in background as well as to provide intensive training in the particular area in which the student plans to carry out research. The departmental courses offered at Rutgers provide a rich resource for this purpose. Most students are expected to take four to five years to complete degree requirements.

Graduate Courses

Biophysical Chemistry I and II, 16:160:537 and 538, are required courses. Exemptions may be granted for students transferring equivalent graduate credits. The advanced electives in molecular biophysics can be selected from a long list of existing courses in several graduate programs.

16:696:601,602. SEMINAR IN MOLECULAR BIOPHYSICS (1,1)
Oral presentations and discussions of the current literature in molecular biophysics.

16:696:611,612. LABORATORY ROTATION IN MOLECULAR BIOPHYSICS (BA,BA)
Introduction to the techniques and research areas of molecular biophysics. Participation in the research projects of 2-3 faculty. Students are encouraged to take rotations in different areas. At least one of the rotations should be involved with the structural investigation (either by experimental or theoretical means) of a biopolymer.

MOLECULAR BIOSCIENCES

The Consolidated Graduate Programs in Molecular Biosciences coordinates recruitment and admission for applicants to the doctoral programs in biochemistry, cell and developmental biology, microbiology and molecular genetics, and cellular and molecular pharmacology, and has established a common first-year doctoral core curriculum for those disciplines. The consolidated programs are conducted jointly by the Graduate School–New Brunswick of Rutgers University and the Graduate School of Biomedical Sciences of the University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School.

Participating students may study with any of the more than 170 faculty members affiliated with the programs, giving opportunities for doctoral study in a wide range of fields, including biochemistry, biotechnology, cell biology, computational molecular biology, developmental biology, macromolecular structure, microbiology, molecular biology, molecular biophysics, molecular genetics, molecular virology, and protein engineering.

Admission Requirements

The most appropriate preparations for the molecular biosciences are undergraduate degrees in biology (cellular, developmental, molecular, or microbiology), in biochemistry, or in chemistry (analytical, organic, or physical). Applicants must have adequate backgrounds in both calculus and physics, and all applicants are required to have earned an undergraduate cumulative grade-point average of 3.0 or better.

Faculty Affiliations

Rutgers, The State University of New Jersey

Faculty of Arts and Sciences–New Brunswick

Department of Biological Sciences
Department of Chemistry
Department of Molecular Biology and Biochemistry

College of Pharmacy

Department of Chemical Biology and Pharmacognosy

Cook College

Department of Animal Sciences
Department of Applied Microbiology and Plant Physiology
Department of Food Science

University of Medicine and Dentistry of New Jersey–
Robert Wood Johnson Medical School

Department of Biochemistry
Department of Cell and Molecular Pharmacology
Department of Medicine (and other clinical departments)
Department of Molecular Genetics and Microbiology
Department of Neurosciences and Cell Biology
Department of Pathology
Department of Physiology and Biophysics

Academic Research Centers and Institutes

Cancer Institute of New Jersey (CINJ)
Center for Advanced Biotechnology and Medicine (CABM)
Center for Agricultural Molecular Biotechnology (Agbiotech)
Center of Alcohol Studies
Environmental and Occupational Health Sciences Institute
Waksman Institute of Microbiology

First-Year Core Curriculum

Fall Term

16:115:501 Biochemistry (3)
16:115:502 Biochemistry (Molecular Biology) (3)
16:115:556 Ethical Scientific Conduct (1)
16:695:611 Special Topics in Molecular and Cell Biology I (1)
16:695:615 Laboratory Rotation in Molecular and Cell Biology I (4)

Spring Term

16:681:502 Microbial and Molecular Genetics (3)
16:695:601 Advanced Cell Biology (3)
16:695:612 Special Topics in Molecular and Cell Biology II (1)
16:695:616 Laboratory Rotation in Molecular and Cell Biology II (2 or 4)
one elective course (3)

For information regarding specific areas of study as well as course listings, see the program descriptions for biochemistry, cell and developmental biology, and microbiology and molecular genetics within this chapter of the catalog and in related materials from UMDNJ-RWJMS.

MUSIC 700

Degree Programs Offered: Master of Arts, Master of Arts for Teachers, Doctor of Philosophy
Director of Graduate Program: Professor Floyd Grave, Chapel Drive, Douglass Campus (732/932-9302)

Members of the Graduate Faculty

Irene Alm, Assistant Professor of Music, MGSA; Ph.D., California (Los Angeles)
Baroque music; opera
Gerald C. Chenoweth, Professor of Music, MGSA; Ph.D., Iowa
Music composition; theory and analysis
Noel G. DaCosta, Professor of Music, MGSA; M.A., Columbia
Music theory; composition

Floyd Grave, Associate Professor of Music, MGSA; Ph.D., New York
Eighteenth-century music; history of music theory
Douglas Johnson, Professor of Music, MGSA; Ph.D., California (Berkeley)
Eighteenth- and nineteenth-century music; Beethoven
George Jones, Professor of Music, MGSA; Ph.D., New York
Renaissance music; wind instruments
Martin Picker, Professor Emeritus of Music, MGSA; Ph.D., California (Berkeley)
Renaissance music; history of notation
Charles Wuorinen, Professor of Music, MGSA; M.A., Columbia
Music composition; electronic sound synthesis; theory and analysis

Associate Members of the Graduate Faculty

William Berz, Associate Professor of Music, MGSA; Ph.D., Michigan State
Music education; instructional technology
Richard Chrisman, Associate Professor of Music, MGSA; Ph.D., Yale
Contemporary music theory
Colleen M. Conway, *Assistant Professor of Music, MGSA; Ed.D., Columbia*
Music education
Nancy Cooper, Assistant Professor of Music, MGSA; D.M.E., Indiana
Music education
Anita Davis, Assistant Professor of Music, MGSA; Ph.D., Florida State
Music education
Daniel Goode, Associate Professor of Music, MGSA; M.A., Columbia
Music composition; theory and analysis
Wilbert Davis Jerome, Professor of Music, FAS-C; Ph.D., Bryn Mawr
Baroque and classical performance practice; wind instruments
Andrew Kirkman, *Assistant Professor of Music, MGSA; Ph.D.,*
Kings College (London)
Music history
Charlotte Mattax, Associate Professor of Music, MGSA; D.M.A., Stanford
Baroque performance practice; harpsichord and forte piano
Lewis Porter, Associate Professor of Music, FAS-N; Ph.D., Brandeis
Jazz research and performance
Nancy Rao, *Assistant Professor of Music, MGSA; Ph.D., Michigan*
Music theory and analysis
Marilyn F. Somville, Dean of MGSA and Professor of Music; Ph.D., Stanford
Performance practice, aesthetics, and criticism
Floyd G. Sumner, Professor of Music, MGSA; Ph.D., Rutgers
Music history; Renaissance instrumental music
Ronald Surak, Part-time Lecturer in Music, MGSA; Ph.D., Rutgers
Music composition; electronic sound synthesis
Margaret Thomas, *Assistant Professor of Music, MGSA; Ph.D., Yale*
Music theory and analysis
J. Kenneth Wilson, Associate Professor of Music, FAS-N; Ph.D., Harvard
Eighteenth-century opera

Programs

Areas of concentration in graduate music programs encompass music scholarship on one hand and composition on the other. Both areas incorporate extensive study of music theory. Thus, for the M.A. degree, candidates specialize either in music history and theory or composition and theory. Similarly, the Ph.D. program involves specialization either in musicology or in composition and theory.

Requirements for the M.A. degree include a minimum of 30 credits. For students specializing in composition, the following courses are required: 16:700:501, 522, 525, 526, 531, 532, 601, and 602 (16:700:531, 532 may be replaced with 16:700:515, 516). Those concentrating in music history must take 16:700:501, 502, 519, 520, 522, 525, 526, and 602 (16:700:525, 526 may be replaced with 16:700:567, 568). A reading knowledge of one foreign language (German, French, Italian, or Latin), to be demonstrated by the second year of residency, is also required for the M.A. degree. For those planning to continue toward the Ph.D. degree, a reading knowledge of two foreign languages should be demonstrated before completion of the program. German (required for the Ph.D.) is strongly recommended as the first language. All candidates must pass a written comprehensive examination. Candidates in music history submit a master's essay; candidates in composition submit a work for chamber ensemble.

Requirements for the M.A.T. degree include a minimum of 36 credits of course work (which may include advanced undergraduate courses) consisting of at least 18 credits of graduate courses in music (music education, history, theory), 12 credits of electives (music, education, or a foreign language) to be chosen in consultation with the graduate program director, and 6 credits

in performance (applied music or music ensemble). Additional requirements include a reading knowledge of one foreign language (German, French, Italian, or Latin) and a written comprehensive examination in music. Alternatively, M.A.T. candidates may follow a more specific music-education curriculum consisting of graduate courses in music theory (6 credits), music history (6 credits), performance (6 credits), electives (6 credits), and music education (12 credits, 3 of which may be devoted to a final research project). There are no foreign language requirements. All M.A.T. candidates must pass a written comprehensive examination.

For admission to the Ph.D. program, applicants should have satisfied requirements for the M.A. degree or their equivalents. Applicants in musicology should submit an essay giving evidence of their ability to engage in scholarly research. Applicants in composition should submit (1) a work based on a traditional procedural model such as motet, chorale prelude, invention, or fugue, and (2) a portfolio of recent representative compositions. Ph.D. candidates in composition must take 16:700:631, 632, 651, 652, and 6 elective credits. Ph.D. candidates in musicology must take 16:700:619, 620, 651, 652, and 6 elective credits. In addition, a minimum of 24 credits in individual research is required. Work with electronic sound-generating facilities may be used to satisfy a part of this requirement. Language requirements to be fulfilled by written examination are: for students in musicology, a working knowledge of German and French and an additional language to be chosen with the approval of the graduate director (two of these language requirements should be met by the third year of graduate study); for students in composition, a working knowledge of German and one Romance language to be chosen with the approval of the graduate director (both requirements should be met by the third year of graduate study). As part of their graduate training, doctoral students are also required to fulfill certain teaching duties under faculty supervision. Before admission to candidacy for the Ph.D. degree, all students must pass a written and oral comprehensive examination. For students in musicology, a dissertation is required. Candidates in composition must submit an original work of substantial proportions, along with an appropriate critical or theoretical essay.

The Master of Philosophy degree is available to doctoral candidates. The faculty also cooperates with the M.A. program in theology, with a major in music, offered by the New Brunswick Theological Seminary.

All students of composition (both M.A. and Ph.D. candidates) are expected to participate in the Composer Forum, a periodic meeting of students and faculty that provides a setting for the performance and discussion of students' music.

In addition to courses listed below, a student may, with approval of the graduate director, receive credit for certain upper-level undergraduate or graduate classes offered by other departments (for example 01:730:365 Philosophy of Music, offered by the philosophy department) whose content is relevant to the student's interests.

Graduate Courses

16:700:501. (F) INTRODUCTION TO MUSIC RESEARCH (3)
Survey of bibliographic materials for research in music.

16:700:502. (S) TECHNIQUES OF MUSIC RESEARCH (3)
Prerequisite: 16:700:501.

The application of research techniques to specific problems of musical research, including the transcription and editing of musical sources.

16:700:509, 510. MUSIC HISTORY—INTENSIVE REVIEW (3,3)
Review of major historical periods of music from antiquity to the modern era with emphasis on the development of musical styles.

16:700:511, 512. MUSIC THEORY—INTENSIVE REVIEW (3,3)
Review of counterpoint (two- and three-part species counterpoint, including imitation); harmony (part-writing and progressions); sight-reading and analysis.

16:700:513. PHILOSOPHICAL FOUNDATIONS IN MUSIC EDUCATION (3)

Significant philosophical positions that have influenced contemporary music education. The history and purpose of music in education; current curriculum models and theories; teaching strategies.

16:700:514. RESEARCH IN MUSIC EDUCATION (3)

Design, analysis, and evaluation in music education. Recent research. Planning and development of independent project.

16:700:515,516. SOUND SYNTHESIS AND COMPUTER-ASSISTED COMPOSITION (3,3)

Prerequisite: Permission of instructor.
Analysis of sound and timbre. Use of the computer for musical composition.

16:700:519,520. PROSEMINAR IN MUSIC HISTORY (3,3)

Prerequisites: 16:700:501,502.
Intensive study of selected areas in the history of music, with guided research leading to oral and written reports.

16:700:521,522. STUDIES IN MUSIC THEORY (3,3)

Exercises in canon, motet, and fugue, based on practices from the Renaissance to the tonal period.

16:700:525,526. STUDIES IN MUSIC ANALYSIS (3,3)

Study of styles and structures in compositions from the Middle Ages to the present and their relationship to ideas on composition held by composers and theorists.

16:700:527. STUDIES IN OPERA (3)

Prerequisite: Permission of instructor. Offered in alternate years.
Study of selected operas. Historical background, sources, editions, textual criticism, analysis, performance practice.

16:700:528. STUDIES IN CHORAL LITERATURE (3)

Prerequisite: Permission of instructor. Offered in alternate years.
Study of selected works for chorus and vocal ensemble from the sixteenth century to the present. Historical background, sources, editions, textual criticism, analysis, performance practice.

16:700:529. STUDIES IN INSTRUMENTAL ENSEMBLE LITERATURE (3)

Prerequisite: Permission of instructor. Offered in alternate years.
Study of selected chamber and orchestral works from the seventeenth century to the present. Historical background, sources, editions, textual criticism, analysis, performance practice.

16:700:530. STUDIES IN KEYBOARD LITERATURE (3)

Prerequisite: Permission of instructor. Offered in alternate years.
Study of selected works for keyboard instruments. Historical background, sources, editions, textual criticism, analysis, performance practice.

16:700:531,532. PROSEMINAR IN COMPOSITION (3,3)

Prerequisite: 16:700:522.
Practice in the techniques of creative composition. Includes participation in the Composer Forum.

16:700:535. SEMINAR IN MUSIC EDUCATION METHODOLOGY (3)

Prerequisite: Permission of instructor.
Current trends in music curriculum theory and design, teaching and learning styles, and program assessment. Principles and applications of contemporary music education methods.

16:700:536. THE KODÁLY APPROACH TO MUSIC EDUCATION (3)

Prerequisite: Permission of instructor.
Introduction to Kodály philosophy and techniques, including children's vocal development, folk song and choral literature, and music literacy training in choral and general music.

16:700:537. INSTRUCTIONAL TECHNOLOGY IN MUSIC EDUCATION (3)

Prerequisite: Permission of instructor.
Introduction to instructional media in music education, with particular emphasis on development of educational models.

16:700:538. PROSEMINAR IN MUSIC EDUCATION (3)

Prerequisite: Permission of instructor.
Intensive study of selected areas in music education, with guided research leading to oral and written reports.

16:700:541,542. SPECIAL TOPICS IN MUSIC THEORY AND ANALYSIS (3,3)

Prerequisite: Permission of instructor.
Study of selected musical repertoires and styles from a variety of theoretical perspectives.

16:700:551. JAZZ RESEARCH AND ANALYSIS (3)

Prerequisite: 16:700:501. Recommended: 16:700:525 (as pre- or corequisite).
Introduction to scholarly research in jazz. Covers research methods, transcription, and analysis of recorded jazz performances, pertinent African-American cultural issues, and questions of performance practice.

16:700:567,568. PROSEMINAR IN PERFORMANCE PRACTICE (3,3)

Prerequisite: Permission of instructor.
Problems of performance practice in vocal and instrumental music from the Renaissance through the eighteenth century.

16:700:571,572. SCHENKERIAN ANALYSIS (3,3)

Prerequisite: Permission of instructor. Offered in alternate years.
Premises, terminology, and analytical procedures derived from Heinrich Schenker's theory of linear structure, with emphasis on verification of analysis through critical listening.

16:700:573,574. TWENTIETH-CENTURY THEORY (3,3)

Prerequisite: Permission of instructor. Offered in alternate years.
Analysis of selected compositions from ca. 1910 to the present. Theoretical strategies and perspectives.

16:700:601. INDEPENDENT STUDY (3)

For those specializing in musicology: individual research leading to an essay demonstrating command of the techniques of historical or analytical research. For those specializing in music composition: individual research leading to a composition of substantial size demonstrating command of the techniques of composition.

16:700:602. MASTER'S PROJECT (3)

Prerequisite: 16:700:601.
Completion of the essay or composition required for the M.A. degree.

16:700:619,620. SEMINAR IN MUSICOLOGY (3,3)

For students pursuing the doctoral program.
Individual research in selected areas of music history and musicology.

16:700:631,632. SEMINAR IN COMPOSITION (3,3)

For students pursuing the doctoral program.
Advanced study in the techniques of creative composition. Includes participation in the Composer Forum.

16:700:651,652. HISTORY OF MUSIC THEORY AND NOTATION (3,3)

Prerequisite: Permission of instructor. Offered in alternate years.
Intensive study of selected sources from antiquity to the twentieth century, with emphasis on medieval and Renaissance notational systems, church modes, the teaching of counterpoint, and theories of tonality.

16:700:701,702. RESEARCH IN MUSIC (BA,BA)

Individual research leading either to a musical composition, an extended essay in an area of music history or theory, or toward completion of the Ph.D. degree.

NUTRITIONAL SCIENCES 709

Degree Programs Offered: Master of Science, Doctor of Philosophy

Director of Graduate Program: Professor Susan K. Fried,
132 Thompson Hall, Cook Campus (732/932-9039)

Members of the Graduate Faculty

- Robert E. Brolin, Professor of Surgery, UMDNJ-RWJMS; M.D., Michigan
Treatment of medically severe obesity; intestinal ischemic disease
- Julie M. Fagan, Associate Professor of Animal Sciences, CC; Ph.D., Arizona
Muscle growth; mechanisms of protein breakdown in mammalian cells
- Hans Fisher, Professor of Nutritional Sciences, CC; Ph.D., Illinois
Amino acid nutrition; histamine and serotonin metabolism and stress
- Susan K. Fried, Associate Professor of Nutritional Sciences, CC; Ph.D., Columbia
Obesity; adipose tissue metabolism; leptin
- Michael W. Hamm, Associate Professor of Nutritional Sciences, CC;
Ph.D., Minnesota
Lipids; local food supplies; nutrition and environment; urban ecology and nutrition
- Bernadette G. Janas, Assistant Professor of Nutritional Sciences, CC;
Ph.D., Cornell
Nutrition education and dietary change
- Barry W. Jesse, Associate Professor of Animal Sciences, CC; Ph.D., Michigan State
Nutritional biochemistry of ruminant livestock
- Debra P. Keenan, Assistant Professor of Nutritional Sciences, CC; Ph.D.,
Pennsylvania State
Nutrition education
- Paul A. Lachance, Professor of Food Science, CC; Ph.D., Ottawa
Applied human nutrition; nutrition and food processing; genetic obesity
- Debra L. Laskin, Associate Professor of Pharmacology and Toxicology, CP; Ph.D.,
Medical College of Virginia
Immunology; immunotoxicology; monoclonal antibodies; flow cytometry
- Patricia A. Schoknecht, Assistant Professor of Animal Sciences, CC; Ph.D., Cornell
Nutritional physiology of pregnancy and neonatal growth; postnatal growth
- Adria R. Sherman, Professor of Nutritional Sciences, CC; Ph.D.,
Pennsylvania State
Trace elements; nutrition and immunity; developmental nutrition
- T. Peter Stein, Professor of Surgery, UMDNJ-SOM; Ph.D., Cornell
Parenteral nutrition; protein metabolism
- Nancy R. Stevenson, Associate Professor of Physiology, UMDNJ-RWJMS;
Ph.D., Rutgers
Nutrition and physiology
- Judith Storch, Professor of Nutritional Sciences, CC; Ph.D., Columbia
Cellular lipid transport; structure and function of fatty acid-binding proteins
- Malcolm Watford, Associate Professor of Nutritional Sciences, CC;
D.Phil., Oxford
Regulation of glutamine metabolism
- G. Terence Wilson, Professor of Psychology, GSAPP; Ph.D., SUNY (Stony Brook)
Cognitive-behavioral therapy; assessment and treatment of weight and eating disorders
- James E. Wohlt, Associate Professor of Animal Sciences, CC; Ph.D., Illinois
Nutrient requirements for growth and lactation
- Chung S. Yang, Professor of Chemical Biology and Pharmacognosy, CP;
Ph.D., Cornell
Mechanisms by which dietary and nutritional factors affect drug metabolism, carcinogen metabolism, and carcinogenesis

Associate Members of the Graduate Faculty

- Ronaldo P. Ferraris, Assistant Professor of Physiology, UMDNJ-NJMS; Ph.D.,
Hawaii (Manoa)
Gastrointestinal physiology; membrane transport; intestinal function/dysfunction in aging
- Sue A. Goldstein-Shapses, Assistant Professor of Nutritional Sciences, CC;
Ph.D., Columbia
Biochemistry of cartilaginous tissue; diet, human metabolism, muscle function
- Peter J. Guarnaccia, Associate Professor of Human Ecology, CC;
Ph.D., Connecticut
Anthropology of foods and health
- Elaine A. Leventhal, Associate Professor of Medicine, UMDNJ-RWJMS; M.D.,
Wisconsin (Madison); Ph.D., Yale
Geriatrics; chronic and acute illnesses; occult malnutrition in the elderly
- Karen D. Mittleman, Assistant Professor of Exercise Science and Sport Studies,
FAS-NB; Ph.D., Simon Fraser
Thermoregulation; thermosensitivity; adaptation and endocrine mechanisms
- Sarah L. Ralston, Associate Professor of Animal Sciences, CC; Ph.D.,
V.M.D., Pennsylvania
Equine clinical nutrition; stress and immune function; aging metabolism
- Vincent A. Rifici, Assistant Professor of Medicine, UMDNJ-RWJMS;
Ph.D., Rutgers
Lipoprotein metabolism and atherosclerosis

- T.J. Thomas, Associate Professor of Medicine, UMDNJ-RWJMS; Ph.D., Indian
Institute of Science
Regulation of ornithine decarboxylase in autoimmune diseases
- Beverly J. Tepper, Associate Professor of Food Science, CC; Ph.D., Tufts
Nutrition; food intake regulation; sensory evaluation; taste in disease
- John Worobey, Associate Professor of Nutritional Sciences, CC; Ph.D.,
Pennsylvania State
Infant nutrition and behavior

Programs

Graduate work in nutrition is supervised by faculty members located in the departments of nutritional sciences, animal sciences, food science, human ecology, the College of Pharmacy, and the University of Medicine and Dentistry of New Jersey (UMDNJ). Areas of specialization include nutritional biochemistry; nutrient regulation of gene expression; nutrition and disease; sociological and behavioral aspects of nutrition; mineral, protein and amino-acid, and lipid metabolism; community nutrition; and developmental nutrition.

Applicants are expected to have an undergraduate major in a biological science, chemistry, or other field relevant to advanced training in nutritional sciences. The Graduate Record Examination must be taken. Prerequisites for admission include one year of general chemistry, one year of organic chemistry (or one term of organic chemistry and one term of biochemistry), and 12 additional credits of course work in advanced biology, chemistry, biochemistry, nutrition, food science, physics, or calculus.

The graduate program in nutritional sciences offers an M.S. with basic or applied emphasis and a Ph.D. in nutrition. All students complete course work that includes biochemical, physiological, molecular, and clinical aspects of nutrition; seminars; and electives in the advanced life sciences. Students in the applied emphasis option also pursue advanced courses in community nutrition, public health, epidemiology, and psychology.

A joint program leading to an M.S./D.I. (dietetic internship with the University of Medicine and Dentistry of New Jersey–New Jersey Medical School [UMDNJ–NJMS]) is also offered. This program provides students with the scientific knowledge and critical thinking skills to become leaders in the field of dietetics. The program is open only to students who have completed a Didactic Program in Dietetics approved by the Commission on Accreditation/Approval for Dietetics Education. Students must be jointly accepted and simultaneously enrolled in the dietetic internship at UMDNJ–NJMS and the M.S. program at Rutgers.

The M.S. degree requires 24 credits of course work and 6 credits of research including a thesis. The Ph.D. program requires 39 credits of course work in biochemistry, physiology, and nutrition and 33 credits of research. Candidates for the Ph.D. degree must spend a minimum of twelve consecutive months (two terms and a summer session) in residence and register for at least 24 credits of course work and 6 credits of research. Requests for exceptions to this policy are reviewed by the curriculum committee of the program. There is no language requirement. The Master of Philosophy degree is available to doctoral candidates.

Graduate Courses

- 16:709:503. INTRODUCTION TO APPLIED NUTRITION RESEARCH (3)
Pre- or corequisites: 16:709:552, 553, and statistics.
- 16:709:504. (S) SEMINAR IN NUTRITION EDUCATION (3)
Prerequisites: 11:709:400, 401 or equivalent.
Investigation, discussion, and evaluation of current research in nutrition education.
- 16:709:506. NUTRITIONAL ASPECTS OF DISEASE (3)
Prerequisites: 16:709:552, 553.
Advanced study of pathophysiological aspects of disease states and the relation to nutrition.
- 16:709:515. PRINCIPLES OF NUTRITION RESEARCH (3)
Prerequisites: 16:709:552, 553.
Advanced topics in metabolic regulation including principles of experimental design as applied to nutrition research.

16:709:521. (S) COMMUNITY NUTRITION (3)

Prerequisites: 11:709:400,401; or equivalent.

Study of nutritional aspects of public health service and community agencies, and of programs designed to improve nutritional status of various population groups.

16:709:552,553. NUTRITION: A BIOCHEMICAL AND PHYSIOLOGICAL BASIS (4,4)

Prerequisites: 01:115:403; 16:115:511 or equivalent. Required of all students.

Digestion, function, and metabolism of proteins and amino acids, carbohydrates, lipids, minerals, and vitamins. Regulatory mechanisms, developmental changes, and species differences that influence the requirements and metabolism of nutrients. Effect of nutrient supply on metabolism at the molecular, cellular, and systemic levels, including special metabolic needs during growth, reproduction, stress, and senescence in animals and man.

16:709:601,602. NUTRITIONAL SCIENCES SEMINAR (1,2)

Seminar presentations on current nutrition research topics with emphasis on selection, preparation, and presentation.

16:709:603,604. ADVANCED STUDIES IN NUTRITION (BA,BA)

16:709:621. ADVANCED TOPICS: METABOLIC REGULATION (1)

Prerequisites: 16:709:552,553.

Informal, critical discussion and directed study of current literature and concepts in nutrient metabolism.

16:709:622. ADVANCED TOPICS IN MINERAL NUTRITION (1)

Prerequisites: 16:709:552,553.

Informal, critical discussion and directed study of current literature and concepts in mineral nutrition.

16:709:623. ADVANCED TOPICS: MOLECULAR NUTRITION (1)

Prerequisites: 16:709:552,553.

Informal, critical discussion and directed study of current literature and concepts in the nutritional control of gene expression.

16:709:624. ADVANCED TOPICS IN NUTRITIONAL SCIENCES (1)

Prerequisites: 16:709:552,553.

Informal, critical discussion and directed study in current areas of nutrition research.

16:709:625. RECENT ADVANCES IN NUTRITIONAL SCIENCES (1)

Prerequisites: 16:709:552,553, or permission of instructor.

Informal, critical discussion and directed study in nutritional sciences, ranging from specialized research approaches and techniques to aspects of national and international nutrition policy.

16:709:687,688. INDEPENDENT STUDIES IN NUTRITIONAL SCIENCES (3,3)

16:709:701,702. RESEARCH IN NUTRITIONAL SCIENCES (BA,BA)

OCEANOGRAPHY 712

Degree Programs Offered: Master of Science, Doctor of Philosophy

Director of Graduate Program: Professor Dale Haidvogel

Associate Director: Professor Gary Taghon, Marine Sciences Building, Cook Campus (732/932-6555)

Members of the Graduate Faculty

Kenneth W. Able, Professor of Marine and Coastal Sciences, CC; Ph.D.,

William and Mary

Ecology and behavior of fishes

Gail Ashley, Associate Professor of Geological Sciences, FAS-NB; Ph.D.,

British Columbia

Sedimentology; geomorphology; environmental ecology; modern processes

Roni Avissar, Professor of Meteorology, CC; Ph.D., Hebrew

Micrometeorology; boundary layer meteorology; atmospheric modeling

Scott M. Glenn, Associate Professor of Marine and Coastal Sciences, CC; Sc.D.,

Massachusetts Institute of Technology / Woods Hole Oceanographic Institution

Physical oceanography; satellite remote sensing

J. Frederick Grassle, Professor of Marine and Coastal Sciences, CC; Ph.D., Duke

Marine ecology; oceanography

Judith P. Grassle, Professor of Marine and Coastal Sciences, CC; Ph.D., Duke

Population genetics; marine benthic ecology

Dale B. Haidvogel, Professor of Marine and Coastal Sciences, CC; Ph.D.,

Massachusetts Institute of Technology / Woods Hole Oceanographic Institution

Physical oceanography; numerical ocean circulation modeling

Lee J. Kerkhof, Assistant Professor of Marine and Coastal Sciences, CC; Ph.D.,

California (San Diego) / Scripps Institution of Oceanography

Marine microbiology-molecular biology; microbial population dynamics

Uwe Kils, Associate Professor of Marine and Coastal Sciences, CC; Ph.D., Kiel

Behavior and microdistribution of juvenile fish; in situ-optics

David S. Kosson, Associate Professor of Chemical and Biochemical Engineering,

CE; Ph.D., Rutgers

Hazardous waste control

Richard Lutz, Professor of Marine and Coastal Sciences, CC; Ph.D., Maine

Marine ecology and paleoecology; shellfish ecology; biology of deep-sea

hydrothermal vents

George R. McGhee, Professor of Geological Sciences, FAS-NB; Ph.D., Rochester

Marine paleoecology; evolutionary theory; mass extinction

James R. Miller, Professor of Marine and Coastal Sciences, CC; Ph.D., Maryland

Air-sea interactions; remote sensing; climate modeling; earth system science

Kenneth G. Miller, Sr., Associate Professor of Geological Sciences, FAS-NB; Ph.D.,

Massachusetts Institute of Technology / Woods Hole Oceanographic Institution

Cenozoic stratigraphy and paleoceanography; integrated biostratigraphy,

isotope stratigraphy, magnetostratigraphy, and seismic stratigraphy

Michael R. Muller, Professor of Mechanical and Aerospace Engineering, CE;

Ph.D., Brown

Fluid mechanics; internal gravity waves and thermals

Andreas Münchow, Assistant Professor of Marine and Coastal Sciences, CC;

Ph.D., Delaware

Observational oceanography; dynamics of coastal oceans and estuaries

Karl F. Nordstrom, Associate Professor of Marine and Coastal Sciences, CC;

Ph.D., Rutgers

Geomorphology; sedimentology

Richard K. Olsson, Professor of Geological Sciences, FAS-NB; Ph.D., Princeton

Micropaleontology; stratigraphy; paleoecology; paleobathymetry of Cretaceous and

Cenozoic formations

Eric N. Powell, Professor of Marine and Coastal Sciences, CC; Ph.D.,

North Carolina (Chapel Hill)

Shellfish biology / modeling, carbonate preservation, reproductive biology

Norbert P. Psuty, Professor of Marine and Coastal Sciences, CC; Ph.D.,

Louisiana State

Coastal geomorphology; shoreline erosion; coastal zone management

Clare Reimers, Associate Professor of Marine and Coastal Sciences, CC; Ph.D.,

Oregon State

Marine geochemistry

Anna-Louise Reysenbach, Assistant Professor of Biochemistry and Microbiology,

CC/CTAG; Ph.D., Cape Town

Hydrothermal vent microbial ecology, thermophilic microorganisms

Peter A. Rona, Professor of Geological and Marine and Coastal Sciences, CC;

Ph.D., Yale

Structure and evolution of continental margins and ocean basins; ocean ridges

and seafloor hydrothermal processes

Oscar M.E. Schofield, Assistant Professor of Marine and Coastal Sciences, CC;

Ph.D., California (Santa Barbara)

Marine phytoplankton ecology; bio-optics; effects of ultraviolet radiation

on phytoplankton

Sybil P. Seitzinger, Visiting Professor of Marine and Coastal Sciences, CC; Ph.D.,

Rhode Island

Nutrient dynamics in marine, freshwater, and terrestrial ecosystems

Robert E. Sheridan, Professor of Geological Sciences, FAS-NB; Ph.D., Columbia

Geology and geophysics of the Atlantic continental margin

Robert Sherrell, Assistant Professor of Marine and Coastal Sciences, CC; Ph.D.,

Massachusetts Institute of Technology / Woods Hole Oceanographic Institution

Trace metals in the oceanic water column; environmental chemistry

Peter Smouse, Professor of Marine and Coastal Sciences, CC; Ph.D.,

North Carolina State

Genetics and ecology

Gary L. Taghon, Associate Professor of Marine and Coastal Sciences, CC; Ph.D.,

Washington (Seattle)

Marine benthic ecology

Christopher G. Uchir, Professor of Environmental Sciences, CC; Ph.D., Michigan

Mathematical modeling of contaminant transport in surface and ground waters

Robert J. Vrijenhoek, Professor of Marine and Coastal Sciences, CC;

Ph.D., Connecticut

Evolutionary genetics; ecology

Sam C. Wainright, Assistant Professor of Marine and Coastal Sciences, CC;

Ph.D., Georgia

Ecosystem ecology

Associate Members of the Graduate Faculty

Hernan G. Arango, Assistant Research Professor of Marine and Coastal Sciences, CC; Ph.D., Texas A&M

Development and application of ocean models and data assimilation
Jennifer A. Francis, Assistant Research Professor of Marine and Coastal Sciences, CC; Ph.D., Washington

Satellite remote sensing of polar regions; air/ice/ocean energy transfer
Mohamed Iskandarani, Assistant Research Professor of Marine and Coastal Sciences, CC; Ph.D., Cornell

Numerical modeling in fluids; pollutant/sediment transport; wave hydrodynamics
W. Waldo Wakefield, Assistant Research Professor of Marine and Coastal Sciences, CC; Ph.D., California (San Diego)/Scripps Institution of Oceanography

Biological oceanography; marine fisheries; deep-sea biology

Adjunct Member of the Graduate Faculty

Michael J. Kennish, Research Marine Scientist in Marine and Coastal Sciences, CC; Ph.D., Rutgers

Marine geology; estuarine and marine ecology; marine pollution

Programs

The program has a diverse faculty representing the major oceanographic disciplines including physical, biological, and chemical oceanography, geology and geophysics, and engineering. The faculty are all members of the Institute of Marine and Coastal Sciences, established in 1989 to foster interdisciplinary research and coordinate Rutgers' marine and coastal programs.

The M.S. and Ph.D. degrees are offered in two options, physical oceanography and biological oceanography; preference in admission is given to candidates seeking a Ph.D. Applicants are required to demonstrate a commitment to interdisciplinary studies that include study of the physical and dynamical behavior of ocean systems. Applicants to the physical oceanography sequence are expected to hold an undergraduate degree in mathematics, physical science, or engineering and to have completed two years of calculus (through differential equations) and one year each of physics and chemistry. Applicants in the area of biological oceanography are expected to hold an undergraduate degree in one of the biological sciences and have successfully completed courses (one year each) in calculus, physics, general chemistry, and organic chemistry. Applicants should show proficiency in a high-level computer language.

The Ph.D. requires a minimum of 72 credits of work beyond the bachelor's degree, including a minimum of 42 credits of Ph.D. thesis research. Qualifying examinations for the doctorate include both written and oral components. A typical program of course work includes new graduate-level courses within the Department of Marine and Coastal Sciences and related courses offered by other graduate programs such as Ecology and Evolution, Environmental Sciences, Mechanical and Aerospace Engineering, and Meteorology.

Research opportunities are available in a broad range of marine and coastal topics, including applied genetics and evolution, biogeochemistry, bottom boundary layer studies, coastal processes, community ecology, ecosystem-level studies, larval transport and recruitment, marine genetics, nutrient cycling, ocean modeling, physical oceanography, population biology, remote sensing, systematics, and fish biology.

A state-of-the-art research building on the Cook College campus includes sea-water, morphometrics, molecular biology, remote-sensing, ocean-modeling, and cartography laboratories. The institute's resources include a satellite receiving station and a network of small, medium, and large computer platforms including approximately eighty IBM and Mac PC systems, about twenty Unix-based workstations (IBM RS-6000s, Stardent Titan 3000s, and Sun Sparc Stations), and a 2048-node Connection Machine (CM-200).

In addition to the central campus in New Brunswick, research opportunities are provided at three field stations. The Rutgers University Marine Field Station, located at the northern entrance to Great Bay, is the site of a large tract of pristine marsh and a major estuary that retains most of its natural characteristics. An extensive program of long-term oceanographic and ecosystems research is underway at the station. Long-term ecosystem observatory sites (LEOs) have been established on the continental shelf, slope, and rise in conjunction with the New York Bight National Undersea Research Center. One of these sites (LEO-15) is connected to the Marine Field Station by electric/fiber optic cable, providing power and two-way communications with a variety of in-situ sensors.

The Rutgers University Haskin Shellfish Research Laboratory, located on Delaware Bay, has small boats and docking facilities. Research areas include microbiology, histopathology, shell structure, shellfish physiology, shellfish pathophysiology, analytical chemistry, cytogenetics, and biochemistry/physiology. Rutgers University Pineland Research Station, in Lebanon State Forest, is located near New Lisbon in the Pinelands National Reserve where there is ready access to a diversity of upland and wetland habitats.

Graduate Courses

16:712:501. (F) PHYSICAL OCEANOGRAPHY (3)

Glenn, Miller. Prerequisites: One year of college calculus; one year of college physics.

Physical properties and basic equations for describing waves, tides, currents, and the large-scale wind-driven and thermohaline circulation. Ekman, geostrophic, and inertial flows. Gulf Stream; air-sea interactions; El Niño.

16:712:502. (S) LARGE-SCALE OCEAN DYNAMICS (3)

Haidvogel. Prerequisite: 16:712:501 or permission of instructor. Offered in alternate years.

Observational basis for large-scale ocean circulation; derivation of oceanic equations of motion; Kelvin, planetary, and topographic waves; wind-driven ocean circulation; simple models of abyssal circulation and thermocline; instabilities and mesoscale eddies.

16:712:503. (S) COASTAL OCEAN DYNAMICS (3)

Münchow. Prerequisites: 16:712:501; 16:712:502 or 508. Offered in alternate years.

Observation basis and theoretical foundation of coastal ocean dynamics; tides; rotation; Kelvin and vorticity waves; buoyancy driven shelf flows forced by point (rivers) and line (glaciers) sources; fronts and plumes.

16:712:508. (S) REGIONAL OCEANOGRAPHY OF THE COASTAL OCEAN: AN INTRODUCTION (3)

Münchow. Prerequisite: 16:712:501. Offered in alternate years.

Tidal, wind, and density driven circulation and their biological and geological implications on the continental shelves of the Atlantic, Pacific, Indian, and Arctic oceans.

16:712:521. (S) MARINE BENTHIC ECOLOGY (3)

Taghon. Prerequisites: One year of college calculus; invertebrate zoology. Offered in alternate years.

Emphasis on fauna living in soft sediments: roles in nutrient cycling and marine food webs; feeding biology, reproduction, and recruitment; community structure as influenced by physical and chemical properties of the environment.

16:712:522. (S) BIOLOGICAL OCEANOGRAPHY (3)

Wainright. Prerequisite: One year of college biology. Offered in alternate years.

Interactions between biological, physical, and chemical components of the marine environment, including primary production and secondary production, biogeochemical cycles, food web interactions, and ecosystem analysis of selected marine ecosystems. Habitats considered include the open ocean, coastal waters, kelp beds, coral reefs, estuaries, the deep sea, and hydrothermal vent environments.

16:712:523. (F) PRIMARY PRODUCTION IN AQUATIC ECOSYSTEMS (3)

Schofield. Prerequisite: Permission of instructor. Offered in alternate years.

Regulation of phytoplankton productivity in nature; physiological ecology of phytoplankton in dynamic environments; impact of phytoplankton on water column optical and chemical properties; new technologies being used in fieldwork.

16:712:540. (S) CHEMICAL OCEANOGRAPHY (3)

Reimers. Prerequisites: One year of college chemistry; 16:712:501.

Chemical description of the ocean and its major chemical cycles; salinity and the elements of seawater; nutrients; the carbonate system; marine organic matter; radioisotopes; hydrothermal processes and ocean evolution.

16:712:545. (S) DYNAMICS OF WAVES, CURRENTS, AND SEDIMENT TRANSPORT ON THE CONTINENTAL SHELF (3)

Glenn. Prerequisite: 16:712:501. Offered in alternate years.
Equations of motion; linear theory for surface waves, wave boundary layers; current Ekman layers, coastal current circulation patterns; sediment transport in steady flow, oscillatory flow, and combined waves and currents.

16:712:603. (F) NUMERICAL MODELING OF THE ATMOSPHERE AND OCEAN I (3)

Avissar, Haidvogel. Prerequisites: 16:375:547, 16:712:601; or equivalent; proficiency in a high-level programming language. Offered in alternate years.
Governing equations of atmospheric/oceanic motion; simplification and scaling; parameterization issues; numerical solution of the equations; Fourier and spectral methods; evaluation of atmospheric and oceanic models.

16:712:604. NUMERICAL MODELING OF THE ATMOSPHERE AND OCEAN II (3)

Avissar, Haidvogel. Prerequisite: 16:712:603. Offered in alternate years.
Laboratory course for practical application of numerical approaches taught in 16:712:603, including literature review, problem formulation, model development, and synthesis and presentation of results.

16:712:615. GEOPHYSICAL DATA ANALYSIS (3)

Munchow. Prerequisites: Calculus; differential equations.
Analysis of equally and unequally spaced data; filters; FFT; spectra; linear systems theory; empirical orthogonal functions; harmonic analysis; grid interpolation techniques; emphasis on applied data analysis.

16:712:693,694. INDEPENDENT STUDY IN OCEANOGRAPHY (BA,BA)

16:712:695,696. SPECIAL PROBLEMS IN OCEANOGRAPHY (BA,BA)

16:712:697,698. TOPICS IN OCEANOGRAPHY (BA,BA)

16:712:701-702. RESEARCH IN OCEANOGRAPHY (BA,BA)

OPERATIONS RESEARCH 711

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Peter L. Hammer,
Center for RUTCOR Building, Brett and Bartholomew Roads,
Busch Campus (732/445-4812)

Members of the Graduate Faculty

Susan L. Albin, Associate Professor of Industrial and Systems Engineering, CE; D.E.Sc., Columbia

Queueing; simulation; quality control and reliability
Farid Alizadeh, Assistant Professor of Operations Research, RUTCOR; Ph.D., Minnesota

Combinatorial optimization; convex programming; computational biology
Tayfur Altioik, Assistant Professor of Industrial and Systems Engineering, CE; Ph.D., North Carolina State

Production lines; production/inventory systems; queueing networks
Ronald D. Armstrong, Professor of Management Science, FM/RUTCOR; Ph.D., Massachusetts

Network theory, integer programming and applications
Benjamin Avi-Itzhak, Professor of Management and Operations Research, FM/RUTCOR; D.Sc., Israel Institute of Technology

Stochastic models in operations research
Adi Ben-Israel, Professor of Operations Research, FM/RUTCOR; Ph.D., Northwestern

Matrix theory; convexity and optimization; mathematical programming; mathematical economics
Douglas H. Blair, Professor of Economics, FM/RUTCOR; Ph.D., Yale

Microeconomic theory; social choice theory
Endre Boros, Professor of Operations Research, RUTCOR/FM; Ph.D., Budapest

Discrete and combinatorial optimization; integer programming
Michael Lee Bushnell, Associate Professor of Electrical and Computer

Engineering, CE; Ph.D., Carnegie Mellon
VLSI design; testing of logic circuits; computer-aided design

Vasek Chvatal, Professor of Computer Science, FAS-NB; Ph.D., Waterloo
Algorithms; combinatorics; graph theory; operations research

Jonathan Eckstein, Assistant Professor of Management Science and Information Systems, FM/RUTCOR; Ph.D., Massachusetts Institute of Technology
Mathematical programming; parallel computing; convex analysis; proximal methods; applied combinatorial optimization

Michael R. Greenberg, Professor of Urban Planning and Public Health, EJBSPPP; Ph.D., Columbia

Environmental planning; public health
Michael D. Grigoriadis, Professor of Computer Science, FAS-NB; Ph.D., Wisconsin

Algorithms for network optimization
Peter L. Hammer, Professor of Mathematics and Computer Science Management and Director of the Center for Operations Research, RUTCOR/FM; Ph.D., Bucharest

Boolean methods in operations research; discrete optimization
Ronald Harstad, Associate Professor of Management, FM; Ph.D., Pennsylvania

Game theory; laboratory economics; auctions
Stephen J. Herschkorn, Assistant Professor of Management Science and Information Systems, FM/RUTCOR; Ph.D., California (Berkeley)

Sequential decision making under uncertainty; stochastic modeling; stochastic optimization
Alan Hoffman, Visiting Professor of Mathematics, RUTCOR; Ph.D., Columbia

Combinatorics and optimization; linear algebra
Douglas H. Jones, Associate Professor of Management, FM; Ph.D., Florida State

Psychometrics; integer programming applications to test construction; optimal experimental design; Bayesian methods; optimal financial portfolios
Jeffrey N. Kahn, Professor of Mathematics, FAS-NB; Ph.D., Ohio State

Matroids; extremal problems in set theory and graph theory; finite geometries
Paul Kantor, Professor of Library and Information Studies, SCILS; Ph.D., Princeton

Information and decision systems; information economics; library and information systems evaluation; system interfaces
Michael N. Katehakis, Associate Professor of Management, FM; Ph.D., Columbia

Dynamic programming reliability; queueing; sequential statistics; operations management
Leonid Khachiyan, Professor of Computer Science, FAS-NB; Ph.D., U.S.S.R.

Academy of Sciences
Mathematical programming; complexity; discrete optimization
Alexander Kogan, Assistant Professor of Management, FM; Ph.D., U.S.S.R.

Academy of Sciences
Expert systems; logical analysis of data; Boolean functions; combinatorial optimization; information systems
Cheng-few Lee, Professor of Finance, FM; Ph.D., SUNY (Buffalo)

Applying econometrics and economic theory in finance and accounting research
Lei Lei, Assistant Professor of Management Science, FM; Ph.D., Wisconsin (Madison)

Vehicle scheduling and cyclic scheduling; convex resource allocation and production planning algorithms
Richard McLean, Associate Professor of Economics, FAS-NB; Ph.D., SUNY (Stony Brook)

Game theory and its applications
Benjamin Melamed, Professor of Management Science and Information Systems, FM/RUTCOR; Ph.D., Michigan

Stochastic processes; modeling and simulation; telecommunications modeling; programming languages
Joseph I. Naus, Chairperson and Professor of Statistics, FAS-NB; Ph.D., Harvard

Applied probability; data quality control; clustering
Rosa Oppenheim, Professor of Operations Research, FM; Ph.D., Polytechnic Institute of Brooklyn

Mathematical programming; graph theory; forecasting
Lee Papayanopoulos, Associate Professor of Operations Research, FM; D.Sc., Columbia

Interactive optimization; voting reapportionment; social choice theory
Andras Prekopa, Professor of Operations Research and Statistics, FAS-NB; Ph.D., Budapest

Stochastic processes; stochastic optimization; linear and nonlinear programming; inventory control; applications to engineering design
Fred S. Roberts, Professor of Mathematics, FAS-NB, and Director of the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS); Ph.D., Stanford

Discrete mathematical models; graph theory; decision making; measurement theory
Michael H. Rothkopf, Professor of Management and Operations Research, FM/RUTCOR; Ph.D., Massachusetts Institute of Technology

Practice of operations research; models of bidding; energy economics
Michael E. Saks, Associate Professor of Mathematics, FAS-NB; Ph.D., Massachusetts Institute of Technology

Combinatorial optimization and algorithms; extremal set theory; partially ordered sets
Glenn Shafer, Professor of Management, FM; Ph.D., Princeton

Probability in statistical inference; expert systems; causal conjecture

David F. Shanno, Professor of Management and Operations Research, FM/RUTCOR; Ph.D., Carnegie-Mellon
 Linear and nonlinear programming; numerical analysis; parallel computing

Eduardo D. Sontag, Professor of Mathematics, FAS-NB; Ph.D., Florida System and control theory

William L. Steiger, Professor of Computer Science, FAS-NB; Ph.D., Australian National
 Algorithms; parallel computations; computational geometry

William E. Strawderman, Professor of Statistics, FAS-NB; Ph.D., Rutgers
 Decision theory; inference; multivariate statistics

Julius Surkis, Professor of Operations Research, FM; Ph.D., Polytechnic Institute of Brooklyn
 Scheduling, simulation

Hector J. Sussmann, Professor of Mathematics, FAS-NB; Ph.D., New York System and control theory

Hiroki Tsurumi, Professor of Economics, FAS-NB; Ph.D., Pennsylvania Bayesian econometrics and statistical inference

Yehuda Vardi, Professor of Statistics, FAS-NB; Ph.D., Cornell
 Stochastic modeling; applied probability; statistical theory and methods

Robert Vichnevetsky, Professor of Computer Science, FAS-NB; Ph.D., Brussels
 Numerical analysis; modeling and simulation of systems

Charles A. Weibel, Professor of Mathematics, FAS-NB; Ph.D., Harvard
 Algebraic K-theory; homological algebra; algebraic topology; category theory

Programs

The field of operations research is by nature an interdisciplinary one. It has its origins in the Second World War, when scientists, engineers, and mathematicians were asked to develop ways to make the most effective use of limited military resources. Since then, operations research has found widespread application in industry and government, in problems involving decisions about the use of scarce resources and problems involving complex design, allocation, planning, or logistics elements. Modern operations research is essential to improve the efficiency of business and government.

The faculty represented in the program work on a variety of research problems, from the theoretical to the applied. Recent faculty research interests include combinatorial optimization, linear and nonlinear programming, network optimization and synthesis, Boolean functions, integer programming, dynamic programming, graph theory, matroid theory, artificial intelligence and expert systems, mathematical models of social and policy problems, measurement theory, utility and decision making, social choice, game theory, computational complexity, queueing theory, stochastic processes and stochastic optimization, competitive bidding, statistical decision theory, design and analysis of surveys, random algorithms, economics of uncertainty, natural resources, numerical analysis, simulation, reliability theory, production analysis, inventory theory, scheduling, performance analysis, system theory, dynamic systems, and optimal control problems.

The Ph.D. program in operations research emphasizes both the theory and the practice of operations research. Doctoral students are exposed to theoretical and computational aspects of operations research, as well as to its applications. They are also expected to specialize by taking a series of courses chosen to complement their individual strengths and interests. Students are encouraged to get involved in the research activities of the Rutgers Center for Operations Research (RUTCOR) from the time of their arrival on campus.

The M.S. program in operations research is a more recent program than the Ph.D. program, and is currently being developed. It is planned that the degree will aim to prepare students for careers in industry and government that apply methods of operations research to practical problems. Students in the M.S. program are encouraged to take as many practically-oriented interdisciplinary operations research courses as possible and to participate in the various operations research programs at RUTCOR aimed at industry and government applications.

The major requirements for the Ph.D. involve course work (48 credits), research work (24 credits), a Ph.D. qualifying examination, and a dissertation. There is also a seminar requirement. The major requirements for the M.S. will involve course work (30 credits), an essay, and a final examination. The essay can be expository or it may involve the development of new theoretical results, software, computer implementation of algorithms, modeling, etc. There is also a seminar requirement.

A wide variety of courses related to operations research are given by the programs participating in RUTCOR and other departments at the university. In addition, students in the Ph.D. and M.S. programs may sign up for independent study courses for credit toward the 48-credit or 30-credit requirements. All students are also expected to be regular attendees and participate in RUTCOR's seminars and colloquia.

Admission to the M.S. and Ph.D. programs is awarded selectively by the admissions committee. Applicants to the M.S. program should have an undergraduate degree in one of the fields related to O.R., and applicants to the Ph.D. program should have either a bachelor's or a master's degree in one of these fields. Both programs are intended to be small and are aimed at a high-quality group of students. Applications should include transcripts, three letters of recommendation, and scores from the Graduate Record Examination, both the general test and a subject test in a field related to O.R. Foreign students should supply a score on the TOEFL. The official deadline for application is May 1, although this deadline is waived whenever possible for qualified students.

Students entering the programs in operations research are expected to have knowledge of undergraduate probability, statistics, advanced calculus, linear algebra, and introductory computer science. Up to four undergraduate courses at Rutgers may be taken for credit by students with a deficient undergraduate background.

Financial support for graduate study in operations research at Rutgers is coordinated through RUTCOR. Students are supported through teaching, graduate, and research assistantships in the participating departments of RUTCOR or in RUTCOR itself, research on faculty members' research projects, fellowships, and adjunct teaching jobs. Applications for financial support should be included with the application for admission, and are due by March 1 for the following academic year (beginning in September). Late applications for financial support are accepted as long as support is available.

Graduate Courses

16:711:513. (S) DISCRETE OPTIMIZATION (3)

Prerequisite: 16:198:521 or equivalent.

Develops the mathematical foundation of linear and nonlinear optimization procedures for problems in which the variables can only take on values in a finite set, usually $(0,1)$. A variety of algorithms are presented, along with numerous applications.

16:711:517. (F) COMPUTATIONAL PROJECTS IN OPERATIONS RESEARCH (2)

Staff. Prerequisite: 01:640:350 or 354.

Individual and group assignments; intensive computer practice; coding; programming.

16:711:525. (S) STOCHASTIC MODELS OF OPERATION RESEARCH (3)

Staff. Prerequisites: 01:640:477 or 16:960:654.

Overview of stochastic operations research model construction. Elements of queueing theory. Stochastic models of inventory and production control. Reliability models. Models in stochastic and dynamic programming. Stochastic simulation and its use in operations research.

16:711:547, 548. CASE STUDIES IN APPLIED OPERATIONS RESEARCH (3,3)

Prerequisites: Linear programming, probability, and computer programming.

Applications in operations research. Investigates the modeling process as it deals with economic uncertainties, missing information, risk, and priorities. The case study approach is used, with students writing "recommendation to management" reports. Guest lecturers from industry describe actual projects.

16:711:553. BOOLEAN AND PSEUDO-BOOLEAN FUNCTIONS (3)

Prerequisite: Permission of instructor. Recommended: 16:198:521, 16:642:581, or equivalent.

The theory and applications of Boolean functions and of set (or, pseudo-Boolean) functions. Important classes of such functions, e.g., threshold functions, are examined. Applications to graph theory, integer programming, and decision making.

16:711:555. (F) STOCHASTIC PROGRAMMING (3)

Prekopa. Prerequisites: 01:640:477, 16:198:521.

Decision principles in stochastic programming: penalty models, probabilistic constrained models, dynamic type models. Convexity theory and solutions of the relevant optimization problems by mathematical programming techniques. Applications in economics, business, and engineering.

16:711:556. (S) QUEUEING THEORY (3)

Avi-Itzhak. Prerequisites: 16:960:581 or 680.

Review of major properties of stochastic processes and Markovian-type queues. General theorems in the theory of queues. M/G/1 type systems. Priority disciplines. Conservative queues. Lindley's model. Ordering and monotonicity. Bounds and approximations. Tandem queues. Reversibility, symmetry, and networks. Applications.

916:711:601,602. SEMINAR IN OPERATIONS RESEARCH (0,0)

Prerequisite: Permission of instructor.

Regular participation in the colloquia and seminars run by RUTCOR is required of all M.S. and Ph.D. students.

16:711:611,612,613,614. SELECTED TOPICS IN OPERATIONS RESEARCH (BA,BA,BA,BA)

Prerequisite: Permission of instructor.

Topics of current interest relevant to operations research.

16:711:695,696,697,698,699. INDEPENDENT STUDY IN OPERATIONS RESEARCH (BA,BA,BA,BA,BA)

A course on a specialized topic in operations research individually designed with a supervising faculty member.

16:711:701,702. RESEARCH IN OPERATIONS RESEARCH (BA,BA)

See also courses listed under computer science, economics, industrial and systems engineering, statistics, and mathematics (applied mathematics), and in the doctoral program in management at Graduate School–Newark, including the following courses:

16:198:503. DATA STRUCTURES AND ALGORITHMS (3)

16:198:510. NUMERICAL ANALYSIS (3)

16:198:513. DESIGN AND ANALYSIS OF DATA STRUCTURES AND ALGORITHMS I (3)

16:198:517. QUEUEING SYSTEMS AND PERFORMANCE MODELS (3)

16:198:521. LINEAR PROGRAMMING (3)

16:198:522. NETWORK AND COMBINATORIAL OPTIMIZATION ALGORITHMS (3)

16:198:524. NONLINEAR PROGRAMMING ALGORITHMS (3)

16:198:538. COMPLEXITY OF COMPUTATION (3)

16:220:501. MICROECONOMIC THEORY I (3)

16:220:502. MICROECONOMIC THEORY II (3)

16:220:507. ECONOMETRICS I (3)

16:220:508. ECONOMETRICS II (3)

16:220:602. SEMINAR IN ECONOMETRICS (3)

26:390:571. SURVEY OF FINANCIAL THEORY (3)

16:540:510. DETERMINISTIC MODELS IN INDUSTRIAL ENGINEERING (3)

16:540:515. STOCHASTIC MODELS IN INDUSTRIAL ENGINEERING (3)

16:540:520. DESIGN OF PHYSICAL DISTRIBUTION SYSTEMS (3)

16:540:525. APPLIED QUEUEING THEORY (3)

16:540:530. FORECASTING AND TIME SERIES ANALYSIS (3)

16:540:555. SIMULATION OF PRODUCTION SYSTEMS (3)

16:540:565. FACILITIES PLANNING AND DESIGN (3)

16:540:585. SYSTEM RELIABILITY ENGINEERING I (3)

16:540:655. PERFORMANCE ANALYSIS OF MANUFACTURING SYSTEMS (3)

16:540:685. SYSTEM RELIABILITY ENGINEERING II (3)

26:630:576. QUANTITATIVE METHODS IN MARKETING (3)

16:642:573,574. NUMERICAL ANALYSIS (3,3)

16:642:577,578. SELECTED MATHEMATICAL TOPICS IN SYSTEM THEORY (3,3)

16:642:581. APPLIED GRAPH THEORY (3)

16:642:582,583. COMBINATORICS I, II (3,3)

16:642:585. MATHEMATICAL MODELS OF SOCIAL AND POLICY PROBLEMS (3)

16:642:586. THEORY OF MEASUREMENT (3)

16:642:587. SELECTED TOPICS IN DISCRETE MATHEMATICS (3)

26:711:561. FUNDAMENTALS OF OPTIMIZATION (3)

26:711:585. CONTROL MODELS IN OPERATIONS MANAGEMENT (3)

26:711:586. PLANNING MODELS IN OPERATIONS MANAGEMENT (3)

26:711:676. STATISTICAL ASPECTS OF STOCHASTIC SIMULATION (3)

16:960:563. REGRESSION ANALYSIS (3)

16:960:575. ACCEPTANCE SAMPLING THEORY (3)

16:960:580. BASIC PROBABILITY (3)

26:960:580. STOCHASTIC PROCESSES (3)

16:960:582. THEORY OF STATISTICS I (3)

16:960:583. THEORY OF STATISTICS II (3)

16:960:586,587. INTERPRETATION OF DATA I, II (3,3)

16:960:652,653. ADVANCED THEORY OF STATISTICS I, II (3,3)

16:960:595. INTERMEDIATE PROBABILITY (3)

16:960:654. STOCHASTIC PROCESSES (3)

16:960:663. REGRESSION THEORY (3)

PACKAGING SCIENCE AND ENGINEERING

Programs

Academic and research training in the area of packaging science and engineering for master's candidates is available at Rutgers, The State University of New Jersey, in the following programs of the Graduate School–New Brunswick: ceramic science and engineering, food science, industrial and systems engineering, materials science and engineering, and pharmaceutical science.

Degree requirements are set in accordance with the graduate program to which the student is admitted. The student electing this option enrolls in an interdisciplinary program that includes core courses in business, science, and engineering and a concentration in one of the six participating disciplines. Coordination among the five faculties sponsoring the packaging option provides maximum flexibility and variety in the arrangement of individual degree programs.

For a Master of Science degree, a student must be admitted to, and meet the requirement of, one of the following programs of the Graduate School–New Brunswick: ceramic science and engineering, food science, industrial and systems engineering, mechanics and materials science, or pharmaceutical science. This requires a minimum of 18 credits involving courses in the degree program unrelated to packaging. The student must also meet the following common core requirements: the courses in packaging engineering, 16:150:571,572; the seminars in packaging, 16:150:581,582; the materials and design in packaging courses, 16:150:577,578; and either the special problems in packaging courses, 16:150:587,588, or the research thesis on packaging as approached through the departmental specialization.

The interaction of packaging and the environment is a broad subject of common concern underlying all programs that feature the option in packaging. Within this area, students are expected

initially to indicate which one of the following three concentrations they wish to explore: packaging science and technology, packaging and production engineering, or packaging and marketing/management. For further information, the interested student should contact the director of one of the above programs or Professor James D. Idol, College of Engineering, Busch Campus (732/445-3224).

PHARMACOLOGY, CELLULAR AND MOLECULAR 718

Degree Programs Offered: Doctor of Philosophy

Director of Graduate Program: Professor N. Ronald Morris,
Department of Pharmacology, University of Medicine and
Dentistry of New Jersey–Robert Wood Johnson Medical School
(732/235-4590)

Members of the Graduate Faculty

Charles O. Brostrom, Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Illinois
Intracellular signaling systems; regulation of protein synthesis

Margaret A. Brostrom, Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Illinois
Stress responses of excitable cells

Edward T. Browning, Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Illinois
Pharmacology of the glial cell; biochemistry of synaptic transmission

Khew-Voon Chin, Assistant Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Rutgers
Drug resistance; gene amplification; regulation of gene expression

Allan H. Conney, Professor of Pharmacology, CP; Ph.D., Wisconsin
Cytochromes P-450 and drug metabolism; chemical carcinogenesis

Marc R. Gartenberg, Assistant Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Yale
Nuclear organization of DNA; chromosome structure; yeast plasmid segregation

Herbert M. Geller, Professor of Pharmacology and Neurology, UMDNJ-RWJMS;
Ph.D., Case Western Reserve
Developmental and cellular neurobiology

William N. Hait, Professor of Medicine and Pharmacology, UMDNJ-RWJMS;
M.D., Ph.D., Medical College of Pennsylvania
Calcium-calmodulin-mediated signal transduction and drug resistance;
cancer pharmacology

Frederick C. Kauffman, Professor of Pharmacology, CP; Ph.D., Illinois
Influence of intermediary metabolism on xenobiotic metabolism; neurotoxicity

Jeffrey D. Laskin, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., SUNY (Buffalo)
Carcinogenesis and differentiation in cell culture

John Lenard, Professor of Physiology, UMDNJ-RWJMS; Ph.D., Cornell
Enveloped RNA viruses; transcription, replication, entry, and assembly

Alice Y.-C. Liu, Professor of Biological Sciences, FAS-NB; Ph.D., Mount Sinai
Molecular and cell biology of aging

Leroy F. Liu, Professor and Chairperson of Pharmacology, UMDNJ-RWJMS;
Ph.D., California (Berkeley)
DNA topoisomerases and control of cell division; cancer pharmacology

Peter Lobel, Associate Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Columbia
Intracellular targeting of proteins; mannose 6-phosphate receptors

Randall D. McKinnon, Assistant Professor of Neurosurgery, UMDNJ-RWJMS;
Ph.D., McMaster
The role of polypeptide growth factors in oligodendrocyte development

N. Ronald Morris, Professor of Pharmacology, UMDNJ-RWJMS; M.D., Yale
Molecular genetics of nuclear migration, mitosis, and microtubules

William R. Moyle, Professor of Obstetrics and Gynecology, UMDNJ-RWJMS;
Ph.D., Harvard
Hormonal control of gene expression; structure and function of human
chorionic gonadotropin

William J. Nicklas, Professor of Neurology and Pharmacology, UMDNJ-RWJMS;
Ph.D., Fordham
Neurotoxicity; CNA amino acid metabolism; neuronal-glial interactions

Larissa A. Pohorecky, Professor of Neuropharmacology, CAS; Ph.D., Chicago
Alcohol and psychological stress on brain monoamines and behavior

Tariq M. Rana, Assistant Professor of Pharmacology, UMDNJ-RWJMS; Ph.D.,
California (Davis)
Drug design; artificial proteolysis; RNA-protein interactions in HIV

Alexey G. Ryazanov, Assistant Professor of Pharmacology, UMDNJ-RWJMS;
D.Sci., Moscow State
Regulation of protein synthesis and the cell cycle

Eric H. Rubin, Assistant Professor of Medicine, UMDNJ-RWJMS; M.D.,
South Florida
Clinical and molecular approaches to inhibition of DNA topoisomerases

Marilyn M. Sanders, Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Washington
Fungal topoisomerases; stress-altered translation and gene expression

Stephen M. Shea, Professor of Pathology, UMDNJ-RWJMS; M.D.,
National University of Ireland (Galway)
Transport systems of endothelial surfaces; glomerular filtration

Tetsuo Shimamura, Professor of Pathology, UMDNJ-RWJMS; M.D., Yokohama
Structure and function of the renal medulla; urine-concentrating mechanisms

Patricia K. Sonsalla, Associate Professor of Neurology, Psychiatry, and
Pharmacology, UMDNJ-RWJMS; Ph.D., Utah
Neurotoxicology; monoamines and CNS function

Nancy C. Walworth, Assistant Professor of Pharmacology, UMDNJ-RWJMS;
Ph.D., Yale
Control of cell cycle progression in yeast

Donald J. Wolff, Professor of Pharmacology, UMDNJ-RWJMS; Ph.D., Wisconsin
Pharmacology of nitric oxide synthesis; calcium/calmodulin dependent processes

Chung S. Yang, Professor of Pharmacognosy, CP; Ph.D., Cornell
Nitrosamines; carcinogenesis; molecular biology of cytochrome P-4507

Associate Member of the Graduate Faculty

Jerome Parness, Assistant Professor of Anesthesia, Pharmacology, and Pediatrics,
UMDNJ-RWJMS; M.D., Ph.D., Yeshiva (Einstein)
Regulation of intracellular calcium pools

Programs

Graduate studies in pharmacology are conducted by faculty of Rutgers, The State University of New Jersey, and of the University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School. Areas of research specialization currently emphasized are molecular, cellular, and neuropharmacology. Investigations focus on drug metabolism, intracellular signaling systems, protein synthesis and processing, carcinogenesis, and the control of cell growth, division, differentiation, and DNA replication; and the biochemical basis of Parkinson's disease, addiction, and adverse drug reactions.

Applicants who have completed a bachelor's degree in biology, chemistry, or neuroscience are viewed as optimal candidates for admission. However, those with undergraduate training in related areas are also acceptable candidates provided deficiencies are eliminated during the first year of study.

The Ph.D. program requires a minimum of 72 credits, including 32 credits of course work. At least 24 credits of advanced research must be conducted during one year of residence. Admission to candidacy for the Ph.D. requires the satisfactory completion of course work and a qualifying examination that includes the defense of a detailed research proposal. The doctoral dissertation is based on original laboratory research.

Joint Ph.D. degrees are awarded in this program. See related information at the beginning of this chapter.

In addition to the courses listed below, students draw upon courses offered in other graduate programs, such as biochemistry and molecular biology, computer science, microbiology, neuroscience, physiology, and toxicology. Students are encouraged to participate in seminar programs and journal clubs.

Students other than transfers or M.D./Ph.D. candidates will generally enter the program through the recruitment process of the core curriculum in molecular biosciences. Upon completing the requirements of the core (one year), students opting to specialize in cellular and molecular pharmacology must select a faculty adviser from the program.

Graduate Courses

16:718:522. (S) PHARMACOLOGY (6)

Prerequisites: Permission of graduate director and instructor.

The principles of drug action illustrated by study of basic actions and properties of established therapeutic agents. Demonstrations, clinical case studies, and problem sessions supplement lecture material.

16:718:562. ADVANCED PHARMACOLOGY LABORATORY (3)

Prerequisite: Permission of instructor.

16:718:564. (S) ADVANCED TOPICS IN PHARMACOLOGY (3)
Prerequisites: Permission of graduate director and instructor.
Macroaspects of pharmacology, with emphasis on the interaction of drugs with physiological and pathological processes.

16:718:565,566. ADVANCED PROBLEMS IN PHARMACOLOGY (BA,BA)
Prerequisites: Permission of graduate director and instructor.
Independent research with a faculty member on some aspect of a research problem. With minimum supervision, student is expected to analyze, interpret, and report the experimental data.

16:718:571,572. SPECIAL TOPICS IN CELLULAR AND MOLECULAR PHARMACOLOGY (2,2)
Prerequisite: One year of biochemistry. Required of all degree candidates.
A literature review of specialized aspects of molecular, cellular, and neuropharmacology. Subject matter changes each term.

16:718:573. RECEPTOR LIGAND-PROTEIN INTERACTIONS (2)
Lenard, Lobel. Prerequisite: Permission of instructor.
Readings, seminars, and discussions based on the primary literature emphasize current understanding of and methodology for investigating membrane structure, receptor classification, and the principles of ligand-receptor interactions. Emphasis on the mathematics used to analyze receptor-binding experiments. The dopamine receptor serves as a focus for much of the discussion.

16:718:574. PHARMACOLOGY OF NEUROTRANSMISSION (2)
Geller, Nicklas. Prerequisite: Permission of instructor.
Seminar presentations consider the mechanisms of synaptic transmission in the nervous system, the role of voltage- and ligand-gated ion channels, and G-protein coupled receptors in information transmission. Material includes the regulation of the synthesis, storage, release, and destruction of neurotransmitters.

16:718:575. INTRACELLULAR SIGNALING SYSTEMS (2)
Wolff. Prerequisite: Permission of instructor.
Seminar presentations consider intracellular second messenger systems that mediate hormonally induced cellular responses; the role of G-proteins, tyrosine kinases, cAMP, Ca²⁺, and phosphoinositides in transducing regulatory signals and promoting post-translational modification of proteins.

16:718:576. PHARMACOLOGY OF GROWTH CONTROL (2)
L. Liu, Walworth. Prerequisite: Permission of instructor.
Agents that promote or retard cell division including anti-cancer treatments, oncogens, tumor suppressors, and growth factors. Alteration of cellular growth by carcinogenesis.

16:718:577. PHARMACOLOGY OF SUBCELLULAR ORGANELLES (2)
C. Brostrom, M. Brostrom. Prerequisite: Permission of instructor.
Readings, seminars, and discussions emphasize selected papers from the primary literature pertaining to subcellular organelle structure, function, and responses to pharmacologic substances. Topics include the structure and function of the endoplasmic reticulum, its role in calcium homeostasis and protein processing for secretion, and the golgi system.

16:718:578. METABOLISM OF FOREIGN SUBSTANCES (2)
Conney, Kauffman. Prerequisite: Permission of instructor.
Readings, seminars, and discussions emphasize selected papers from the primary literature pertaining to the metabolism of foreign chemicals. Critical discussions of publications that describe the properties and regulation of foreign compound-metabolizing enzymes in microorganisms, plants, insects, lower mammals, and humans. Consideration of the significance of these enzymes for the metabolism and action of foreign chemicals and endogenous substrates in intact cells and organisms.

16:718:602. SEMINAR IN PHARMACOLOGY (1)
Faculty and student presentations.

16:718:603. CANCER PHARMACOLOGY (2)
Chin. Prerequisite: Permission of instructor.
Pharmacological aspects of oncogenes and tumor suppressor genes, regulation of gene expression, carcinogenesis and tumor igenesis, drug target interaction and the consequential development of resistance to cytotoxic chemotherapeutic drugs in cancer.

16:718:604. PHARMACOLOGY OF THE CELL CYCLE (2)
Morris, Ryazanov. Prerequisite: Permission of instructor.
Biology, pharmacology, and molecular biology of the cell cycle.

16:718:605. NUCLEIC ACIDS (2)
Gartenberg, Rana. Prerequisite: Permission of instructor.
Basic principles of the secondary and tertiary structures of nucleic acids used to explore aspects of nucleic acid biology such as protein-nucleic acid interactions, RNA-catalyzed reactions, and nucleic acid pharmacology.

16:718:606. PHARMACOLOGY OF LOCAL CELL INTERACTIONS (2)
Browning. Prerequisite: Permission of instructor.
Local cellular interactions that mediate processes of development, function, and pathophysiology of mammalian tissues. Strategies for pharmacological modulation of these interactions.

16:718:701,702. RESEARCH IN PHARMACOLOGY (BA,BA)

PHARMACEUTICAL SCIENCE 720

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Edmund J. LaVoie,
Pharmacy Building, Busch Campus (732/445-3831)

Members of the Graduate Faculty

Philip A. Babcock, Associate Professor of Pharmacognosy, CP; Ph.D., Iowa
Pharmacognosy
Leonard C. Bailey, Professor of Pharmaceutical Chemistry, CP; Ph.D., Rutgers
Pharmaceutical analysis
Metin Celik, Assistant Professor of Pharmaceutics, CP; Ph.D., Leicester Polytechnic
Pharmaceutical technology
Yie W. Chien, Parke-Davis Professor of Pharmaceutics, CP; Ph.D., Ohio State
Controlled systemic delivery of pharmaceuticals and therapeutic peptides
John L. Colaizzi, Professor of Pharmacy and Dean of the College of Pharmacy;
Ph.D., Purdue
Applied pharmacokinetics and biopharmaceutics
Edmond J. LaVoie, Chairperson and Professor of Medical Chemistry, CP; Ph.D.,
SUNY (Buffalo)
Metabolism and structure-activity studies of pharmacological agents
Nicholas G. Lordi, Glaxo Professor of Pharmaceutics, CP; Ph.D., Purdue
Pharmaceutics
Thomas Medwick, Professor of Pharmaceutical Chemistry, CP; Ph.D., Wisconsin
Pharmaceutical analysis
Joseph E. Rice, Associate Professor of Medicinal Chemistry, CP; Ph.D.,
Polytechnic Institute of New York
Synthetic organic chemistry as applied to problems of biological interest
Bartley J. Sciarone, Professor of Pharmacy, CP; Ph.D., Wisconsin
Pharmaceutics
Patrick J. Sinko, Assistant Professor of Pharmaceutics, CP;
Ph.D., Michigan
Biopharmaceutics; intestinal absorption mechanism; peptide drug analog and
anti-HIV drug metabolism
Kyonghee Son, Assistant Professor of Pharmaceutics, CP; Ph.D., Illinois
Pharmaceutics
Eric H. Weyand, Associate Professor of Pharmaceutical Chemistry, CP; Ph.D.,
Virginia Polytechnic Institute
In vivo and in vitro metabolism of drugs and xenobiotics
Joel L. Zatz, Chairperson and Professor of Pharmaceutics, CP; Ph.D., Columbia
Pharmaceutics, percutaneous absorption and topical drug delivery

Associate Members of the Graduate Faculty

- Albert Cuitiño, *Assistant Professor of Mechanical and Aerospace Engineering, CE; Ph.D., Brown*
Computational solid mechanics
- Fernando Muzzio, *Associate Professor of Chemical and Biochemical Engineering, CE; Ph.D., Massachusetts (Amherst)*
Mixing; chaos and randomness; transport phenomena
- S. David Kimball, *Research Group Leader, Squibb Institute for Medical Research; Ph.D., SUNY (Stony Brook)*
Novel agents for the treatment of hypertension, myocardial ischemia, arrhythmia, and other cardiovascular diseases
- Richard E. Riman, *Associate Professor of Ceramic Science and Engineering, CE; Ph.D., Massachusetts Institute of Technology*
Synthesis; intelligent process modeling and control

Programs

Programs leading to the Master of Science and Doctor of Philosophy degrees in pharmaceuticals, industrial pharmacy, pharmaceutical chemistry, and medicinal chemistry, are available to full- and part-time students with undergraduate pharmacy degrees. Applicants who have degrees in the physical or biological sciences may be accepted with the proviso that certain undergraduate courses be satisfactorily completed during the first two years. Areas of research specialization include pharmacokinetics, controlled drug release technology, packaging and related problems, surface chemistry, percutaneous absorption, structure-activity relations, drug analysis, drug synthesis, and isolation and identification of natural products.

Degree requirements for the M.S. degree normally include a minimum of 24 credits of course work and completion of an original research problem and thesis (6 credits).

The Ph.D. program normally requires a minimum of 48 credits of course work and 24 credits of research beyond the baccalaureate degree. For the Ph.D., a residence requirement of one academic year must be satisfied, preferably after completion of most of the required course work.

Academic and research training in the area of packaging science and engineering is available in this program. For further information concerning this option, refer to Packaging Science and Engineering in this chapter of the catalog.

In addition to the courses described below, students will normally draw upon courses offered in other graduate programs, such as chemistry, biochemical engineering, food science, pharmacology, and toxicology.

In addition to the degrees of Master of Science and Doctor of Philosophy with specialization in Pharmaceutical Science, offered by the Graduate School—New Brunswick, a professional Doctor of Pharmacy (Pharm.D.) degree in clinical pharmacy is offered by the College of Pharmacy. For further information about the Doctor of Pharmacy degree, contact Dr. Joseph Barrone at 732/445-3285.

Graduate Courses

16:720:507. ADVANCED PHARMACEUTICS (3)

Lordi. Prerequisites: Physical chemistry and associated math requirements. The application of physical-chemical principles to the study and evaluation of pharmaceutical systems: solubility phenomena, equilibria, complexation, phase transitions, and pharmaceutical stability, and the fundamentals of pharmacokinetics.

16:720:510. ADVANCED PHARMACOKINETICS (3)

Prerequisites: 01:160:327,328.
Kinetics of drug absorption, distribution, and elimination; clearance concepts; compartmental, noncompartmental, and physiological models.

16:720:511,512. PHARMACEUTICAL FORMULATIONS (4,4)

Lordi. Lec. 2 hrs., con. 1 hr., lab. 3 hrs. Prerequisites: 16:720:508, 516.
Design and development of pharmaceutical dosage forms.

16:720:515,516. PHARMACEUTICAL PROCESSES AND EQUIPMENT (2,2)

Celik. Lec. 2 hrs., lab. 3 hrs.
The various processes utilized in pharmaceutical manufacturing, including the basic principles involved and the equipment used.

16:720:517,518. PHARMACEUTICAL PROCESSES AND EQUIPMENT LAB (1,1)

16:720:520. THERAPEUTIC PEPTIDES AND DELIVERY SYSTEMS (3)

Chien, special invited lecturer. Prerequisites: 01 or 11:115:301; 30:721:301,302, 403,404, or permission of instructor.
Study of biochemical, biopharmaceutical, and pharmacologic bases of peptide- and protein-based macromolecular drugs, and application of multidisciplinary approaches to their formulation, development, and systemic delivery.

16:720:522. CONTROLLED DRUG DELIVERY TECHNOLOGY (3)

Chien. Prerequisites: 16:720:507, 515,516.
Multidisciplinary approaches to concepts, fundamentals, and biomedical assessments in the research and development of novel drug delivery systems.

16:720:523. DERMACEUTICS (3)

Zatz. Prerequisite: 16:720:507 or permission of instructor.
Design of topical drug delivery systems; theoretical and practical considerations in development of topical disperse systems; skin permeation of drugs and its optimization; dermatologic and cosmetic applications.

16:720:525. INTRODUCTION TO EXPERIMENTAL SURGERY (3)

Weyand. Prerequisite: Permission of instructor.
Experimental surgical techniques commonly used in research laboratories. Emphasis on aseptic surgery techniques, survival surgery, and chronic cannulation procedures.

16:720:531. ADVANCED PHARMACOGNOSY I (4)

Lec. 3 hrs., lab. 3 hrs. Prerequisite: 30:717:405.
A study of the natural occurrence and the chemistry of the major groups of alkaloids, including the isolation, purification, and characterization of alkaloids and alkaloid-like substances from natural sources.

16:720:532. ADVANCED PHARMACOGNOSY II (4)

Lec. 3 hrs., lab. 3 hrs. Prerequisite: 30:717:405.
A study of the major occurrence and the chemistry of the major classes of nonalkaloids, including the isolation, purification, and characterization of nonalkaloid chemical compounds from natural sources.

16:720:540. INDEPENDENT RESEARCH PROPOSAL (3)

Enrollment limited to Ph.D. candidates with approval of their adviser.
Develop a written research proposal using the standard HHS/NIH format as part of the Ph.D. degree requirements. Proposal is evaluated as to its originality, scientific merit, and quality.

16:720:581. ADVANCED PHARMACEUTICAL ANALYSIS (3)

Bailey, Medwick. Lec. 3 hrs. Prerequisites: 01:160:323,324 or 327,328 or 341,342.
A survey of instrumental design with emphasis on instrumental capabilities related to the parameter to be measured. Selected electrometric, spectrometric, and separation methods of interest in pharmaceutical analysis.

16:720:582. ADVANCED PHARMACEUTICAL ANALYSIS LABORATORY (1)

16:720:591. ADVANCED MEDICINAL CHEMISTRY I (3)

LaVoie, Rice, Kimball
Qualitative and quantitative structure-biological activity relationships and their utility in drug design.

16:720:592. ADVANCED MEDICINAL CHEMISTRY II (3)

Rice, LaVoie
A strategy-based approach to synthetic organic medicinal chemistry.

16:720:601,602. SEMINAR IN PHARMACEUTICAL SCIENCE (1,1)

Presentation and discussion of recent developments in the pharmaceutical sciences.

16:720:607,608. SPECIAL TOPICS (3,3)

Selected topics in pharmaceutical science.

16:720:610,611. INDEPENDENT STUDY IN PHARMACEUTICAL SCIENCE (BA,BA)

No more than 3 credits may be taken as part of a student's program. Independent library and/or laboratory research into special aspects of pharmaceutical science; arranged under the supervision of a specific faculty member.

16:720:612,613. CURRENT TOPICS IN PHARMACEUTICAL SCIENCE (1,1)

Seminar with lectures by scientists from the pharmaceutical industry on advanced topics within a particular area of pharmaceutical science, such as medicinal chemistry, pharmaceutical analysis, and pharmaceuticals.

16:720:701,702. RESEARCH IN PHARMACEUTICAL SCIENCE (BA,BA)

PHILOSOPHY 730

Degree Programs Offered: Master of Arts, Doctor of Philosophy

Director of Graduate Program: Professor Brian Loar, Davison Hall, Douglass Campus (732/932-9181)

Members of the Graduate Faculty

Martha Bolton, Professor of Philosophy, FAS-NB; Ph.D., Michigan
Early modern philosophy

Robert H. Bolton, Professor of Philosophy, FAS-NB; Ph.D., Michigan

Ancient philosophy; philosophy of language; metaphysics
Martin R. Bunzl, Professor of Philosophy, FAS-NB; Ph.D., Minnesota
Philosophy of science

Ruth Chang, Assistant Professor of Philosophy, FAS-NB/SL-C; J.D., Harvard;
D.Phil., Oxford
Philosophy of law; ethics

Frances Egan, Associate Professor of Philosophy, FAS-NB; Ph.D., Western Ontario
Philosophy of psychology; philosophy of mind; philosophy of science

Seymour Feldman, Professor of Philosophy, FAS-NB; Ph.D., Columbia

Medieval and seventeenth-century philosophy; philosophy of religion
Jerry A. Fodor, Professor of Philosophy, FAS-NB; Ph.D., Princeton

Philosophy of mind; cognitive psychology
Richard Foley, Dean of the Faculty of Arts and Sciences–New Brunswick,
Dean of the Graduate School–New Brunswick, and Professor of Philosophy,
FAS-NB; Ph.D., Brown
Epistemology

Jorge Garcia, Professor of Philosophy, FAS-NB; Ph.D., Yale
Ethics; philosophy of law

Mary B. Gibson, Associate Professor of Philosophy, FAS-NB; Ph.D., Princeton
Social/political/feminist/Marxist philosophy; reproductive practices; autonomy

Richard Henson, Professor Emeritus of Philosophy, FAS-NB; Ph.D., Yale
Ethics; social and political philosophy

Nancy Holmstrom, Associate Professor of Philosophy, FAS-N; Ph.D., Michigan

Social and political philosophy; Marxism; feminist theory
Douglas N. Husak, Professor of Philosophy, FAS-NB; Ph.D., J.D., Ohio State

Philosophy of law; social and political philosophy; ethics

Peter Kivy, Professor of Philosophy, FAS-NB; Ph.D., Columbia
Aesthetics; early modern philosophy

Peter D. Klein, Professor of Philosophy, FAS-NB; Ph.D., Yale
Epistemology

Ernest P. Lepore, Professor of Philosophy, FAS-NB; Ph.D., Minnesota
Philosophy of language

Brian Loar, Professor of Philosophy, FAS-NB; D.Phil., Oxford
Philosophy of mind; philosophy of language; metaphysics

Barry M. Loewer, Professor of Philosophy, FAS-NB; Ph.D., Stanford
Philosophy of science; logic; philosophy of mind

Robert Matthews, Chairperson and Professor of Philosophy, FAS-NB;
Ph.D., Cornell

Philosophy of psychology and language; theoretical psycholinguistics

Tim Maudlin, Professor of Philosophy, FAS-NB; Ph.D., Pittsburgh

Philosophy of science; ancient philosophy; epistemology

Howard McGary Jr., Professor of Philosophy, FAS-NB; Ph.D., Minnesota

Social and political philosophy; ethics; Afro-American philosophy

Colin McGinn, Professor of Philosophy, FAS-NB; B.Phil., Oxford

Philosophy of mind; metaphysics; Wittgenstein

Brian P. McLaughlin, Professor of Philosophy, FAS-NB; Ph.D. North Carolina

Metaphysics; epistemology

Stephen Neale, Professor of Philosophy, FAS-NB; Ph.D., Stanford

Logic; philosophy of language

Kenneth J. Safir, Professor of Linguistics, FAS; Ph.D., Massachusetts Institute

of Technology

Frederic Schick, Professor of Philosophy, FAS-NB; Ph.D., Columbia

Decision theory; social and political philosophy

Fadlou A. Shehadi, Professor Emeritus of Philosophy, FAS-NB; Ph.D., Princeton

Islamic philosophy; aesthetics; phenomenology and existentialism

Laurent Stern, Professor of Philosophy, FAS-NB; Ph.D., Zurich

Aesthetics; phenomenology; modern philosophy

Stephen P. Stich, Professor of Philosophy, FAS-NB; Ph.D., Princeton

Epistemology; philosophy of psychology

Albert Sweet, Professor of Philosophy, FAS-N; Ph.D., Emory

Logic; philosophy of science

Simon Thomas, Professor of Mathematics, FAS-NB; Ph.D., London

Model theory; infinite groups

Pheroze S. Wadia, Professor of Philosophy, FAS-N; Ph.D., New York

Philosophy of religion; theory of knowledge

Renee Weber, Professor Emerita of Philosophy, FAS-NB; Ph.D., Columbia

Existentialism; interdisciplinary and comparative philosophy

Bruce Wilshire, Professor of Philosophy, FAS-NB; Ph.D., New York

Aesthetics; American philosophy; phenomenology and existentialism

John W. Yolton, Professor Emeritus of Philosophy, FAS-NB; Ph.D., Oxford

Epistemology; early modern philosophy

Associate Members of the Graduate Faculty

Pierre Pellegrin, Visiting Professor of Philosophy, FAS-NB; Professor
of Philosophy, CREA (France); Ph.D., Paris I

Ancient philosophy

Michael D. Rohr, Associate Professor of Philosophy, FAS-N; Ph.D., Stanford

Ancient philosophy; theory of knowledge

Andrew von Hirsch, Professor of Criminal Justice, SCI; L.L.B., Harvard

Philosophy of criminal law; criminal sentencing theory and policy

Robert L. Woolfolk, Professor of Psychology, FAS-NB; Ph.D., Texas (Austin)

Behavioral therapy

Roger Woolhouse, Visiting Professor of Philosophy, FAS-NB; Professor

of Philosophy, York (UK); Ph.D., Cambridge

Seventeenth- and eighteenth-century philosophy

Programs

The faculty in philosophy offers a comprehensive program of doctoral studies in the principal branches of the subject, organized to encourage breadth of background prior to specialization, providing a wide range of special options in the later stages of study and research, and complemented by advanced studies in the related humanities and sciences offered by other faculties in the Graduate School–New Brunswick. A normal program leading to the Ph.D. requires 48 credits (sixteen courses) to be pursued four courses per term (or three courses per term for students appointed to teaching assistantships) and 24 credits of research. There is no additional residency requirement.

Applicants with distinguished undergraduate records who lack certain prerequisites for graduate study in philosophy may be accepted with the stipulation that they remedy such deficiencies with undergraduate courses taken without graduate credit.

There are five requirements in the doctoral program: the course requirement, the distribution requirement, the area of concentration requirement, a literature review, and the dissertation. Successful completion of both the area of concentration requirement and the literature review constitute the graduate school's requirement for passing a qualifying examination.

To complete the course requirement, students are required to pass sixteen courses (48 credits) that have been approved by the department.

To complete the distribution requirement, students are required to pass, with a grade of B or better, one designated 500-level course in each of six specific areas and at least two 500- or 600-level courses in four of these same areas. The areas of distribution are:

1. ancient/medieval philosophy (up until 1600 A.D.);
2. modern philosophy;
3. logic and philosophy of language;
4. epistemology and philosophy of science;
5. metaphysics and philosophy of mind; and
6. ethics and value theory.

To complete the area of concentration requirement, students must demonstrate that they have competence in one of the six areas of distribution listed above by passing a comprehensive examination for that area.

The literature review is written after completing the area of concentration requirement. The student selects a fairly specific (but not overly specific) topic in one of the six categories listed above. The graduate director, with the agreement of the student, appoints a committee of three faculty members; two faculty members from within the area of literature review and one faculty member from outside the area of review. The committee constructs a list of relevant literature. Typically, this consists of twenty or so papers and a few books. The student then writes a critical review of this literature, approximately thirty pages long.

After all of the above requirements have been completed, the final requirement is a dissertation judged to be publishable so far as scholarship, style, and originality are concerned. When a student has reached the dissertation stage, the director of the graduate program, in consultation with the student, appoints a dissertation committee, with one member designated as dissertation adviser, to direct the student's work on the dissertation. Before proceeding with the dissertation, the student must submit a dissertation proposal for formal approval by the committee. The completed dissertation must be approved by all members of the committee.

To obtain a Master of Arts in Philosophy degree a student must: a) satisfy all of the master's degree area distribution course requirements (this includes nine courses in philosophy); b) pass with grades of B or better 30 credits of courses approved by the philosophy department; c) pass either the area of concentration requirement or the literature review requirement. This requirement constitutes the comprehensive examination.

Graduate Courses

16:730:510. (F) MATHEMATICAL LOGIC (3)

An introduction to the basic results of mathematical logic including completeness, undecidability, and Gödel's theorems.

16:730:513. (F) LOGIC AND NATURAL LANGUAGE (3)

Prerequisite: 16:730:510.

Logic as a tool in the semantic analysis of natural language; relation between symbolic and natural languages.

16:730:520. SEMINAR IN PLATO (3)

A study of representative works from the main periods of Plato's thought.

16:730:521. SEMINAR IN ARISTOTLE (3)

A study of some main works of central importance in the Aristotelian Corpus.

16:730:526. SEMINAR IN MEDIEVAL PHILOSOPHY (3)

Medieval metaphysics; philosophy of nature and epistemology; time and eternity; the infinite; creation; causality; skepticism.

16:730:530. SEMINAR IN SEVENTEENTH-CENTURY PHILOSOPHY (3)

Examination of a major philosopher, work, or topic of the period. Emphasis on metaphysics and epistemology; connections with other problems in philosophy and the natural sciences.

16:730:533. SEMINAR IN EIGHTEENTH-CENTURY PHILOSOPHY (3)

Examination of a major philosopher, work, or topic of the period. Emphasis on metaphysics and epistemology; connections with other problems in philosophy and the natural sciences.

16:730:536. SEMINAR IN NINETEENTH-CENTURY PHILOSOPHY (3)

From post-Kantian idealism to the early stages of phenomenology.

16:730:550. SEMINAR IN EPISTEMOLOGY (3)

Nature of justification, belief, and truth; rival accounts of knowledge; traditional and contemporary perspectives on empiricism, rationalism and pragmatism, and skepticism.

16:730:553. SEMINAR IN METAPHYSICS (3)

The problem of universals. The concepts of the infinite, time, causality, notions of possibility and necessity, and counterfactuals.

16:730:556. SEMINAR IN PHILOSOPHY OF SCIENCE (3)

Philosophical problems connected with modern science.

16:730:570. SEMINAR IN PHILOSOPHY OF LANGUAGE (3)

The nature and varieties of linguistic meaning; signs and symbols; speech acts criteria of meaningfulness.

16:730:575. SEMINAR IN PHILOSOPHY OF MIND (3)

Contemporary discussions of cognitive and noncognitive mental activities and their influences on behavior; analyses of self-knowledge and self-deception; theories of mind-body identity.

16:730:580. SEMINAR IN ETHICS (3)

Typically concerned with several philosophers, e.g., Aristotle, Hume, Kant, Mill, or problems, e.g., rights, justice, virtue, relativism, nihilism, utilitarianism.

16:730:583. SEMINAR IN SOCIAL AND POLITICAL PHILOSOPHY (3)

Some recent philosophical theories and their relevance to contemporary issues in social science and politics.

16:730:585. SEMINAR IN PHILOSOPHY OF LAW (3)

The concept of law and criteria of legal validity. Relation of these issues to questions of political obligation and the limits of judicial discretion.

16:730:590. SEMINAR IN AESTHETICS (3)

A study of representation, interpretation, and evaluation. The definition and the ontology of art. Expressive properties, artistic qualities, metaphorical expressions.

16:730:595. SEMINAR ON TEACHING (N3)

Techniques and problems of teaching philosophy to undergraduates.

16:730:601,602. SPECIAL STUDIES IN PHILOSOPHY (BA,BA)

16:730:620. ADVANCED TOPICS IN PLATO (3)

Intensive study of selected dialogues or topics in Plato's philosophy.

16:730:621. ADVANCED TOPICS IN ARISTOTLE (3)

Intensive study of selected works or topics in Aristotle's philosophy.

16:730:624. ADVANCED TOPICS IN ANCIENT PHILOSOPHY (3)

Detailed examination of selected central issues or writers, such as Parmenides and the early pluralists, theories of language, early Stoics, ancient Scepticism.

16:730:626. ADVANCED TOPICS IN MEDIEVAL PHILOSOPHY (3)

Detailed examination of selected central topics in metaphysics, philosophy of nature, and epistemology. Readings in translations from original sources.

16:730:630. ADVANCED TOPICS IN SEVENTEENTH-CENTURY PHILOSOPHY (3)

Detailed examination of a problem, e.g., Descartes' theory of method, Spinoza's doctrine of substance and attributes, controversies about the nature of time and space.

16:730:633. ADVANCED TOPICS IN EIGHTEENTH-CENTURY PHILOSOPHY (3)

Detailed examination of a problem, e.g., Berkeley's and Hume's attack on abstract ideas, Kant's refutation of idealism, issues in the theory of perception.

16:730:636. ADVANCED TOPICS IN NINETEENTH-CENTURY PHILOSOPHY (3)

Post-Kantian philosophy from Fichte to Nietzsche. The new social sciences; theories of interpretation; anticipations of twentieth-century philosophy.

16:730:640. ADVANCED TOPICS IN AMERICAN PHILOSOPHY (3)

Reception and transformation of European world views by American philosophers from Peirce to Dewey. Emphasis on notions of meaning, truth, freedom, and education.

16:730:645. ADVANCED TOPICS IN CONTINENTAL PHILOSOPHY (3)
Husserl's different conceptions of philosophy. Existential phenomenology: Heidegger and Merleau-Ponty. Contemporary Marxism. The tension between analytic and continental thought.

16:730:648. ADVANCED TOPICS IN ANALYTIC PHILOSOPHY (3)
Writings of such authors as Russell, Moore, Carnap, Wittgenstein, Ryle, and Strawson.

16:730:650. ADVANCED TOPICS IN EPISTEMOLOGY (3)
Detailed examination of selected central issues or writers, such as scepticism, causal theories of perception and knowledge, epistemic rationality, Wittgenstein's On Certainty.

16:730:653. ADVANCED TOPICS IN METAPHYSICS (3)
Intensive examination of one or two selected issues in contemporary metaphysics.

16:730:656. ADVANCED TOPICS IN PHILOSOPHY OF SCIENCE (3)
Intensive examination of one or two selected issues in contemporary philosophy of science.

16:730:658. ADVANCED TOPICS IN PHILOSOPHY OF PHYSICS (3)
Philosophical issues related to particular areas of both classical and modern physics. Discussions of relativity and quantum theory.

16:730:660. ETHICS AND LITERATURE (3)
Examination of ethical issues as they arise within literary texts, focusing on the nature of evil, questions of character and motivation, and the way such matters are treated by literary works.

16:730:664. ADVANCED TOPICS IN PHILOSOPHY OF SOCIAL SCIENCE (3)
Intensive examination of one or two selected issues in contemporary philosophy of social science.

16:730:667. ADVANCED TOPICS IN PHILOSOPHY OF HISTORY (3)
Conceptions of historical knowledge from the early nineteenth century to the present; explanation and understanding; narration and description in historical writings; limits of historical understanding.

16:730:670. ADVANCED TOPICS IN PHILOSOPHY OF LANGUAGE (3)
Intensive examination of one or two selected issues in contemporary philosophy of language.

16:730:675. ADVANCED TOPICS IN PHILOSOPHY OF MIND (3)
Intensive examination of one or two selected issues in contemporary philosophy of mind.

16:730:676. ADVANCED TOPICS IN THE PHILOSOPHY OF PSYCHOLOGY (3)
Examination of selected topics in the philosophy of psychology, focusing especially on issues in the foundations of cognitive/computational psychology. Topics include representationalism, learnability theory, the innateness controversy.

16:730:678. ADVANCED TOPICS IN DECISION THEORY (3)
The logic of choice and of action; valuation and probability; risk and uncertainty; coherence and rationality. Survey of current theories and of outstanding problems.

16:730:679. TOPICS IN LOGIC (3)
Survey of a variety of topics in logic.

16:730:680. ADVANCED TOPICS IN ETHICS (3)
Intensive examination of one or two selected issues in contemporary ethics.

16:730:683. ADVANCED TOPICS IN SOCIAL AND POLITICAL PHILOSOPHY (3)
Intensive examination of one or two selected issues in contemporary social and political philosophy.

16:730:685. ADVANCED TOPICS IN PHILOSOPHY OF LAW (3)
Limits of state authority in the context of criminal law. Conduct beyond criminal sanction. Discussions of paternalism, obscenity, negligence, strict liability, mistake, excuses, justifications, harm.

16:730:690. ADVANCED TOPICS IN AESTHETICS (3)
A study of representation, interpretation, and evaluation. The definition and the ontology of art. Expressive properties, artistic qualities, metaphorical expressions.

16:730:692. ADVANCED TOPICS IN INTERPRETING: THEORY AND PRACTICE (3)
Development of our notions of interpretation since the late eighteenth century. The search for a theory supporting interpretive decisions. Sceptical challenges raised against such theories.

16:730:693. ADVANCED TOPICS IN PHILOSOPHY OF RELIGION (3)
Detailed examination of a problem in the contemporary literature, e.g., divine omniscience, religion and morality, problem of evil, the nature of religious belief.

16:730:695. PROSEMINAR IN PHILOSOPHY (3)
Open only to upper-level Ph.D. students in philosophy.
An advanced seminar in which students present their dissertation research.

16:730:701,702. RESEARCH IN PHILOSOPHY (BA,BA)

PHYSICS AND ASTRONOMY 750

Degree Programs Offered: Master of Science, Master of Science for Teachers, Doctor of Philosophy
Director of Graduate Program: Professor Jolie A. Cizewski,
Serin Physics Laboratories, Busch Campus (732/445-2502);
e-mail: graduate@physics.rutgers.edu

Members of the Graduate Faculty

Elihu Abrahams, Bernard Serin Professor of Physics and Astronomy, FAS-NB; Ph.D., California (Berkeley)
Theoretical condensed-matter physics
Eva Y. Andrei, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Rutgers
Experimental condensed-matter physics
Natan Andrei, Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Theoretical condensed-matter and particle physics
Thomas Banks, Professor of Physics and Astronomy, FAS-NB; Ph.D., Massachusetts Institute of Technology
Theoretical elementary particle physics
Robert A. Bartynski, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Pennsylvania
Experimental condensed-matter physics
John B. Bronzan, Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Theoretical elementary particle physics
Herman Y. Carr, Professor Emeritus of Physics and Astronomy, FAS-NB; Ph.D., Harvard
Experimental condensed-matter physics
Sang-Wook Cheong, Professor of Physics and Astronomy, FAS-NB; Ph.D., California (Los Angeles)
Experimental condensed matter physics and material science
Jolie A. Cizewski, Associate Chairperson and Professor of Physics and Astronomy, FAS-NB; Ph.D., SUNY (Stony Brook)
Experimental nuclear physics
Piers Coleman, Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Theoretical condensed-matter physics
John Conway, Assistant Professor of Physics and Astronomy, FAS-NB; Ph.D., Chicago
Experimental elementary particle physics
Mark C. Croft, Professor of Physics and Astronomy, FAS-NB; Ph.D., Rochester
Experimental condensed-matter physics
Thomas J. Devlin, Professor of Physics and Astronomy, FAS-NB; Ph.D., California (Berkeley)
Experimental elementary particle physics
Michael R. Douglas, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., California Institute of Technology
Theoretical elementary particle physics

Glennys Farrar, Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Theoretical elementary particle physics

Daniel Friedan, Professor of Physics and Astronomy, FAS-NB; Ph.D., California (Berkeley)
Theoretical elementary particle physics

Eric Garfunkel, Associate Professor of Chemistry, FAS-NB; Ph.D., California (Berkeley)
Experimental surface science

Michael E. Gershenson, *Assistant Professor of Physics and Astronomy, FAS-NB; Ph.D., Institute of Radio Engineering and Electronics (Moscow)*
Experimental condensed-matter physics

Ronald Gilman, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Pennsylvania
Experimental nuclear physics

Charles M. Glashauser, Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Experimental nuclear physics

Torgny Gustafsson, Professor of Physics and Astronomy, FAS-NB; D.Sc., Chalmers (Sweden)
Experimental condensed-matter physics

David R. Harrington, Professor of Physics and Astronomy, FAS-NB; Ph.D., Carnegie Institute of Technology
Theoretical nuclear physics

B. Jane Hinch, Assistant Professor of Chemistry, FAS-NB; Ph.D., Cambridge
Surface studies using atomic and molecular scattering

George K. Horton, Professor of Physics and Astronomy, FAS-NB; Ph.D., Birmingham
Theoretical condensed-matter physics

John Hughes, *Assistant Professor of Physics and Astronomy, FAS-NB; Ph.D., Columbia*
Observational astrophysics

Lev Ioffe, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Landau Institute for Theoretical Physics
Condensed-matter theory

Shirley A. Jackson, Professor of Physics and Astronomy, FAS-NB; Ph.D., Massachusetts Institute of Technology
Theoretical condensed-matter physics

Charles L. Joseph, Assistant Research Professor of Physics and Astronomy, FAS-NB; Ph.D., Colorado
Observational astronomy and detector development

Mohan S. Kalelkar, Professor of Physics and Astronomy, FAS-NB; Ph.D., Columbia
Experimental elementary particle physics

Willem M. Kloet, Professor of Physics and Astronomy, FAS-NB; Ph.D., Utrecht
Theoretical nuclear physics

Haruo Kojima, Associate Dean and Professor of Physics and Astronomy, FAS-NB; Ph.D., California (Los Angeles)
Experimental condensed-matter physics

Noémie Koller, Professor of Physics and Astronomy, FAS-NB; Ph.D., Columbia
Experimental nuclear physics

B. Gabriel Kotliar, Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Theoretical condensed-matter physics

Theodore H. Kruse, Professor of Physics and Astronomy, FAS-NB; Ph.D., Columbia
Experimental nuclear physics

Antti Kupiainen, Professor of Mathematics and Physics and Astronomy, FAS-NB; Ph.D., Princeton
Statistical mechanics theory; mathematical physics

David C. Langreth, Professor of Physics and Astronomy, FAS-NB; Ph.D., Illinois
Theoretical condensed-matter physics

Paul L. Leath, Chairperson and Professor of Physics and Astronomy, FAS-NB; Ph.D., Missouri
Theoretical condensed-matter physics

Joel L. Lebowitz, George William Hill Professor of Mathematics and Physics and Astronomy, FAS-NB; Ph.D., Syracuse
Mathematical physics and statistical mechanics

Peter Lindenfeld, Professor of Physics and Astronomy, FAS-NB; Ph.D., Columbia
Experimental condensed-matter physics

Claud W. Lovelace, Professor of Physics and Astronomy, FAS-NB; B.S., Capetown
Theoretical elementary particle physics

Theodore E. Madey, State of New Jersey Professor of Surface Science and Director of the Laboratory for Surface Modification, FAS-NB; Ph.D., Notre Dame
Experimental surface science physics

Terry A. Matilsky, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Observational astrophysics

Aram Z. Mekjian, Professor of Physics and Astronomy, FAS-NB; Ph.D., Maryland
Theoretical nuclear physics

David R. Merritt, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Princeton
Theoretical astrophysics

Daniel E. Murnick, Professor of Physics, FAS-N; Ph.D., Massachusetts Institute of Technology
Experimental nuclear and atomic physics

Herbert Neuberger, Professor of Physics and Astronomy, FAS-NB; Ph.D., Tel Aviv
Theoretical elementary particle physics

Joe Pifer, Associate Chairperson and Professor of Physics and Astronomy, FAS-NB; Ph.D., Illinois
Experimental condensed-matter physics

Richard J. Plano, Professor of Physics and Astronomy, FAS-NB; Ph.D., Chicago
Experimental elementary particle physics

Carlton P. Pryor, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Harvard
Observational astrophysics

Ronald D. Ransome, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Texas (Austin)
Experimental nuclear physics

Allen B. Robbins, Professor of Physics and Astronomy, FAS-NB; Ph.D., Yale
Experimental nuclear physics

Ronald M. Rockmore, Professor of Physics and Astronomy, FAS-NB; Ph.D., Columbia
Theoretical nuclear physics

Andrei E. Ruckenstein, Professor of Physics and Astronomy, FAS-NB; Ph.D., Cornell
Theoretical condensed-matter physics

Joseph V. Sak, Professor of Physics and Astronomy, FAS-NB; Ph.D., Institute of Solid State Physics (Prague)
Theoretical condensed-matter physics

Stephen R. Schnetzer, Professor of Physics and Astronomy, FAS-NB; Ph.D., California (Berkeley)
Experimental elementary particle physics

Nathan Seiberg, Professor of Physics, Institute for Advanced Study; Ph.D., Weizmann Institute of Science
Theoretical elementary particle physics

Jeremy Sellwood, Associate Professor of Physics and Astronomy, FAS-NB; Ph.D., Manchester
Theoretical astrophysics

Joel A. Shapiro, Professor of Physics and Astronomy, FAS-NB; Ph.D., Cornell
Theoretical elementary particle physics

Earl D. Shaw, Professor of Physics, FAS-N; Ph.D., California (Berkeley)
Experimental laser physics

Stephen H. Shenker, Professor of Physics and Astronomy, FAS-NB; Ph.D., Cornell
Theoretical elementary particle physics

Sunil Somalwar, Assistant Professor of Physics and Astronomy, FAS-NB; Ph.D., Chicago
Experimental particle physics

Michael J. Stephen, Professor of Physics and Astronomy, FAS-NB; Ph.D., Oxford
Theoretical condensed-matter physics

Georges M. Temmer, University Professor Emeritus; Ph.D., California (Berkeley)
Experimental nuclear physics

Gordon Thomson, Professor of Physics and Astronomy, FAS-NB; Ph.D., Harvard
Experimental elementary particle physics

David Vanderbilt, Professor of Physics and Astronomy, FAS-NB; Ph.D., Massachusetts Institute of Technology
Experimental condensed matter physics

Russell E. Walstedt, Distinguished Visiting Scientist in Physics and Astronomy, FAS-NB; Ph.D., California (Berkeley)
Experimental condensed matter physics

Terence L. Watts, Professor of Physics and Astronomy, FAS-NB; Ph.D., Yale
Experimental elementary particle physics

Theodore Williams, Professor of Physics and Astronomy, FAS-NB; Ph.D., California Institute of Technology
Observational astrophysics

Larry Zamick, Professor of Physics and Astronomy, FAS-NB; Ph.D., Massachusetts Institute of Technology
Theoretical nuclear physics

Alexander Zamolodchikov, Professor of Physics and Astronomy, FAS-NB; Ph.D., Institute of Theoretical and Experimental Physics (Moscow)
Theoretical elementary physics

Harold S. Zapolsky, Professor of Physics and Astronomy, FAS-NB; Ph.D., Cornell
Theoretical astrophysics

Frank M. Zimmerman, *Assistant Professor of Physics and Astronomy, FAS-NB; Ph.D., Cornell*
Experimental surface-science physics

Programs

The research activities of the program are both theoretical and experimental and cover the main areas of interest in contemporary physics, including astrophysics, condensed matter and statistical physics, surface physics, elementary particle physics, and nuclear physics. Experimental facilities are located on campus in Serin, a modern research laboratory. A new surface modification and interface dynamics laboratory houses 1.7 MeV tandemron and 400- keV ion accelerators as well as scanning tunneling microscopes

and other surface analytical equipment. There are also several mK-range dilution refrigerators available that are used in low-temperature physics studies. Nuclear structure experiments are carried out at accelerators at Yale University and the Argonne and Lawrence Berkeley National Laboratories. Intermediate energy experiments are done at the continuous electron beam facilities at Mainz and Jefferson Laboratory in Virginia. Elementary particle physics experiments are carried out at the Fermi National Accelerator Laboratory and the Stanford Linear Accelerator Center. Rutgers astrophysicists use the observatory facilities at Kitt Peak and Cerro-Tololo (Chile).

The program for the master's degree requires a minimum of 30 credits and includes either a critical essay or a thesis on a research problem.

The program for the Ph.D. degree requires a dissertation and an appropriate combination of course work and research credits. The qualifying examination is given in two parts, written and oral. Courses in other programs may be added to those conducted by the graduate program in physics and astronomy on the approval of the graduate director. Ph.D. candidates are normally expected to spend at least one year in full-time residence, although this requirement may be waived by the graduate studies committee. There is no language requirement. The Master of Philosophy degree is available to doctoral candidates.

Teaching assistantships or research fellowships are available for both first-year and advanced graduate students; virtually all students receive financial support. Assistants spend no more than fifteen hours per week on their duties and normally take 6 to 10 credits of graduate courses each term; fellowships normally do not entail special duties, and those who hold fellowships can devote their entire time to course work and to research related to their Ph.D. dissertation.

Applications should include the results of the general aptitude test and the advanced physics test of the Graduate Record Examination. Applicants whose native language is not English are required to take the TOEFL examination. Further information on these and other matters may be found in the Graduate Program in Physics, a brochure available from the program director or the graduate admissions office.

Graduate Courses

16:750:501,502. QUANTUM MECHANICS (3,3)

Bronzan. Prerequisite: 01:750:417 or equivalent.

Historical introduction; waves and wave packets; one-dimensional problems; representation theory; angular momentum and spin; time-dependent and time-independent perturbation theory, the WKB approximation; atomic and molecular systems; theory of scattering; semiclassical theory of radiation; Dirac equation.

16:750:503. (F) ELECTRICITY AND MAGNETISM I (3)

Sak. Prerequisite: 01:750:386 or equivalent.

Advanced electromagnetic theory and related mathematical techniques. Boundary value problems in electrostatics and magnetostatics. Complex variables. Green's functions, multipole expansions. Maxwell's equations and plane electromagnetic waves; waveguides.

16:750:504. (S) ELECTRICITY AND MAGNETISM II (3)

Sak. Prerequisite: 16:750:503.

Radiation. Detailed discussion of special relativity, including space-time diagrams, covariance and invariance, twin paradox, uniform acceleration, motion of a charged particle, stress-energy tensors. Radiation by moving charges, bremsstrahlung, multipole fields, radiation damping.

16:750:505. (S) QUANTUM ELECTRONICS (3)

Prerequisites: 01:750:405, 417, or equivalent.

Modern optics; atomic and solid-state phenomena; masers, lasers, theory of amplification, oscillation, coherence; photon correlations; nonlinear optics. Electron and nuclear magnetic resonance. Tunneling phenomena.

16:750:506. (S) MODERN EXPERIMENTAL TECHNIQUES (4)

Ransome. Prerequisites: 01:750:326, 388, or equivalent.

Modern instruments and techniques in experimental physics. Topics include passive network theory and transient and steady state response analysis; transmission lines; operational amplifiers; digital circuits; a detailed study of noise; phase sensitive detection, including lock-in amplifiers and signal averagers; low-level measurement techniques, including quantum interference devices; particle detection techniques.

16:750:507. (F) CLASSICAL MECHANICS (3)

Zapolsky. Prerequisite: 01:750:382 or equivalent.

Advanced classical mechanics: Lagrangian mechanics, calculus of variations. Hamilton's equations, canonical transformations, Hamilton-Jacobi theory, small oscillations. Rigid body motion.

16:750:509. (F) PHYSICS APPLICATION OF COMPUTERS (3)

Kotliar. Lec. 2 hrs., lab. 3 hrs. Prerequisite: Programming experience.

Survey of applications. Survey of hardware and software of a computer installation; interactive computing. Advanced Fortran, program structures, style, documentation, debugging. Machine language basics, data acquisition, equipment control. Use of data tapes, data processing. Monte Carlo techniques. Statistics and data fitting. Basic numerical methods. Laboratory: programming on several computers. Broadens knowledge of applications and facilitates development of techniques.

16:750:511. (F) TOPICS IN MATHEMATICAL PHYSICS (3)

Zapolsky. Prerequisites: 01:640:403, 423, or equivalent.

Functions of a complex variable, contour integration, calculus of residues, conformal mapping with applications to electrostatics, magnetostatics, and fluid dynamics in two dimensions. Solution of boundary-value problems of physics by integral equation methods, construction of Green's functions. Fourier and Laplace transform theory with applications to harmonic motion, electrostatics, heat conduction, circuits, and transients.

16:750:523. (F) TECHNIQUES IN EXPERIMENTAL PHYSICS (3)

Prerequisite: Elementary physics laboratory. Not intended for students in the Ph.D. program.

Electronics as it is used in experimental physics. Transistors and their equivalent circuits, amplifiers, networks, digital logic, light and particle detectors, low-level measurements including quantum interference devices.

16:750:524. (S) TOPICS IN PHYSICS (3)

Not intended for students in the Ph.D. program.

A "self-paced" course in which the student studies independently. The faculty act as "tutors," providing help as needed and administering examinations. The subject matter is divided into units, covering a wide range of subjects drawn from classical and modern physics. The units are chosen in consultation with an adviser, taking into account the background and interests of each student.

16:750:541. (S) INTRODUCTORY ASTROPHYSICS (3)

Pryor. Prerequisites: 01:750:382, 386, or equivalent.

Introduction to stellar astrophysics and modern astronomy. Stellar interiors, nucleosynthesis, energy transport, stellar evolution, white dwarfs, neutron stars, and black holes. Other topics of current interest from astrophysics.

16:750:601,602. (F) SOLID-STATE PHYSICS (3,3)

Vanderbilt. Prerequisites: 16:750:502, and 01:750:351 or equivalent.

Introduction to crystal lattices, scattering of radiation, lattice dynamics, electron bands, interaction among elementary excitations, disordered systems, transport properties, superconductivity and superfluidity, magnetism, crystal-field effects, phase transitions, optical properties.

16:750:603. (S) SOLID-STATE PHYSICS (3)

Abrahams

Advanced treatment of the areas surveyed in 16:750:601 and their extension to topics of current interest in solid-state physics.

- 16:750:605. (F) NUCLEAR PHYSICS (3)
Zamick. Prerequisite: 16:750:502 or equivalent.
Survey of essential topics: properties of ground states, shell model, collective model, electromagnetic properties, sample excitations, compound-nucleus and direct reactions, beta decay. Additional topics may include alpha decay, fission, applications of nuclear physics, topics of current interest.
- 16:750:606. (S) NUCLEAR PHYSICS (3)
Advanced treatment of some topics discussed in 16:750:605, together with additional topics chosen in consultation with students.
- 16:750:607. (F) GALACTIC DYNAMICS (3)
Sellwood. Prerequisites: 16:750:341-342, 507, or equivalents.
Equilibrium and stability of stellar systems and the dynamical evolution of galaxies. Modern approach to dynamics with a few practical examples of chaotic systems.
- 16:750:608. (F) COSMOLOGY (3)
Sellwood. Prerequisites: 16:750:341-342 or equivalent.
Models of the universe, their fundamental parameters, and their estimation from observations. Evolution of the universe from soon after its formation to the present. Growth of structure and the formation of galaxies.
- 16:750:609. (F) FLUID AND PLASMA PHYSICS (3)
Sellwood. Prerequisite: 16:750:507 or equivalent.
The fundamental physical properties of liquids, gases, and ionized systems. Includes selected topics from compressible and incompressible flow, electromagnetic interactions, instabilities, turbulence, nonequilibrium phenomena, kinetics, superfluid mechanics, related experimental techniques, and other topics of current interest in fluid and plasma research.
- 16:750:610. (S) INTERSTELLAR MATTER (3)
Williams. Prerequisite: 16:750:541 or equivalent.
Structure of the interstellar medium: its molecular, neutral atomic, and plasma phases. Radiative transfer, dust, particle acceleration, magnetic fields, and cosmic rays. Effects of supernovae, shock fronts, and star formation.
- 16:750:611. (S) STATISTICAL MECHANICS (3)
Shenker. Prerequisites: 16:750:501 and 507.
Statistical methods and probability; the statistical basis for irreversibility and equilibrium; ensemble theory; statistical thermodynamics; classical and quantum statistics; the density matrix; applications of statistical mechanics to nonideal gases, condensed matter, nuclei and astrophysics; fluctuations, nonequilibrium statistical mechanics; kinetic theory.
- 16:750:612. (S) HIGH-ENERGY ASTROPHYSICS (3)
Hughes. Prerequisites: 16:750:341-342 or equivalent.
The origin and detection of high energy photons and particles in the universe. Radiation processes in low density media. Sites of high energy phenomena in astrophysics, such as supernovae, pulsars, active galactic nuclei and quasars, and processes, such as accretion and shocks.
- 16:750:613. (S) PARTICLES (3)
Farrar. Prerequisite: 16:750:502 or equivalent.
Introduction to the concepts and techniques underlying current research in elementary particles. Assumes knowledge of quantum mechanics, scattering theory, and nuclear spectroscopy. Properties of particles and their interactions based on the standard model of strong and electroweak interactions. Conservation laws. Discussion of specific experiments illustrating the standard model.
- 16:750:615. (F) OVERVIEW OF QUANTUM FIELD THEORY (3)
Farrar. Prerequisite: 16:750:502 or equivalent.
Lorentz group; relativistic wave-equations; second quantization; global and local symmetries; QED and gauge invariance; spontaneous symmetry breaking; nonabelian gauge theories; Standard Model; Feynman diagrams; cross sections, decay rates; renormalization group.
- 16:750:616. (S) FIELDS I (3)
Banks. Prerequisite: 16:750:615.
Path integral quantization; perturbation theory: dimensional regularization, renormalization; the renormalization group; spontaneous symmetry breaking and effective potential; critical behavior of ferromagnets; f^4 field theory; Yang-Mills perturbation theory.
- 16:750:617. (F) GENERAL THEORY OF RELATIVITY (3)
N. Andrei. Prerequisites: 16:750:504, 507, or equivalent.
Equivalence principle, tensor analysis with differential forms; review of special relativity and electromagnetism, affine connection and geodesic equation; curvature and geodesic deviation; Einstein field equations; Schwarzschild and Kerr solutions, homogeneous isotropic cosmologies; experimental and observational tests.
- 16:750:618. (S) APPLIED GROUP THEORY (3)
Shapiro. Prerequisite: 16:750:502 or equivalent.
Abstract groups and their representations, finite groups and Lie algebras; symmetries and currents; symmetric group, in homogeneous Lorentz group, SU(n); classification of Lie algebras, Dynkin diagrams. Spontaneous symmetry breaking mechanisms. Gauge theories.
- 16:750:619. (F) FIELDS II (3)
Zamolodchikov. Prerequisite: 16:750:616.
Renormalization group applied to Yang-Mills; asymptotic freedom; spontaneous symmetry breaking applied to Yang-Mills; Weinberg-Salam theory; lattice gauge theory; grand unified theories; supersymmetry; strings.
- 16:750:620. (F) INTRODUCTION TO MANY-BODY THEORY (3)
Ioffe. Prerequisite: 16:750:502 or equivalent.
Second quantization. Elementary excitations. Theory of the Fermi Liquid. Density functional and Hartree-Fock methods. Zero and finite temperature Green's functions. Relation of correlation functions to experimental probes. Perturbation theory. The electron-phonon problem. Collective excitations.
- 16:750:621. (S) ADVANCED MANY-BODY PHYSICS (3)
Ioffe. Prerequisite: 16:750:620 or equivalent.
Systems of interacting bosons and fermions. Theory of superconductivity and superfluidity. Application of the renormalization group to many-body problems. One-dimensional electron gas. Kondo problem and heavy fermions.
- 16:750:623,624. ADVANCED STUDIES IN PHYSICS (3,3)
Prerequisite: Permission of graduate director.
Individual studies supervised by a member of the faculty.
- 16:750:627. (F) SURFACE SCIENCE I (3)
Madey
Introduction to structure and dynamics of clean surfaces, atoms and molecules on surfaces, and interfaces. Topics include: atomistic description of geometrical structure, surface morphology, electronic structure, surface composition, and theoretical and experimental bases of modern experimental methods.
- 16:750:628. (S) SURFACE SCIENCE II (3)
Madey
Kinetics and dynamics of processes at surfaces; structure and reactivity of molecules at surfaces; thermal and nonthermal excitations; magnetic properties. Surfaces of metals, oxides, and semiconductors, as well as solid-solid and solid-liquid interfaces.
- 16:750:629. (S) OBSERVATIONAL TECHNIQUES (3)
Williams. Prerequisite: 16:750:541 or equivalent.
Introduction to tools and techniques of modern observational astronomy. Survey of instruments and capabilities at current telescope sites around the world and in space. Data reduction methods. Practical experience with Serin Observatory.
- 16:750:633,634. SEMINAR IN PHYSICS (1,1)
Cizewski. Prerequisite: Permission of instructor.
Seminars in fields of investigations of current interest.

The following courses may be taken in any order.
Offered in alternate years.

- 16:750:681,682. ADVANCED TOPICS IN SOLID-STATE PHYSICS I, II (3,3)
16:750:685,686. ADVANCED TOPICS IN NUCLEAR PHYSICS I, II (3,3)
16:750:689,690. ADVANCED TOPICS IN ASTROPHYSICS I, II (3,3)
16:750:693,694. ADVANCED TOPICS IN HIGH ENERGY PHYSICS I, II (3,3)
16:750:695. ADVANCED TOPICS IN MATH PHYSICS (3)
16:750:699. NONTHESIS STUDY (1)
16:750:701,702. RESEARCH IN PHYSICS (BA,BA)

PHYSIOLOGY AND NEUROBIOLOGY 761

Degree Program Offered: Doctor of Philosophy
Director of Graduate Program: Professor Ira B. Black, Room 342,
CABM, Busch Campus (732/235-5388)

Members of the Graduate Faculty

- Cory Abate, Associate Professor of Neuroscience and Cell Biology,
UMDNJ-RWJMS, CABM; Ph.D., Cornell Medical College
Molecular processes that control gene expression during mammalian
neuronal development
- Sidney B. Auerbach, Associate Professor of Biological Sciences, FAS-NB;
Ph.D., Wisconsin (Madison)
Control of neurotransmitters in the brain
- John W. C. Bird, Professor of Biological Sciences, FAS-NB; Ph.D., Iowa
Muscle intracellular proteinases and their inhibitors
- Ira B. Black, Chairperson and Professor of Neuroscience and Cell Biology,
UMDNJ-RWJMS/CABM; M.D., Harvard
Environmental regulation of brain gene expression; role of growth and trophic
factors in mammalian nervous systems; regulation of brain synaptic plasticity
- Timothy M. Casey, Professor of Entomology, CC; Ph.D., California
(Los Angeles)
Respiration; bioenergetics; thermoregulation; locomotion
- Kuang-Yu Chen, Professor of Chemistry, FAS-NB; Ph.D., Yale
Protein kinase pathway in neuronal development; neuroblastoma differentiation
- Robin L. Davis, Associate Professor of Biological Sciences, FAS-NB;
Ph.D., Stanford
Regeneration and electrophysiology of peripheral auditory neurons
- Emanuel M. DiCicco-Bloom, Associate Professor of Neuroscience and
Cell Biology, UMDNJ-RWJMS, CABM; M.D., Cornell Medical College
Cellular and molecular regulation of neurogenesis in vivo and in vitro
- Cheryl F. Dreyfus, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS,
CABM; Ph.D., Cornell
Role of environmental factors on brain neuron ontogeny
- M. David Egger, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS;
Ph.D., Yale
Neurophysiology; neuroanatomy; neurogenetics
- Julie M. Fagan, Associate Professor of Animal Sciences, CC; Ph.D., Arizona
Muscle growth; mechanisms of protein breakdown in mammalian cells in health
and in disease
- Allahverdi Farmanfarmanian, Professor of Biological Sciences, FAS-NB;
Ph.D., Stanford
Membrane transport; comparative physiology
- Charles Flaherty, Professor of Psychology, FAS-NB; Ph.D., Wisconsin
Animal learning; psychopharmacology
- Herbert M. Geller, Professor of Pharmacology and Neurology, UMDNJ-RWJMS;
Ph.D., Case Western Reserve
Developmental and molecular neurobiology
- Bijan K. Ghosh, Professor of Physiology and Biophysics, UMDNJ-RWJMS;
D.Sc., Calcutta
Protein transport; membrane differentiation
- Lindsay Grandison, Associate Professor of Physiology and Biophysics,
UMDNJ-RWJMS; Ph.D., Michigan State
Neuroendocrine functions
- Arnold G. Hyndman, Professor of Biological Sciences, FAS-NB; Ph.D.,
California (Los Angeles)
Development of CNS neurons
- Bela Julesz, Professor of Psychology, FAS-NB; Ph.D., Hungarian Academy
of Sciences
Visual perception
- Joseph Kedem, Associate Professor of Physiology and Biophysics,
UMDNJ-RWJMS; Ph.D., Hebrew
Quantitative relation between cardiac function and metabolism
- George M. Krauthamer, Professor of Neuroscience and Cell Biology,
UMDNJ-RWJMS; Ph.D., New York
Neurophysiology; neuroanatomy
- John Lenard, Professor of Physiology and Biophysics, UMDNJ-RWJMS;
Ph.D., Cornell
Insulin actions in fungi; virus membrane assembly and disassembly
- John K.-J. Li, Professor of Biomedical Engineering, CE; Ph.D., Pennsylvania
Cardiovascular dynamics and hypertension; instrumentation
- Gordon J. Macdonald, Professor of Neuroscience and Cell Biology, UMDNJ-
RWJMS; Ph.D., Rutgers
Reproductive endocrine functions
- Randall D. McKinnon, Assistant Professor of Surgery, UMDNJ-RWJMS;
Ph.D., McMaster
Growth factors and glia
- Sasha Malamed, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS;
Ph.D., Columbia
Ultrastructure and function of endocrine cells
- Gary F. Merrill, Associate Professor of Biological Sciences, FAS-NB; Ph.D.,
Michigan State
Regulation of coronary blood flow
- Richard S. Nowakowski, Associate Professor of Neuroscience and Cell Biology,
UMDNJ-RWJMS; Ph.D., Harvard
Development of central nervous system
- Timothy Otto, Assistant Professor of Psychology, FAS-NB; Ph.D.,
New Hampshire
Neurobiology of memory; synaptic plasticity; rodent olfactory learning
- Charles H. Page, Professor of Biological Sciences, FAS-NB; Ph.D., Illinois
Cellular neurophysiology and motor control
- Thomas V. Papathomas, Associate Professor of Biomedical Engineering,
FAS-NB; Ph.D., Columbia
Mechanisms and models for stereo, motion, and texture perception
- Isaac Peng, Assistant Professor of Neuroscience and Cell Biology, UMDNJ-
RWJMS; Ph.D., Temple
Actin structure-function relationships; actin monomer-polymer equilibrium
- Claudio W. Pikielny, Assistant Professor of Neuroscience and Cell Biology,
UMDNJ-RWJMS; Ph.D., Brandeis
Molecular genetics of olfaction in *Drosophila*
- John E. Pinter, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS/
CABM; Ph.D., Oregon
Role of insulin growth factor family during embryogenesis; development biology
of the pituitary gland
- Mark R. Plummer, Associate Professor of Biological Sciences, FAS-NB;
Ph.D., Stanford
Modulation and regulation of calcium channels in mammalian CNS neurons
- Jamshid Rabii, Associate Professor of Biological Sciences, FAS-NB; Ph.D.,
California (San Francisco)
Neuroendocrine regulation of prolactin, LH, and other pituitary hormones
- David J. Riley, Professor of Medicine, Adjunct Professor of Physiology and
Biophysics, UMDNJ-RWJMS; M.D., Maryland
Respiratory physiology
- Tetsuo Shimamura, Professor of Pathology, UMDNJ-RWJMS; M.D.,
Ph.D., Yokohama
Renal structure and function
- Arabinda K. Sinha, Associate Professor of Physiology and Biophysics,
UMDNJ-RWJMS; Ph.D., California (San Francisco)
Metabolic alterations between sleep and wakefulness
- Judith M. Stern, Professor of Psychology, FAS-NB; Ph.D., Rutgers
Sexual and maternal behaviors in animals and women
- Nancy R. Stevenson, Associate Professor of Physiology, UMDNJ-RWJMS;
Ph.D., Rutgers
Digestive absorptive functions; gastrointestinal function
- Mark Takahashi, Associate Professor of Physiology, UMDNJ-RWJMS;
Ph.D., Wisconsin
Enzymology; signal transduction mechanisms in cytokine-induced differentiation
- Carol A. Tozzi, Assistant Professor of Medicine, UMDNJ-RWJMS;
Ph.D., Rutgers
Hypertension matrix turnover and signaling factors in vascular remodeling
- William G. Wadsworth, Assistant Professor of Pathology, UMDNJ-RWJMS;
Ph.D., Missouri
Extracellular matrix and axonal guidance in *C. aenorhabditis elegans*
- George Wagner, Associate Professor of Psychology, FAS-NB; Ph.D., Chicago
Neurochemical mechanisms underlying behavior
- Harvey R. Weiss, Professor of Physiology and Biophysics, UMDNJ-RWJMS;
Ph.D., Duke
Circulatory and cardiac physiology
- Mark O. West, Associate Professor of Psychology, FAS-NB; Ph.D., Bowman Gray
Analysis of basal ganglia and limbic circuits in the rat during behavior and in
electrophysiological response to drugs

Kuo Wu, Associate Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS/CABM; Ph.D., SUNY (Brooklyn)
Elucidation of molecular mechanisms that regulate synaptic structure

Wise Young, Professor of Cell Biology, Developmental Biology, and Neurobiology, FAS-NB; Ph.D., Iowa; M.D., Stanford
Spinal cord nerve regeneration

Edward J. Zambraski, Professor of Biological Sciences, FAS-NB; Ph.D., Iowa
Renal and exercise physiology

James Q. Zheng, Assistant Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS; Ph.D., Tsinghua
Molecular/cellular mechanisms underlying the formation of neuronal circuitry

Renping Zhou, Assistant Professor of Chemical Biology, CP; Ph.D., California (Berkeley)
Development of the brain: function of growth factors and their receptors

Associate Members of the Graduate Faculty

Juan P. Advis, Associate Professor of Animal Sciences, CC; Ph.D., Texas D.V.M., Austral (Chile)
Neuroendocrinology of reproduction

Stella Elkabes, Adjunct Assistant Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS/CABM; Ph.D., Weizmann Institute of Science
Role of growth factors in neural development and injury: molecular mechanisms

Alan Gelperin, Biophysics Research Department, AT&T Bell Laboratories; Ph.D., Pennsylvania
Computational neuroscience; cellular bases of learning and behavior

Barbara Q. Kreider, Assistant Professor of Zoology; FAS-C; Ph.D., Pennsylvania
Control of proliferation and differentiation of oligodendroglia

Joseph V. Martin, Assistant Professor of Zoology; FAS-C; Ph.D., Southern California
Mechanisms of action of hypnotic drugs

William M. Saidel, Assistant Professor of Zoology; FAS-C; Ph.D., Massachusetts Institute of Technology
Vision in fishes and the evolution of vision

Michael V.K. Sukhdeo, Associate Professor of Animal Sciences, CC; Ph.D., McGill
Behavioral ecology of parasitic helminths in the host environment

Program

This graduate program is administered in a cooperative, integrated fashion by faculties in animal sciences, biological sciences, neuroscience and cell biology, pharmacology, physiology, and psychology. Areas of specialization include gene action in the brain, membrane transport and biophysics, mechanisms and regulatory controls of learning and memory, developmental neurobiology, organ system responses to exercise and other stresses, cardiac and circulatory function, and endocrine/neuroendocrine responses to diet, growth, and environment.

The program selects students on the basis of their academic records, Graduate Record Examination scores, and references. A student must have at least a B undergraduate cumulative grade-point average to be considered for admission. Prerequisite courses include biology, general and organic chemistry, calculus, and physics. Applications are accepted throughout the year, but are normally completed by March 1 for admission to study for the fall term. Financial aid is provided to highly qualified students. Financial aid typically includes a stipend to cover living expenses and remission of tuition fees. Three classes of direct support are available: 1) fellowships, 2) graduate assistantships provided through research grants held by individual professors, and 3) teaching assistantships associated with individual teaching units of the program.

While doctoral requirements vary with the area of specialization, at least 28 course credits are required, of which 24 credits must be at the 500 level or above. Because students must pass a qualifying examination in physiology or neurobiology for acceptance into the doctoral program, those concentrating in physiology should be knowledgeable in the areas of biochemistry and cellular, comparative, mammalian, and environmental physiology, while those concentrating in neurobiology should be knowledgeable in neural anatomy, neurophysiology, neural chemistry, neuropharmacology, neuroendocrinology, neural development, and the neural bases of behavior. The program has no foreign language requirement. To meet the residence requirements in the program a student must be registered for 24 credits of course work or research or some combination of both within one period of twelve consecutive months during his or her doctoral training.

For more information about joint Ph.D. degrees available in this program, see the beginning of this chapter.

Graduate Courses

- 16:761:501-502. MAMMALIAN PHYSIOLOGY (3,3)
Advis. Prerequisite: Physiology. Prerequisite to 16:761:502: 16:761:501.
Functions of organs and organ systems in the mammal.
- 16:761:507. (F) COMPARATIVE PHYSIOLOGY (3)
Casey, Farmanfarmaian, John-Alder, Page. Prerequisite: Physiology.
Offered in alternate years.
Topics of current interest in physiology from a comparative point of view using subject matter derived entirely from recent, original papers.
- 16:761:508. (S) MOLECULAR AND CELL PHYSIOLOGY (3)
Bird. Prerequisites: Course in physiology or cell biology, biochemistry, or permission of instructor.
Lectures on membrane structure, transport phenomena, muscle, nerve, and cell organelles.
- 16:761:513. (S) CARDIOVASCULAR PHYSIOLOGY (3)
Merrill. Offered in even-numbered years.
A comprehensive study of the cardiovascular system in mammals. Special consideration given to coronary circulation, myocardial-oxygen consumption, and cardiac arrhythmias.
- 16:761:515. (S) MEDICAL PHYSIOLOGY (7)
Stevenson. Prerequisite: Permission of instructor.
Study of human physiology from the molecular to the systems level. Emphasis is on the integration of the systems within the healthy individual. Teaching modalities include lectures, small discussion groups, and laboratories in pulmonary and cardiovascular physiology.
- 16:761:517. (S) MOLECULAR NEUROTRANSMISSION (2)
Wu. 2 hrs., 15 weeks. Prerequisite: Neuroscience.
Emphasis on current topics on molecular mechanisms that govern neuron-to-neuron communication through chemical pathways in the mammalian brain; pharmacological and pathological conditions.
- 16:761:520. (F) ENVIRONMENTAL PHYSIOLOGY (3)
Casey, John-Alder
Physiological mechanisms of homeostasis in vertebrate animals and the limitations that the environment places on normal functions, with emphasis on energetics, oxygen uptake and transport, thermoregulation, and water balance.
- 16:761:537. (F) EXERCISE PHYSIOLOGY (4)
Zambraski. Lec. 3 hrs., lab. 3 hrs. Prerequisite: 16:761:501. Offered in alternate years.
Examination of the physiological responses associated with an acute exercise stress, in addition to the effects of repeated exercise or training. Emphasis on the control mechanisms involved in these processes. Laboratory involves students making measurements on themselves at rest and during exercise. Experiments utilizing animals are conducted to demonstrate muscle-neural and endocrine functions during exercise.
- 16:761:540. (S) TROPHIC MECHANISMS IN THE NERVOUS SYSTEM (2)
Dreyfus. 1.5 hrs., 14 weeks. Prerequisites: Cell biology, neurobiology, and biochemistry. Offered in even-numbered years.
Introduction to neurotropic factor field. In particular, the critical nature of trophic agents in the establishment and maintenance of a functioning nervous system.
- 16:761:544. (F) MOLECULAR REGULATION OF NEUROGENESIS (2)
DiCicco-Bloom. Prerequisites: Neurobiology, molecular biology of cells. Offered in odd-numbered years.
Discussion of current literature, explores concepts and mechanisms regulating neuronal generation, and specification from undifferentiated precursors in invertebrates and vertebrates are examined, including cell lineage, homeotic genes, neurotransmitters, and growth, trophic, and transcription factors.
- 16:761:545. (F) REPRODUCTION (3)
Sukhdeo

16:761:546. (S) NEUROENDOCRINOLOGY (3)
Rabii. Prerequisites: Mammalian physiology and permission of instructor.
Recommended: General endocrinology.

Principles of neurosecretion and neuroendocrine regulation.
The CNS control of hormone secretion and function.

16:761:553. (F) MOLECULAR ASPECTS OF MEMBRANE
TRANSPORT (3)

Farmanfarmaian. Offered in alternate years.
Survey of transfer of materials across biological membranes with
emphasis on methods of study, analysis of data, and theories
of transport.

16:761:554. (F) GENE REGULATION IN THE BRAIN (2)

Abate. Offered in odd-numbered years. See also 16:115:554.
Survey of recent literature regarding the regulation of gene expres-
sion in the nervous system. Emphasis on the molecular mechanisms
involved in gene regulation during neuronal development.

16:761:555. (F) NEUROBIOLOGY (3)

Plummer. Recommended: Biochemistry, physiology, or animal behavior.
Introductory survey emphasizing experimental approaches
to the study of invertebrate and vertebrate nervous systems.
Molecular, biophysical, and biochemical bases of nerve cell
function. Higher-level functions shown as emerging from nerve
cell properties, anatomical development, and mature connections.
See also 16:830:555.

16:761:557. (S) NEUROSCIENCE (4)

Nowakowski. Lec. 3 hrs., lab. and demonstration 3 hrs.
Study of the human central nervous system involving gross and
microscopic examination and physiological study of the brain,
spinal cord, receptors, and effectors with correlated clinical
demonstration of neurological disorders.

16:761:558,559. SPECIAL TOPICS IN NEUROBIOLOGY (2,2)

Prerequisite: Permission of instructor.
The analysis and discussion of contemporary research in cellular
and molecular aspects of neuronal functioning or selected topics of
current research in developmental neurobiology examined by his-
torical review, presentation of current research papers, and analysis
of new approaches and unifying theories, in alternating terms.

16:761:605,606. ADVANCED STUDIES IN PHYSIOLOGY
AND NEUROBIOLOGY (BA,BA)

Research literature review or independent reading.

16:761:701,702. RESEARCH IN PHYSIOLOGY AND NEUROBIOLOGY
(BA,BA)

Prerequisite: Permission of instructor.

PLANT BIOLOGY 765

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Bradley I. Hillman,
Foran Hall, Cook Campus (732/932-9375, ext. 358)

Members of the Graduate Faculty

Faith C. Belanger, Assistant Professor of Plant Sciences, CC; Ph.D., Illinois
Plant molecular biology; hormone-induced secretion
Douglas S. Bush, Associate Professor of Biological Sciences, FAS-N; Ph.D.,
California (Berkeley)
Calcium role in signaling; ion transport
Raul I. Cabrera, Assistant Extension Specialist in Plant Sciences, CC; Ph.D.,
California (Davis)
Nursery crops production/management; mineral nutrition of woody ornamentals
Tseh An Chen, Professor of Plant Pathology, CC; Ph.D., New Hampshire
Plant mycoplasma and plant biotechnology; plant nematology;
nematode ultrastructure
Chee-kok Chin, Professor of Plant Sciences, CC; Ph.D., Alberta
Plant cell and tissue culture

Bruce B. Clarke, Associate Professor of Plant Pathology and Associate Extension
Specialist in Plant Pathology, CC, and Director, Center for Turfgrass Science;
Ph.D., Rutgers
Turfgrass pathology; soilborne diseases; disease forecasting and control; mycology
Bill D. Davis, Associate Professor of Biological Sciences, FAS-NB; Ph.D., Purdue
Tissue culture; cell and developmental physiology
Peter Rodney Day, University Professor of Genetics and Director of the Center for
Agricultural Molecular Biology; Ph.D., London
Genetic engineering; genetics of host-pathogen interaction
Hugo K. Dooner, Professor of Genetics, CC/WIM; Ph.D., Wisconsin
Transposons; gene tagging; molecular analysis of meiotic recombination in plants
Edward F. Durner, Associate Research Professor of Plant Sciences, CC; Ph.D.,
North Carolina State
Low-temperature stress resistance in tree fruit
Joan G. Ehrenfeld, Associate Professor of Ecology, Evolution, and Natural
Resources, CC; Ph.D., CUNY
Plant community ecology; ecosystem ecology; pollution impacts
Joseph A. Fiola, Assistant Extension Specialist in Plant Sciences, CC;
Ph.D., Maryland
Tissue culture, breeding, and cultural practice studies of small fruits
James C. French, Associate Professor of Biological Sciences, FAS-NB;
Ph.D., Cornell
Comparative and developmental anatomy; experimental morphology
Chaim Frenkel, Professor of Plant Sciences, CC; Ph.D., Washington State
Postharvest biology, senescence, fruit ripening, and stress
Cyril R. Funk, Research Professor of Plant Sciences, CC; Ph.D., Rutgers
Turfgrass breeding
Stephen A. Garrison, Professor of Plant Sciences, CC; Ph.D., Illinois
Production techniques for vegetables
Randy Gaugler, Professor of Entomology, CC; Ph.D. Wisconsin
Invertebrate pathology; nematology; biological control
Brandon S. Gaut, Assistant Professor of Plant Sciences, CC/CTAG;
Ph.D., California (Riverside)
Molecular evolution; population genetics in plants
Gene Giacomelli, Associate Professor of Bioresource Engineering, CC;
Ph.D., Rutgers
Controlled environment agriculture; crop production techniques
Thomas J. Gianfagna, Associate Research Professor of Plant Sciences, CC;
Ph.D., Cornell
Plant growth regulators; physiology of fruit crops
Joseph C. Goffreda, Associate Professor of Plant Sciences, CC; Ph.D., Cornell
Genetics and breeding; pest resistance in solanaceous crops
Ann B. Gould, Assistant Extension Specialist in Plant Pathology, CC;
Ph.D., Kentucky
Ornamental pathology
Steven N. Handel, Professor of Ecology, Evolution, and Natural Resources, CC;
Ph.D., Cornell
Plant population ecology; pollination biology; ecological genetics
Jean Marie Hartman, Associate Professor of Landscape Architecture, CC;
Ph.D., Connecticut
Plant ecology; community ecology; restoration ecology; land planning
Joseph R. Heckman, Assistant Extension Specialist in Soil Fertility, CC; Ph.D.,
North Carolina
Plant nutrition
Melvin R. Henninger, Professor of Plant Sciences, CC; Ph.D., Pennsylvania State
Cropping systems of potatoes
Bradley I. Hillman, Associate Research Professor of Plant Pathology, CC; Ph.D.,
California (Berkeley)
Viral infections of plants and fungi
Harry W. Janes, Research Professor of Plant Sciences, CC; Ph.D., Rutgers
Photosynthetic efficiency and source-sink relationships
Gojko Jelenkovic, Professor of Plant Sciences, CC; Ph.D., California (Davis)
Genetic manipulation of plants
Stephen A. Johnston, Associate Extension Specialist in Plant Pathology, CC;
Ph.D., Rutgers
Vegetable crop pathology
Edward G. Kirby, Associate Professor of Botany, FAS-N; Ph.D., Florida
Developmental physiology; tissue culture
Daniel F. Klessig, Professor of Molecular Biology, FAS-NB, and Associate Director
of the Waksman Institute of Microbiology; Ph.D., Harvard
Signal transduction in plant-pathogen interactions
Donald Y. Kobayashi, Assistant Professor of Plant Pathology, CC;
Ph.D., California (Riverside)
Plant bacteriology; host pathogen interaction; molecular biology
John E. Kuser, Associate Professor of Ecology, Evolution, and Natural Resources,
CC; Ph.D., Oregon State
Geneecological variant; provenance and progeny testing; forest tree propagation
Eric Lam, Associate Professor of Plant Sciences, CC; Ph.D., California (Berkeley)
Gene regulating mechanisms in plants; development and photomorphogenesis
Michael A. Lawton, Assistant Professor of Plant Sciences, CC; Ph.D., Oxford
Molecular biology; protein kinases

Thomas Leustek, Associate Professor of Biochemistry and Microbiology, CC; Ph.D., Rutgers
Stress proteins and cell molecular biology

Bradley A. Majek, Associate Professor of Plant Sciences, CC; Ph.D., Cornell
Weed science

Pal Maliga, Professor of Genetics, WIM; Ph.D., Hungarian Academy of Sciences
Plant molecular biology; plastid genetics

Thomas Meagher, Associate Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Duke
Plant population biology, population genetics

David R. Mears, Professor of Bioresource Engineering, CC; Ph.D., Rutgers
Engineering systems and environments for greenhouses

Richard H. Merritt, Professor of Plant Sciences, CC; Ph.D., Rutgers
Environmental and physiological factors affecting crop production in greenhouses

Joachim W. Messing, University Professor of Molecular Biology and Director of the Waksman Institute of Microbiology; Ph.D., Munich
Molecular biology of higher plants; M13 cloning, sequencing genes synthesis

William A. Meyer, Professor of Plant Sciences, CC, and Associate Director, Center for Turfgrass Science; Ph.D., Illinois
Turfgrass breeding, disease resistance, endophytes

James Murphy, Associate Extension Specialist in Turfgrass Management, CC; Ph.D., Michigan State
Development of management systems that minimize stress and improve turf performance

Carlos A. Neyra, Associate Professor of Plant Sciences, CC; Ph.D., Illinois
Plant-microbe interactions; biological control of plant pathogens; biological nitrogen fixation; microbial technologies for agriculture

Elwin R. Orton, Jr., Research Professor of Ornamental Horticulture, CC; Ph.D., Wisconsin
Intra- and interspecific hybridization of trees and shrubs

Peter Oudemans, Assistant Professor of Plant Pathology, CC; Ph.D., California (Riverside)
Fungal plant diseases; population biology of fungi

Carl A. Price, Professor of Plant Biochemistry, WIM; Ph.D., Harvard
Molecular biology of plastids

James A. Quinn, Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Colorado State
Population ecology; species interactions; evolutionary biology

Ilya Raskin, Professor of Plant Biology, CC; Ph.D., Michigan State
Molecular regulation of plant growth, development, and disease resistance

Michael D. Richardson, Assistant Professor of Plant Sciences, CC; Ph.D., Georgia
Turfgrass ecology; stress physiology

John N. Sacalis, Professor of Plant Sciences, CC; Ph.D., Rutgers
Postproduction physiology of floricultural crops

Danny J. Schnell, Assistant Professor of Biology, FAS-N; Ph.D., California (Davis)
Mechanism of protein import into chloroplasts

Edmund W. Stiles, Professor of Ecology, Evolution, and Natural Resources, CC; Ph.D., Washington
Plant-animal interactions; evolutionary ecology

Cecil C. Still, Professor of Plant Physiology, CC; Ph.D., Temple
Hormones; pesticide metabolism; secondary products of metabolism

Richard E. Triemer, Professor of Biological Sciences, FAS-NB; Ph.D., North Carolina
Plant cell biology; phylogeny; ultrastructure

Nilgun E. Tumer, Associate Professor of Plant Pathology, CC; Ph.D., Purdue
Molecular biology of plant viruses, virus replication, disease resistance, plant transformation

Aurea C. Vasconcelos, Professor of Botany, FAS-NB; Ph.D., Chicago
Cell biology; organelle development; plant molecular biology

Nicholi Vorsa, Professor of Plant Sciences, CC; Ph.D., Rutgers
Genetic and cytological studies in blueberries and cranberries

Bruce P. Wasserman, Professor of Food Science, CC; Ph.D., Massachusetts
Plant and enzyme biotechnology; membrane biochemistry

James F. White, Assistant Professor of Plant Pathology, CC; Ph.D. Texas
Systematic mycology; studies of endophytes and epibionts

George J. Wulster, Professor and Extension Specialist in Plant Sciences, CC; Ph.D., Rutgers
Root growth and physiology activity

Barbara A. Zilinskas, Professor of Plant Biochemistry, CC; Ph.D., Illinois
Photosynthesis; plant molecular biology; algal physiology

Associate Members of the Graduate Faculty

William R. Goldner, Research Scientist, Plant Biology Group, Union Camp Corporation; Ph.D., Pennsylvania State
Plant biochemistry and physiology; growth and development; natural products

Maro R. Sondahl, Visiting Professor of Plant Sciences, CC; Ph.D., Ohio State
Plant and cell genetics

Adjunct Members of the Graduate Faculty

Paul J. Kuhn, Senior Research Biologist, American Cyanamid Company; Ph.D., Hull
Agents for plant disease control

David E. Salt, Assistant Research Professor of Plant Physiology, CAMB; Ph.D., Liverpool
Mechanisms involved in heavy metal accumulation in plants

Programs

The faculty offers a comprehensive program of study and research and provides the opportunity to specialize in most fields of plant biology. Greenhouse and research facilities and equipment are extensive. Fieldwork may be performed in any of several experiment stations, farms, or research stations, as well as in a nearby primeval forest ecosystem, old field, and ancient habitats. A seminar series of invited scientists provides rich opportunities for students during graduate study.

The faculty offers the master's degree without thesis, the master's degree with thesis, and the doctoral degree. The Master of Philosophy degree is available to doctoral candidates. Required undergraduate preparation normally includes calculus, general and organic chemistry, physics, general biology or equivalent, genetics, and some botanical training. Students with strong academic records and other evidence of scholarly talents or promise are encouraged to apply. Submission of the Graduate Record Examination score is required and the biology, biochemistry, or cell and molecular biology subject test score is strongly recommended. A variety of fellowships and teaching and research assistantships is available.

The graduate faculty is composed of members from several units, including the Departments of Plant Science; Biochemistry and Microbiology; Plant Pathology; Ecology, Evolution, and Natural Resources; and Environmental Sciences at Cook College and the Department of Biological Sciences of the Faculty of Arts and Sciences—New Brunswick. Faculty may also be affiliated with the Center for Agricultural Molecular Biology, the Center for Theoretical and Applied Genetics, the Waksman Institute of Microbiology, and the Center for Interdisciplinary Studies in Turfgrass Science.

Students in the plant biology program may choose from four research and curriculum tracks: 1) molecular and cellular biology, 2) organismal and population biology, 3) horticulture and plant technology, and 4) plant pathology. Specific curriculum requirements for each student are developed within the general program requirements by his or her committee, with approval by the track coordinator and program director. The tracks are interwoven in that members of the graduate faculty may be members of more than one track, and students are encouraged to take courses in more than one track area.

Students in the molecular and cellular biology track may specialize in photosynthesis, carbon metabolism and partitioning, developmental physiology and genetics, growth regulation, nitrogen metabolism, ion uptake and electrophysiology, molecular biology of subcellular organelles, regulation of gene expression, genetic transformation of plants, senescence, ripening of fruit, seed germination, water relations, tissue culture, comparative or developmental anatomy and morphology, or ultrastructure. Students in the organismal and population biology track may emphasize physiological ecology, population ecology, species interactions, community organization and dynamics, ecosystem dynamics, pollination and reproductive biology, and evolutionary biology. The horticulture and plant technology track focuses on course work and research activity associated with plant biology relating to agriculture. A wide diversity of student interests are served by this track, from fundamental investigations of plant function at the molecular level to studies of how environment and biotic stress affect crop production. Students with interests in agricultural biotechnology, plant breeding and genetics, plant physiology, growth and development, and plant interaction with the environment are supported by this track. Among the issues that students in the plant pathology track may address are host/pathogen interactions, epidemiology and control of plant disease, plant virology, bacteriology, mycoplasma, mycology, molecular biology of plant pathogenic or endophytic microorganisms, and biotechnology.

Few courses are required; a student's curriculum is tailored to his or her interests within general program requirements. For the master's degree without thesis, 31 course credits and 1 credit for a paper are required. For the master's degree with thesis, 26 course credits, 6 research credits, and a research thesis are required. For the doctoral degree, a minimum of 32 course credits and a minimum of 34 research credits, a research thesis, and one academic year in residence are required. There is no language requirement. Prospective students are invited to write the program director for A Guide to Graduate Study in Plant Biology and the Faculty Research Interests books, which provide additional information.

In addition to the graduate courses described below, consult those courses listed under biochemistry, ecology and evolution, environmental sciences, microbiology and molecular genetics, and statistics. Many advanced undergraduate courses (400 level) listed in the New Brunswick Undergraduate Catalog, the Camden Undergraduate Catalog, and the Newark Undergraduate Catalog may be used for graduate credit.

Graduate Courses

16:765:501. (F) PLANT DEVELOPMENT (3)

Prerequisites: Undergraduate plant physiology or equivalent; organic chemistry. Survey of modern aspects of plant physiology with emphasis on recent literature. Topics include cellular function, plant hormones, stress physiology, signal transduction pathways, and developmental processes.

16:765:502. (S) PLANT PHYSIOLOGY (3)

Prerequisites: Undergraduate plant physiology or equivalent; organic chemistry. Survey of modern aspects of plant physiology with emphasis on recent literature. Topics covered include nutrition, development, stress physiology, and crop physiology.

16:765:506. (S) ELECTRON MICROSCOPY FOR CELL AND MOLECULAR BIOLOGY (3)

Pre- or corequisite: Molecular biology of cells, cell biology, or equivalent. Principles and techniques of biological electron microscopy. Use and operation of the transmission electron microscope in studying macromolecules, viruses, cells, and tissues.

16:765:507. (F) PLANT-WATER RELATIONS (3)

Prerequisite: 16:765:501 or equivalent. Whole plant and cell response to water deficits from a physiological perspective. Focus on agronomic plants. Topics include movement of water in the soil-plant-air continuum, water deficit effects on transpiration, photosynthesis, osmotic adjustment, ion and nitrogen metabolism, hormones, and growth. Techniques involve thermocouple psychrometry, gas exchange, and porometry.

16:765:508. (S) FOREST GENETICS (3)

Long breeding cycle of trees, distribution of variation, selection and progeny testing, establishment of seed orchards, clonal and seed propagation. Objectives in breeding programs.

16:765:509. (F) CYTOGENETICS (4)

Lec. 3 hrs., lab. 3 hrs. Prerequisites: General botany, genetics. Cytochemistry, cell morphology and structure, chromosome structure, nucleoli, spindle mechanisms, cell mechanics, mitosis, meiosis, organization and replication of genome, numerical hybrids, qualitative inheritance, recombination, mutations, cytogenes, heterospecific genome interaction.

16:765:510. (F) ADVANCED PLANT GENETICS (3)

Dooner, Jelenkovic. Prerequisite: Undergraduate course in genetics. Classical and molecular genetics of higher plants, including breeding systems, linkage analysis, recombination, gene and chromosomal mutations, epigenetics, genetics-based approaches to cloning, genetic analysis of metabolic pathways, biochemical genetics of storage compounds.

16:765:511. (F) ANGIOSPERM REPRODUCTION AND EMBRYOLOGY (4)

Lec. 3 hrs., lab. 3 hrs. Prerequisites: General botany; plant anatomy and/or morphology or written permission of instructor.

Detailed study of reproduction in the flowering plants; floral development; vascular anatomy of the flower; microsporogenesis and pollen; ovule development, megasporogenesis and megagametophyte; fertilization, embryogeny, and endosperm development; apomixis; seed and fruit.

16:765:512. (S) ANGIOSPERM DIVERSITY (3)

Prerequisite: Introductory botany course. Cladistics and phylogeny, vegetative structure, physiology, diversity, plant development, ecology of highly specialized angiosperms.

16:765:513. (S) PLANT MOLECULAR BIOLOGY (3)

Prerequisite: Undergraduate genetics or equivalent. Fundamental and applied aspects of plant molecular biology, including isolation, structure, and regulation of nuclear and organellar genes, molecular biology of plant-microbe interactions, molecular biology of plant development, and plant biotechnology.

16:765:514. (F) PLANT CELL BIOLOGY (3)

Prerequisites: Undergraduate courses in plant physiology, molecular biology, or cell biology; 16:680:580.

Structure and dynamics of plant cells, with particular emphasis on signaling between cells and signal transduction within cells. Includes regulation of cell division, targeting and secretion, receptors, and other cellular signaling components.

16:765:517. (F) SECONDARY METABOLISM IN PLANTS (2)

Prerequisite: 16:765:501 or equivalent. Secondary metabolism enzymes and pathways. Metabolites in economic botany, medicine, industry, and plant taxonomy. Naturally occurring pesticides.

16:765:518. (S) TOPICS IN PLANT MICROBE INTERACTIONS (2)

Prerequisite: General biology. Recommended: Microbiology. Comprehensive examination of the interactions between plants and microorganisms at the molecular, cellular, and organismal levels in both pathogenic and beneficial interactions.

16:765:520. (S) PLANT METABOLISM (3)

Prerequisite: Plant physiology or equivalent. Physiological significance of principal metabolic systems, including photosynthesis, photorespiration, sulfate and nitrate reduction, hexose metabolism; synthesis of lipids and lipid pigments, photochemical and hormonal controls, chloroplast development and biochemistry of secondary plant products.

16:765:521. (F) PLANT SCIENCE TECHNIQUES (3)

Experimental systems and assays used for the investigation of plant functions. Applications, advantages, and limitations of individual techniques used in plant laboratory research.

16:765:522. (F) APPLIED PLANT SCIENCE STATISTICS (3)

Statistical methods such as experimental design, regression, ANOVA, covariance, field plot techniques, sampling, factorial experiments, treatment comparisons, and estimates of effects.

16:765:523. GENETICS OF SEXUALITY (4)

Prerequisites: Introductory genetics and cytology. Sex-determining mechanisms in selected plant and animal species; incompatibles and sterilities; developmental and evolutionary aspects.

16:765:524. (S) PLANT GROWTH REGULATORS IN AGRICULTURE (3)

Prerequisite: 11:780:382. Recommended: 16:765:501 and 16:765:502. The chemistry, physiology, and use of the naturally occurring and synthetic plant growth substances employed in the management of horticultural and agronomic crops. Action of auxins, gibberellins, ethylene-release agents, and growth retardants in relation to the control of rooting, flowering, fruit ripening, abscission, and the enhancement of yield.

16:765:525. (S) PLANT MINERAL NUTRITION (3)
Role of the essential nutrients in plant growth and development with emphasis on the critical levels in plants, yield formation, and crop quality.

16:765:526. (S) FRUIT RIPENING AND PLANT SENESCENCE (3)
Measurements of plant senescence manifestations including fruit ripening.

16:765:527. (S) ADVANCED FRUIT CULTURE (3)
Discussion of efficient growing systems for major fruit crops including small fruits.

16:765:528. (F) ADVANCED PLANT BREEDING (3)
Prerequisite: A course in general genetics.
Breeding, self-pollinated, cross-pollinated, and apomictic plants; role of mutation, polyploidy, and interspecific hybridization in plant improvement; inheritance of adaptive plant characters; developing and maintaining improved varieties.

16:765:531. (F) PRINCIPLES OF PLANT PATHOLOGY (4)
Lec. 3 hrs., lab. 3 hrs. Prerequisite: Biology or microbiology.
Fundamental concepts elucidating the nature, cause, diagnosis, dissemination, and control of plant diseases. Includes an overview of all plant disease agents.

16:765:532. (S) ADVANCED PLANT PATHOLOGY (3)
Prerequisite: 16:765:531 or equivalent.
Control and epidemiology of plant disease. Properties, activities, and physical considerations of fungicides and nematocides and their application and labeling.

16:765:533. (F) ADVANCED MYCOLOGY (3)
Lec. 2 hrs., lab. 3 hrs. Prerequisite: General mycology or equivalent.
A detailed study of the filamentous and fleshy fungi, with emphasis on identification, mycological literature, reproduction, and other special topics.

16:765:535. (F) PLANT VIROLOGY (3)
Lec. 2 hrs., lab. 3 hrs. Prerequisite: 16:765:531 or equivalent.
Current concepts concerning the history, transmission, detection, identification, biochemistry, classification, ecology, epidemiology, and control of plant viruses. Special topics or techniques covered.

16:765:536. PLANT DISEASE CLINIC (3)
Lec./lab. 6 hrs. Prerequisite: General plant pathology or equivalent. Offered only during the summer session.
A workshop in diagnosing both pathogenic and nonpathogenic plant disorders, isolation and identification of causal organisms, and current disease control measures.

16:765:537. PLANT PATHOGENIC BACTERIA (3)
Lec. 2 hrs., lab. 3 hrs. Prerequisite: General plant pathology.
Basic concepts of phytobacteriology, including diagnosis and identification of plant bacterial diseases, ecology and control of bacteria, pathogenicity, disease physiology, and molecular biology of pathogenicity factors.

16:765:538. (S) PLANT PATHOGENESIS (2)
Prerequisite: 16:765:531 or equivalent.
Mechanisms of pathogenesis; responses of plants to pathogens in terms of structure, function and metabolism; disease resistance, mechanisms, and genetics of pathogenesis.

16:765:589. (F) COMMUNITY DYNAMICS (4)
Lec./sem. 3 hrs., lab. 3 hrs. Includes field investigations. Prerequisite: Ecology or written permission of instructor.
Theory of and evidence for the ecological processes that control inter-specific interactions; the structure of plant and animal communities.

16:765:591. (F) DEVELOPMENTAL PHYSIOLOGY (3)
Prerequisites: General botany, plant physiology.
Chemical, physical, biological factors in growth and differentiation; correlative and compensatory factors in flowering, fruit development, tuber and bulb formation; morphology and physiology of root, stem, leaf differentiation; growth and form.

16:765:601,602. PROBLEMS IN PLANT BIOLOGY (BA,BA)
Prerequisite: Permission of instructor.
A laboratory and conference course for special problems.

16:765:603,604. SELECTED TOPICS IN PLANT BIOLOGY (BA,BA)
Application of basic concepts of plant growth and development to the understanding of production problems and their in-depth study for selected significant topics.

16:765:609,610. SEMINAR IN PLANT BIOLOGY (1,1)
Required of all graduate students. Advanced topics investigated and presented by students.

16:765:699. NONTHESIS STUDY (1)
For students writing their essays for a nonthesis master's degree.

16:765:701,702. RESEARCH IN PLANT BIOLOGY (BA,BA)
For students working on an experimental research problem for their dissertation.

PLANT PATHOLOGY (see Plant Biology 765)

PLANT SCIENCE AND TECHNOLOGY (see Plant Biology 765)

POLITICAL SCIENCE 790

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Director of Graduate Program: Professor Milton Heumann,
Hickman Hall, Douglass Campus (732/932-9261)
Vice Chairperson, Graduate Studies: Professor P. Dennis Bathory,
Hickman Hall, Douglass Campus (732/932-9321)

Members of the Graduate Faculty

Myron J. Aronoff, Professor of Political Science and Anthropology, FAS-NB;
Ph.D., Manchester; Ph.D., California (Los Angeles)
Comparative politics (Middle East); political anthropology
Ross K. Baker, Professor of Political Science, FAS-NB; Ph.D., Pennsylvania
Political institutions; Congress; U.S. foreign policy
Benjamin R. Barber, Walt Whitman Professor of Political Science, FAS-NB;
Ph.D., Harvard
Political theory; democratic institutions
P. Dennis Bathory, Associate Professor of Political Science, FAS-NB;
Ph.D., Harvard
Political theory (ancient and medieval); political leadership
Stephen E. Bronner, Professor of Political Science, FAS-NB; Ph.D.,
California (Berkeley)
Political theory; political economy
Philip H. Burch, Jr., Research Professor of Public Policy, EJBSPPP;
Ph.D., Rutgers
American political institutions; political economy
Pedro A. Cabán, Associate Professor of Political Science, FAS-NB,
Ph.D., Columbia
State formation; alternative economic growth models; role of multinational
corporations, multilateral financial institutions in the Caribbean and
Central America
Barbara J. Callaway, Professor of Political Science, FAS-NB; Associate Provost
for Academic Affairs in the Social Sciences; Ph.D., Boston
Comparative politics (Africa); women and politics
Susan J. Carroll, Professor of Political Science, EIP; Ph.D., Indiana
Women and politics; mass politics
Michael R. Curtis, Professor of Political Science, FAS-NB; Ph.D., Cornell
Comparative politics (Western Europe)
Cynthia R. Daniels, Associate Professor of Political Science, FAS-NB; Ph.D.,
Massachusetts (Amherst)
Women and public policy; productive politics; political economy of gender
Eric Davis, Associate Professor of Political Science, FAS-NB; Ph.D., Chicago
Comparative politics (Middle East); political economy
Yale H. Ferguson, Professor of Political Science, FAS-N; Ph.D., Columbia
International relations theory/history; Latin America
Frank Fischer, Professor of Political Science, FAS-N; Ph.D., New York
Policy analysis

Milton Heumann, Professor of Political Science, FAS-NB; Ph.D., Yale
Public law; legal processes; criminal justice and civil liberties

Robert R. Kaufman, Professor of Political Science, FAS-NB; Ph.D., Harvard
Comparative politics (Latin America); political economy

Richard R. Lau, Professor of Political Science, FAS-NB; Ph.D.,
California (Los Angeles)
Mass politics

Susan E. Lawrence, Associate Professor of Political Science, FAS-NB;
Ph.D., Johns Hopkins
Public law

C. Richard Lehne, Professor of Political Science, FAS-NB; Ph.D., Syracuse
American political institutions

Jack D. Levy, Professor of Political Science, FAS-NB; Ph.D., Wisconsin (Madison)
International relations; foreign policy decision making; causes of war

Barbara C. Lewis, Associate Professor of Political Science, FAS-NB;
Ph.D., Northwestern
Comparative politics (Africa); women and politics

Roy E. Licklider, Professor of Political Science, FAS-NB; Ph.D., Yale
International relations; foreign policy; military policy

Wilson C. McWilliams, Professor of Political Science, FAS-NB; Ph.D.,
California (Berkeley)
Political theory; American political thought

Manus I. Midlarsky, Back Professor of International Peace and Conflict
Resolution, FAS-NB; Ph.D., Northwestern
International relations with emphasis on causes of political violence including
war and revolution

Kenneth E. Miller, Professor of Political Science, FAS-N; Ph.D., Johns Hopkins
Comparative politics (Western Europe, Canada)

Gerald M. Pomper, Professor of Political Science, FAS-NB; Ph.D., Princeton
American political institutions; mass politics

Edward Rhodes, Associate Professor of Political Science, FAS-NB;
Ph.D., Princeton
International relations; national security policy; deterrence theory

Alan Rosenthal, Professor of Public Policy, EJBSPPP; Ph.D., Princeton
American political institutions; state politics and legislatures

Gordon J. Schochet, Professor of Political Science, FAS-NB; Ph.D., Minnesota
Political theory; British political thought

D. Michael Shafer, Professor of Political Science, FAS-NB; Ph.D., Harvard
International relations; political economy

Roberta Sigel, Professor Emerita of Political Science, FAS-NB; Ph.D., Clark
American political institutions; mass politics; women and politics

Jay A. Sigler, Professor of Political Science, FAS-C; Ph.D., Rutgers
Public law

Carl Edward Van Horn, Professor of Public Policy, EJBSPPP; Ph.D., Ohio State
American political institutions; public policy

Harvey Waterman, Associate Professor of Political Science, FAS-NB;
Associate Dean, Graduate School—New Brunswick; Ph.D., Chicago
Comparative politics (Western Europe); domestic sources of foreign policy

Richard W. Wilson, Professor of Political Science, FAS-NB; Ph.D., Princeton
Comparative politics (China); mass politics

Linda Zerilli, Associate Professor of Political Science, FAS-NB; Ph.D.,
California (Berkeley)
Feminist theory; political theory

Cliff Zukin, Associate Professor of Public Policy, EJBSPPP; Ph.D., Ohio State
American political institutions; mass politics

Associate Members of the Graduate Faculty

Andrew Farkas, Assistant Professor of Political Science, FAS-NB;
Ph.D., Princeton
International relations

Leela Fernandes, Assistant Professor of Political Science and Women's Studies,
FAS-NB; Ph.D., Chicago
Women's studies; comparative politics; political economy; cultural studies

Kerry L. Haynie, Assistant Professor of Political Science, FAS-NB;
Ph.D., North Carolina (Chapel Hill)
African-American politics; American government and politics

James Turner Johnson, Professor of Religion, FAS-NB; Ph.D., Princeton
International relations; just war

Jane Junn, Assistant Professor of Political Science, FAS-NB; Ph.D., Chicago
Methodology

Arthur Jay Klinghoffer, Professor of Political Science, FAS-C; Ph.D., Columbia
Comparative politics (Soviet)

Jan Kubik, Assistant Professor of Political Science, FAS; Ph.D., Columbia
East European politics; transitions from communism; politics and culture;
local politics; forms of social protest

Jonathan Mallamud, Professor of Law, SL-C; J.D., Harvard
Public law; judicial behavior; law and politics

Ruth B. Mandel, Board of Governors Professor of Politics, EIP; Ph.D., Connecticut
Women's participation in American politics

Michael Paris, Assistant Professor of Political Science, FAS-NB; J.D., Columbia
American constitutional law/civil liberties; government and politics

Daniel J. Tichenor, Assistant Professor of Political Science, FAS-NB;
Ph.D., Brandeis
American national politics

Programs

The graduate program in political science is directed toward attainment of the Ph.D. Exceptional applicants may be admitted to this program directly upon completion of the bachelor's degree; others enter after completion of a master's degree either at Rutgers or another institution. As a rule, applications to the graduate program are more likely to be accepted if they have a 3.5 cumulative grade-point average or better, particularly in the social sciences, high scores from the Graduate Record Examination, and strong letters of recommendation. However, each case is considered individually. In awarding financial aid to entering students, preference is given to those students who have been admitted directly to the Ph.D. program.

Applications for September admission should be submitted no later than February 1 by students seeking financial assistance; otherwise by March 1. Transcripts, Graduate Record Examination scores, three letters of recommendation, and a writing sample are required.

The graduate program offers concentrations in six areas: political theory, international relations, comparative politics, women and politics, public law, and American politics. Candidates for the Ph.D. select a major area of study from among the six concentrations. To qualify in the major area of study, a student must first pass a written and then an oral examination. The written examination is take-home and open-book and each student has twenty-four hours to complete it. In addition to the major field, Ph.D. students must work in two additional, minor, fields. To qualify in the first minor field, a candidate must pass a written exam. In the second minor field, students must attain a cumulative grade-point average higher than 3.5 in at least three courses. Individual fields may require more than three courses and may designate further specific requirements. Having successfully passed all examinations, the candidate must submit a dissertation proposal within six months.

Students typically take proseminars in the major and minor areas (9 credits). Grading in proseminars is based principally on written exams and no research papers are assigned in those seminars. Ph.D. candidates must also take a two-term methods sequence, 16:790:532-533 Research Design in Political Science, that includes elements of research design, quantitative methods, and epistemology of the social sciences. They must also complete three or four research courses with at least two different instructors (9 to 12 credits), and seven or eight substantive electives (21 to 24 credits) either inside or outside of the program. A total of 48 credits of course work and a significant independent research paper must be completed prior to taking the Ph.D. qualifying examinations.

A full description of the program may be found in the brochure Graduate Program in Political Science, which is available from the department.

Graduate Courses

16:790:501. PROSEMINAR IN AMERICAN POLITICS (3)
Overview of American politics. Topics include individual and institutional levels, the relationship between citizens and institutions, and the relationships between institutions.

16:790:503. PROSEMINAR: APPROACHES TO COMPARATIVE ANALYSIS (3)
Scope and practice of the field: nature of comparison; approaches to comparison; examples of current research on selected topics.

16:790:505. CONSTITUTIONALISM AND JUDICIAL POLITICS (3)
Role of the federal courts in the American system of democracy. Normative and empirical assessments of the foundations of judicial review and the alleged counter-majoritarian problem; interactions between courts and the other electorally accountable branches; the role of litigants and mobilization processes in the judicial development of doctrine and policy.

16:790:506. (S) CONTEMPORARY CONSTITUTIONAL ISSUES (3)
Current public policy questions explored in the judicial forum, both national and state. A variety of research methods employed.

16:790:507. (S) COMPARATIVE STATE POLITICS (3)
Comparative analysis of the problems of all fifty states. Major factors and political processes that shape the outcomes of state politics. A variety of approaches used in comparative analysis.

16:790:509. (S) PUBLIC ADMINISTRATION AND BUDGETING (3)
Organizational theory and decision making; bureaucratic politics; the relationship of the bureaucracy to legislatures and chief executives. Special emphasis on problems of public finance, budgeting procedures, and fiscal analysis.

16:790:510. PUBLIC POLICY (3)
An introduction to the formulation and implementation of public policy with an emphasis on federal policy-making, models for policy choice, and intergovernmental policy problems. A major portion of the course devoted to student projects that analyze the formulation and implementation of a governmental program.

16:790:511,512. PROSEMINAR IN POLITICAL THOUGHT:
PLATO TO MARX (3,3)
Corequisites: 01:790:371,372.
An intensive course in the history of Western political thought from Plato to J.S. Mill.

16:790:513. PHILOSOPHY OF POLITICAL INQUIRY (3)
Prerequisites: 16:790:511,512, or permission of instructor.
Introduction to the major issues in political and social inquiry in the broad perspective of the philosophy of the social sciences. Epistemology, methodology, and historiography in political theory and political science.

16:790:514. AMERICAN POLITICAL THOUGHT (3)
Corequisites: 01:790:375,376, or permission of instructor.
Major themes in American political thought from the seventeenth century to the present; emphasis on contemporary movements and ideas, including the new left, the new right, and black thought.

16:790:517. DEMOCRACY, VALUES, AND PUBLIC POLICY:
THEORETICAL FOUNDATIONS (3)
Theoretical foundations of public policy in a democracy. Complementarity and conflict between such fundamental values as liberty, equality, justice, security, efficiency, quality (of life), planning, community, fraternity, individuality, and privacy; theoretical implications of distinctions between public and private goods, interests, and values.

16:790:521. PROSEMINAR: THEORIES OF INTERNATIONAL
POLITICS (3)
Contemporary approaches to the study of international systems and the behavior of their national subsystems.

16:790:522. THEORIES OF WAR AND PEACE (3)
Levy, Vasquez, Midlarsky, Licklider
A survey of the existing theories and explanations of the causes of war and the conditions of peace.

16:790:523. POLITICS OF AFRICA (3)
Problems particular to African political development; colonial experience, one-crop economies, traditional social arrangements, ethnic particularism, and party organization.

16:790:524. MASS MEDIA AND POLITICS (3)
The role, structure, and effects of mass media. Topics include models of mass communication, government regulation, the media as information sources and agents of socialization, media influence on candidate evaluation and voting.

16:790:527. ANCIENT AND MEDIEVAL POLITICAL PHILOSOPHY (3)
Representative primary texts and significant secondary literature, emphasizing major controversies in the interpretation of classical or medieval political philosophy. Readings selected from the works of Plato, Aristotle, Cicero, Augustine, Aquinas, and their respective contemporaries.

16:790:528. POLITICAL SOCIALIZATION (3)
Theories and empirical findings in political socialization. Emphasizes alternative theoretical approaches and the role of socializing agents.

16:790:530. PROSEMINAR: EXPLANATIONS OF FOREIGN POLICY (3)
Systematic analysis of factors influencing the foreign policies of states; patterns of relationships.

16:790:531. PROBLEMS IN AMERICAN POLITICS (3)
Selected specific problems in American politics, currently emphasizing state and local elections and campaigning.

16:790:532-533. RESEARCH DESIGN IN POLITICAL SCIENCE (3,3)
Research techniques, an introduction to probability and statistics, the logic of political inquiry, and the philosophy of the social sciences.

16:790:534. THE PRESIDENCY (3)
Introduction to the historical development of the presidency as well as significant dimensions of contemporary presidential politics. Contending approaches to studying the presidency. Topics include presidential selection; popular leadership; party politics; interest groups and social movements; and relations with Congress, the courts, and the bureaucracy.

16:790:535. THE LEGISLATIVE PROCESS (3)
State legislatures in the context of state politics, with emphasis on legislative behavior, legislative institutions, and the performance of legislative functions.

16:790:539. POLITICS OF THE MIDDLE EAST (3)
Prerequisite: 16:790:503.
Comparative analysis of nationalist movements, problems of social and cultural change, the Arab-Israeli dispute, and inter-Arab politics. Historical and contemporary perspectives.

16:790:541. POLITICAL CULTURE (3)
Strengths and weaknesses of different political culture approaches; importance of cultural variables for understanding political change.

16:790:542. POLITICAL ANTHROPOLOGY: COMPARATIVE
CULTURAL APPROACHES (3)
Approaches to the analysis of culture, e.g., semiotics, phenomenology, hermeneutics, structuralism, and critical theory; applications. Meaning in politics: the roles of symbol, myth, metaphor, rhetoric, ritual, religion, and performance.

16:790:544. COLLECTIVE IDENTITY: ETHNICITY AND
NATIONALISM (3)
Approaches to conceptualizing collective political identity; comparative analysis of different types of nationalism and its ethnic origins and modernity.

16:790:545. THEORIES IN POLITICAL ECONOMY (3)
Survey of the classical and contemporary literature from Smith and Marx to Lindblom and O'Connor. Normative, theoretical, and empirical implications of competing schools of thought.

- 16:790:547. FOUNDATIONS OF CAPITALISM AND THE MODERN STATE (3)
Comparative historical development of Euro-American capitalism and state structures, from 1450 through the industrial revolution. The role of class relations, state elites, international economic and geopolitical forces.
- 16:790:548. ADVANCED INDUSTRIAL SOCIETIES (3)
State and economy in Western Europe and North America. Cross-national variations in the relationship between state, class, and public policy.
- 16:790:551. COMMUNIST AND POST-COMMUNIST POLITICS (3)
Theories of communism (state socialism) and its rise and fall. Dialogues among Western Sovietology, mainstream comparative political science, and theories produced by the “natives” of state-socialist countries.
- 16:790:552. BUSINESS, POWER, AND POLITICS (3)
Relationship between economic and political power in the United States and other advanced industrial societies. Impact of business interest groups, economic elites, and governmental recruitment on policy making. Issues in power structure analysis.
- 16:790:553. SPECIAL TOPICS IN POLITICAL ECONOMY (3)
Specialized studies in political economy for advanced students. Topics vary by year and instructor.
- 16:790:554. COLLECTIVE PROTEST AND SOCIAL MOVEMENTS (3)
Introduction to the literature on collective action, protests, and social movements; recent examples in Eastern Europe; relationships between structure and agency and between structure and culture.
- 16:790:555. COMPARATIVE POLITICAL ECONOMY (3)
Special reference to the third world. Major periods of sociopolitical transformation: the breakdown of precapitalist social formations, imperialism, decolonization, and revolutionary change. Theories of political economy stemming from the developing world.
- 16:790:556. PROSEMINAR IN PUBLIC LAW (3)
An introduction to the major literature of the field; recent theories and methods in the study of the judicial process.
- 16:790:557. RENAISSANCE AND REFORMATION POLITICAL THOUGHT (3)
Prerequisites: 16:790:511,512, or permission of the instructor.
Western political thought from the fourteenth to the sixteenth centuries. Machiavelli, his predecessors and contemporaries, and the relationships between politics and religion in the Protestant Reformation.
- 16:790:558. THE BRITISH TRADITION (3)
Prerequisites: 16:790:511,512.
Social contract theory, utilitarianism, and empiricism in English political thought, with emphasis on the political sources and meanings of works by Hobbes, Locke, Smith, Burke, Hume, and John Stuart Mill.
- 16:790:559. METROPOLITAN POLITICS (3)
Conflict and consensus with respect to major urban problems: race, schools, housing, transportation, planning, renewal.
- 16:790:560. SEMINAR IN DOCTRINAL ANALYSIS (3)
Contemporary issues before the Supreme Court, the federal district courts, and the state supreme courts; modes of conflict resolution, substantive law findings, and judicial craftsmanship; the interplay of forces at different stages in the adjudicatory process.
- 16:790:561. POLITICAL ECONOMY OF LATIN AMERICA (3)
Relation between models of capital accumulation and the development of democratic and authoritarian regimes. Special reference to Brazil, Argentina, Chile, and Mexico.
- 16:790:563. AMERICAN POLITICAL ECONOMY (3)
The organization of American capitalism. Sources and limits of reform. Consideration of American “exceptionalism”: impact of party structure, federalism, separation of powers, ethnic and racial cleavages on class formation, and public policy.
- 16:790:564. COMPARATIVE LEGAL SYSTEMS (3)
Transnational approaches to judicial policy making with emphasis on mechanisms for the protection of basic freedoms; notions of equality under law; federal versus unitary systems in the distribution of powers; and the nature of the regulatory function in diverse societies.
- 16:790:565. (S) STUDIES IN ADMINISTRATIVE LAW (3)
An inquiry into the lawmaking and judicial function of administrative agencies; critical examination of selected cases drawn from federal and state practice.
- 16:790:567. EMPIRICAL STUDIES OF PEACE AND WAR (3)
Vasques, Levy, Midlarsky, Licklider. Prerequisites: Theories of War and Peace.
An examination of the empirical evidence on the onset of war, its expansion, the impact of war, and of factors associated with peace.
- 16:790:569. AMERICAN FOREIGN POLICY (3)
The institutions and events that have shaped American foreign policy in the postwar era. Roles of the president, Congress, the bureaucracy, the military, and public opinion. The influence of partisan, economic, and social pressures on the formulation and implementation of policy.
- 16:790:571. ELECTIONS AND PARTICIPATION (3)
The determinants and consequences of various forms of political participation. The relationship between structures such as electoral systems and citizen behavior. Theories of democracy in light of empirical findings.
- 16:790:572. POLITICAL PARTIES (3)
The structure and functioning of political parties. Emphasis on empirical studies of membership, nominations, party competition, campaigning, and finance.
- 16:790:578. FEMINISM IN POSTMODERNITY (3)
Political strategies for achieving gender equality in the context of contemporary feminist debates about the category of women, foundationalism, humanism, identity politics, and essentialism.
- 16:790:579. THE ENLIGHTENMENT: THE PHILOSOPHERS AND THEIR CRITICS (3)
Prerequisites: 16:790:511,512, or permission of instructor.
The political thought of Kant, Rousseau, and their contemporaries. Emphasis on Enlightenment responses to the political, educational, and moral problems of modernity.
- 16:790:580. THE NINETEENTH CENTURY: CONTINENTAL POLITICAL THOUGHT FROM HEGEL TO MARX TO NIETZSCHE (3)
Prerequisites: 16:790:511,512, or permission of instructor.
Topics in the political thought of selected theorists from sequences including Hegel, Herder, Marx, and Nietzsche; and de Maistre, Bonald, Comte, and Fourier.
- 16:790:581. TRANSNATIONAL PUBLIC POLICY (3)
New phenomena that defy the basic assumptions of the dominant realist, state-centric model of the global system, including nonstate actors, transnational issues, and new forms of influence.
- 16:790:582. PUBLIC OPINION (3)
Sources and consequences of public knowledge, beliefs, and attitudes about politics. The measurement of public opinion. Political ideology. Linkages between public opinion and public policy.
- 16:790:584. (S) THEMES IN FEMINIST THEORY IN POLITICS (3)
In-depth study of a particular tradition or key debate within contemporary feminist theory. Themes vary.

16:790:585. SOCIAL CLASS AND IDEOLOGY (3)

Effects of changes in the organization of work and labor markets on political behavior and consciousness. Consequences of race, gender, and ethnicity for class formation.

16:790:586. PSYCHOLOGY OF POLITICAL BEHAVIOR (3)

Introduction to basic explanatory theories at the individual level of analysis. Topics may include personality, attitudes, political cognition, group influences, political socialization, and behavioral decision theory.

16:790:587. PROSEMINAR IN WOMEN AND POLITICS (3)

Introduction to approaches, methods, and debates in interdisciplinary feminist scholarship that are useful in analyzing politics.

16:790:588. GENDER AND MASS POLITICS (3)

Gender-related influences on political attitudes, voting behavior, and other forms of political participation. Effects of feminist consciousness on attitudes and behavior.

16:790:589. WOMEN AND POLITICAL LEADERSHIP (3)

The history, background, recruitment, and performance of women in leadership positions. Women leaders' relationship to power and their impact on public policy and public institutions.

16:790:590. GENDER AND POLITICAL THEORY (3)

Analysis of political theory as a signifying practice. The discursive uses of gender in delineating the public sphere, constituting the citizen-subject, and articulating the relations of nation and class.

16:790:591. GENDER AND PUBLIC POLICY (3)

Theoretical and policy questions raised by issues related to gender inequality including: welfare and poverty, reproductive rights, violence against women, women and work, health policy, and women and militarism.

16:790:592. POLITICS, DEVELOPMENT, AND WOMEN (3)

The political, social, and cultural impact of developmental processes on women. Theories of development and feminist critiques.

16:790:594. WOMEN'S MOVEMENTS IN COMPARATIVE PERSPECTIVE (3)

Development and impact of women's movements in cross-cultural perspective. Analysis of the conditions and implications of women's participation in movements such as nationalist, labor, and independent women's movement.

16:790:595. ADVANCED SURVEY RESEARCH (3)

Sample design, questionnaire construction, interviewer training and evaluation, analysis of survey data, and preparation of proposals for potential users.

16:790:596. ADVANCED TOPICS IN WOMEN AND POLITICS (3)

Seminar offered on occasion on topics of special interest to students of women and politics.

16:790:597,598. EMERGING TRENDS IN POLITICAL SCIENCE (1,1)
Shafer

Seminars by eight visiting scholars, each presenting an unpublished paper. Topics vary, but papers are chosen for their empirical and theoretical contributions to the field.

16:790:599. RESEARCH SEMINAR IN POLITICAL SCIENCE APPLICATIONS OF QUANTITATIVE METHODS (3)

Intensive study and research application of selected methods.

16:790:605. PHILOSOPHY OF LAW AND JURISPRUDENCE (3)

The nature of law and its relation to other normative systems; major legal philosophies. Other topics include legal reasoning, the enforcement of morality, and the justification of punishment.

16:790:607. CONTEMPORARY PHILOSOPHY AND POLITICS (3)

Recent developments in philosophy and their implications for politics and political theory.

16:790:610. RESEARCH TOPICS IN POLITICAL PHILOSOPHY (3)

An intensive research seminar for advanced students. Topics vary from year to year.

16:790:611. ADVANCED RESEARCH IN POLITICAL ECONOMY (3)

Working faculty-graduate student seminar. Presentations of original research.

16:790:612. SEMINAR IN LAW AND POLITICS (3)

Intensive study of selected problem areas that may include issues in criminal justice, law and society, and judicial decision making.

16:790:613. LAW, COURTS, AND THE POLITICS OF SOCIAL REFORM (3)

Role of law and courts in the politics of social reform in the U.S. Various ways of understanding and investigating the interplay of law and politics in reform projects, with an emphasis on recent developments in the legal academy (e.g., feminist legal theory, critical race theory), as well as in political science.

16:790:614. ADVANCED TOPICS IN PUBLIC LAW (3)

Open only to upper-level Ph.D. candidates.
An advanced research seminar in public law provides an opportunity for the design of doctoral research projects and the investigation of their feasibility.

16:790:616. THE UNITED STATES CONGRESS (3)

Introduces students to the major components of Congress: congressional elections; the committees; congressional leadership; the legislative process, interest groups, and the relations of Congress with the president and the courts.

16:790:623. SEMINAR IN CONSTITUTIONAL LAW (3)

An advanced seminar with emphasis on individual research projects assessing judicial craftsmanship and doctrinal lines of inquiry.

16:790:626. MORALITY AND WAR (3)

The realism-moralism debate, explored through such authors as Niebuhr, Morgenthau, and Osgood; the role of moral considerations in international affairs examined through cases such as the use of force across national borders and the human rights issue.

16:790:627. TOPICS IN INTERNATIONAL POLITICS (3)

Open only to advanced students.
Specialized studies and research in international politics. Topics include mathematical models in international politics and peace research methods and literature.

16:790:630. INTERNATIONAL POLITICAL ECONOMY (3)

Topics that develop the theory of the structure and dynamic of the global political economy. A current emphasis is on the development of the post-Depression World War II international economy, especially relations among OECD countries.

16:790:633. MULTIVARIATE TECHNIQUES (3)

Focus on multiple regression, but may also include categorical regression, factor analysis, causal modeling, analysis of variance, etc. Heavy emphasis on computer applications.

16:790:634. GAME THEORY FOR POLITICAL SCIENTISTS (3)

Introductory course in game theory for political science graduate students.

16:790:635. FRENCH FEMINIST THEORY (3)

Prerequisite: Permission of instructor.
Linguistic, philosophical, and political tradition of French feminist thought. Readings drawn from Freud, Lacan, D  rri  da, Beauvoir, Irigaray, Kristeva, and Wittig.

16:790:640. RESEARCH SEMINAR ON WAR AND PEACE (3)

Midlarsky, Vasquez, Levy, Licklider. Prerequisites: 16:790:522, 567.
Original research conducted in the area of war and peace.

16:790:651. SEMINAR IN PUBLIC ADMINISTRATION AND POLICY ANALYSIS (3)
Readings in the specialized literature on bureaucracy, followed by the presentation and discussion of individual design for research on a special topic.

16:790:654. QUANTITATIVE APPROACHES TO INTERNATIONAL RELATIONS (3)
Major current attempts to build an empirically based theory of international politics. Data-generation techniques, methods of testing, and substantive findings.

16:790:667. RESEARCH SEMINAR IN POLITICAL PSYCHOLOGY (3)
An advanced seminar examining in depth, through individual research, selected topics in political psychology.

16:790:670. INDEPENDENT STUDY IN INTERNATIONAL RELATIONS (3)

16:790:671. INDEPENDENT STUDY IN PUBLIC LAW (3)

16:790:672. INDEPENDENT STUDY IN WOMEN AND POLITICS (3)

16:790:673. INDEPENDENT STUDY IN POLITICAL THEORY (3)

16:790:674. INDEPENDENT STUDY IN POLITICAL ECONOMY (3)

16:790:676. INDEPENDENT STUDY IN AMERICAN INSTITUTIONS AND POLICY (3)

16:790:677. INDEPENDENT STUDY IN COMPARATIVE POLITICS (3)

16:790:678. INDEPENDENT STUDY IN METHODOLOGY (3)
16:790:680. ADVANCED TOPICS IN INTERNATIONAL RELATIONS (3)
Open only to upper-level Ph.D. students.
An advanced research seminar in international relations, intended to provide an opportunity for the design of doctoral research projects and the investigation of their feasibility.

16:790:701,702. RESEARCH IN POLITICAL SCIENCE (BA,BA)
Designed to provide students working on M.A. and Ph.D. theses with credit for their research.

PSYCHOLOGY 830

Degree Programs Offered: Master of Science *, Doctor of Philosophy
Director of Graduate Program: Professor Charles Flaherty,
Psychology Building, Busch Campus (732/445-2556)
Vice Chair, Graduate Studies: Professor George Wagner,
Psychology Building, Busch Campus (732/445-2555)

Members of the Graduate Faculty

John R. Aiello, Professor of Psychology, FAS-NB; Ph.D., Michigan State
Industrial and organizational psychology; environmental stress;
nonverbal communication
Clayton P. Alderfer, Professor of Psychology, GSAPP; Ph.D., Yale
Group and intergroup relations; organizational diagnosis;
race relations; leadership
Phipps Arabie, Professor of Marketing, GSM; Ph.D., Stanford
Richard D. Ashmore, Professor of Psychology, FAS-NB; Ph.D., California
(Los Angeles)
Intergroup relations; female and male relations
George E. Atwood, Professor of Psychology, FAS-NB; Ph.D., Oregon
Theories of personality; psychobiography and psychotherapy
Sidney B. Auerbach, Associate Professor of Biological Sciences, FAS-NB; Ph.D.,
Wisconsin (Madison)
Serotonin
Ronald J. Barfield, Professor of Biology, FAS-NB; Ph.D., California (Los Angeles)
Behavioral neuroendocrinology
Nicholas J. Belkin, Professor of Library and Information Studies, SCILS;
Ph.D., London
Information science and technology

David M. Brodzinsky, Associate Professor of Psychology, FAS-NB; Ph.D.,
SUNY (Buffalo)
Cognitive development; adoption and foster care
Bert R. Brown, Associate Professor of Psychology, FAS-NB; Ph.D., Columbia
Interpersonal and intergroup studies in conflict
Brenna H. Bry, Professor of Psychology, GSAPP; Ph.D., Missouri (Columbia)
Prevention of substance abuse and other adolescent problems
J. Douglas Carroll, Board of Governors' Professor of Management, GSM;
Ph.D., Princeton
Theory and methods of multidimensional scaling and related techniques
Gretchen Chapman, Assistant Professor of Psychology, FAS-N;
Ph.D., Pennsylvania
Medical decision making; physician reasoning; patient preferences
George H. Collier, Professor Emeritus of Psychology, FAS-NB;
Ph.D., Indiana
Ecological and bioenergetic bases of behavior
Richard J. Contrada, Associate Professor of Psychology, FAS-NB; Ph.D., CUNY
Behavior and health; psychophysiological mechanisms in cardiovascular disease
Richard De Lisi, Professor of Educational Psychology, GSE; Ph.D., Catholic
Cognitive development
M. David Egger, Professor of Neuroscience and Cell Biology, UMDNJ-RWJMS;
Ph.D., Yale
Neurophysiology; neuroanatomy; neurogenetics
Maurice Elias, Professor of Psychology, FAS-NB; Ph.D., Connecticut
Child and adolescent clinical, school, and community preventive psychology
Yakov Epstein, Professor of Psychology, FAS-NB; Ph.D., Columbia
Effects of environment on behavior; communication patterns
John L. Falk, Professor of Psychology, FAS-NB; Ph.D., Illinois
Operant conditioning; determinants of drug-taking
Jacob Feldman, Assistant Professor of Psychology, FAS-NB; Ph.D., Massachusetts
Institute of Technology
Theory of categorization; computational vision
Hans Fisher, Professor of Nutritional Sciences, CC; Ph.D., Illinois
Alcoholism and neurotransmitter metabolism
Charles F. Flaherty, Jr., Professor of Psychology, FAS-NB; Ph.D., Wisconsin
Conditioning of drug effects; incentive relativity
Jerry A. Fodor, Professor of Philosophy, FAS-NB; Ph.D., Princeton
Psycholinguistics; cognition
Cyril M. Franks, Professor Emeritus of Psychology, GSAPP; Ph.D., London
Conceptual foundations of behavior therapy
Ronald Gandelman, Professor of Psychology, FAS-NB; Ph.D., Massachusetts
Hormones and behavior
Arnold L. Glass, Associate Professor of Psychology, FAS-NB; Ph.D., Stanford
Semantic memory; psycholinguistics; neuropsychology
John B. Gormly, Associate Professor of Psychology, FAS-NB; Ph.D., Illinois
Personality
Leonard W. Hamilton, Professor of Psychology, FAS-NB; Ph.D., Chicago
Feeding behavior
Sandra L. Harris, Professor of Psychology, FAS-NB/GSAPP; Dean of the Graduate
School of Applied and Professional Psychology; Ph.D., SUNY (Buffalo)
Autism
Jeannette M. Haviland, Professor of Psychology, FAS-NB; Ph.D., Michigan State
Social and emotional development
Ivan Z. Holowinsky, Professor of Educational Psychology, GSE; Ed.D., Temple
Mental retardation; comparative psychology
Judith Hudson, Associate Professor of Psychology, FAS-NB; Ph.D., CUNY
Cognitive, language, and memory development in children;
autobiographic memory
Carlton T. James, Associate Professor of Psychology, FAS-NB; Ph.D., Indiana
Clinical psychology
Edward E. Johnson, Professor of Psychiatry, UMDNJ-RWJMS; Ph.D., Colorado
Assessment; locus of control in the elderly
Bela Julesz, State of New Jersey Professor of Psychology and Director, Laboratory
of Vision Research, FAS-NB; Ph.D., Hungarian Academy of Science
Visual perception of depth, movement, textures, and form
Lee Jussim, Associate Professor of Psychology, FAS-NB; Ph.D., Michigan
Social interaction, person perception, the self, expectations, and stereotypes
Robert A. Karlin, Associate Professor of Psychology, FAS-NB; Ph.D., Rutgers
Hypnotizability; psychotherapy; psychopathology
Eileen Kowler, Professor of Psychology, FAS-NB; Ph.D., Maryland
Eye movements and visual information processing; attention
Deirdre A. Kramer, Associate Professor of Psychology, FAS-NB; Ph.D., Temple
Life-span development; adult development and aging
George M. Krauthamer, Professor of Anatomy, UMDNJ-RWJMS; Ph.D.,
New York
Sensory-motor integration
Kenneth Kressel, Associate Professor of Psychology, FAS-N; Ph.D., Columbia
Mediation of conflict; interpersonal negotiations
Erich W. Labouvie, Professor of Psychology, CAS; Ph.D., West Virginia
Life-span methodology; adult socioemotional development
Richard R. Lau, Associate Professor of Political Science, FAS-NB; Ph.D.,
California (Los Angeles)
Mass politics

* The department does not offer a terminal master's program.

- Arnold A. Lazarus, Professor of Psychology, GSAPP; Ph.D., Witwatersrand
Clinical psychology; multimodal assessment and therapy
- Russell C. Leaf, Associate Professor of Psychology, FAS-NB; Ph.D., Pennsylvania
Educational alternatives to psychotherapy
- Paul Lehrer, Professor of Psychology, UMDNJ-RWJMS; Ph.D., Harvard
Biofeedback; relaxation; behavioral medicine
- Alan Leslie, Professor of Psychology, FAS-NB; Ph.D., Oxford
Cognitive architecture in development; child's theory of mind; cognitive
neuropsychology of autism
- Howard Leventhal, Board of Governors Professor of Psychology, FAS-NB/
IHHCPAR; Ph.D., North Carolina (Chapel Hill)
Behavioral, cognitive, and emotional factors in health and health decisions
- Michael Lewis, Professor of Psychology, UMDNJ-RWJMS; Ph.D., Pennsylvania
Socioemotional development; infancy
- Michael Leyton, Associate Professor of Psychology, FAS-NB; Ph.D.,
California (Berkeley)
Mathematical theories of cognitive representation, shape perception
- Joseph V. Martin, Associate Professor of Biology, FAS-C; Ph.D., Southern
California (Los Angeles)
Hormonal or drug modulation of GABAA receptor function in sleep and waking
- Louis D. Matzel, Associate Professor of Psychology, FAS-NB; Ph.D.,
SUNY (Binghamton)
Molecular and biophysical mechanisms of memory induction and storage
- Barbara S. McCrady, Professor of Psychology, GSAPP/CAS; Ph.D., Rhode Island
Alcoholism; behavior therapy; marital relationships
- Lorraine McCune, Associate Professor of Education, GSE; Ed.D., Rutgers
Developmental and educational psychology
- David Mechanic, University Professor and René Dubos Professor of Behavioral
Sciences; Ph.D., Stanford
Decision making in medicine and psychiatry
- Stanley Messer, Professor of Psychology, GSAPP; Ph.D., Harvard
Psychoanalytic psychotherapy; cognitive style
- Edith D. Neimark, Professor Emerita of Psychology, FAS-NB; Ph.D., Indiana
Thinking and cognitive development
- Daniel Ogilvie, Professor of Psychology, FAS-NB; Ph.D., Harvard
Identity structure and personality; aging
- Ann M. O'Leary, Associate Professor of Psychology, FAS-NB; Ph.D., Stanford
Cognitive behavior change; AIDS prevention; pain management;
psychoimmunology
- Timothy Otto, Assistant Professor of Psychology, FAS-NB; Ph.D., New Hampshire
Cortical-hypocampal interactions and memory
- Nathanial J. Pallone, University Professor of Psychology; Ph.D., New York
Personality and criminal behavior; clinical treatment of criminal offenders
- Robert J. Pandina, Professor of Psychology and Director of the Center
of Alcohol Studies, GSAPP/CAS; Ph.D., Vermont
Alcoholism
- Thomas V. Papatthomas, Professor of Biomedical Engineering, CE;
Ph.D., Columbia
Motion, depth, and texture perception; computer graphics; image processing
- Lawrence Pervin, Professor of Psychology, FAS-NB; Ph.D., Harvard
Clinical psychology; personality
- Donald R. Peterson, Professor Emeritus of Psychology, GSAPP;
Ph.D., Minnesota
Dyadic communication; interpersonal relationships
- Larissa A. Pohorecky, Professor of Alcohol Studies, CAS; Ph.D., Chicago
Physical and behavioral correlates of alcoholism
- Zenon W. Pylyshyn, Professor of Psychology, FAS-NB; Ph.D., Saskatchewan
Visual attention; foundations of cognitive science
- Richard Rende, *Assistant Professor of Psychology, FAS-NB; Ph.D.,
Pennsylvania State
Clinical and genetic epidemiology*
- Raymond C. Rosen, Professor of Psychiatry, UMDNJ-RWJMS; Ph.D., SUNY
(Stony Brook)
Psychophysiology of sexual response, sleep, antihypertensive therapies
- Seymour Rosenberg, Professor of Psychology, FAS-NB; Ph.D., Indiana
Person perception; personal identity
- Carolyn Rovee-Collier, Professor of Psychology, FAS-NB; Ph.D., Brown
Infant learning and memory; comparative development
- Laurie A. Rudman, *Assistant Professor of Psychology, FAS-N; Ph.D., Minnesota
Social cognition; intergroup relations; impression management and social
influence; attitudes and social behavior; implicit attitude measurement*
- Louis A. Sass, Professor of Psychology, GSAPP; Ph.D., California (Berkeley)
Schizophrenia; assessment; philosophy of psychology
- H. Richard Schiffman, Professor of Psychology, FAS-NB; Ph.D., North Carolina
Perception
- Charles F. Schmidt, Professor of Psychology, FAS-NB; Ph.D., Iowa
Human and machine planning and plan recognition; artificial intelligence
- Judith M. Stern, Professor of Psychology, FAS-NB; Ph.D., Rutgers
Sexual and maternal behaviors in animals and women
- Karin J. Stromswold, Assistant Professor of Psychology, FAS-NB; Ph.D.,
Massachusetts Institute of Technology; M.D., Harvard
Language acquisition, cognitive and neural bases of language,
functional neuroimaging
- Arthur Tomie, Associate Professor of Psychology, FAS-NB; Ph.D., Colorado
Stimulus properties of drugs; intracranial self-stimulation
- George Wagner, Professor of Psychology, FAS-NB; Ph.D., Chicago
Parkinson's disease and schizophrenia
- Arlene S. Walker-Andrews, Professor of Psychology, FAS-NB; Ph.D., Cornell
Perceptual and cognitive development; autism
- Thomas J. Walsh, Associate Professor of Psychology, FAS-NB; Ph.D., Syracuse
Hippocampal function; animal models of CNS diseases; trophic factors
- Neil D. Weinstein, Professor of Human Ecology and Psychology, FAS-NB;
Ph.D., Harvard
Health behavior; environmental stress; risk perception
- Mark O. West, Associate Professor of Psychology, FAS-NB; Ph.D., Bowman Gray
Analysis of basal ganglia and limbic circuits during behavior and in response
to drugs
- David A. Wilder, Professor of Psychology, FAS-NB; Ph.D., Wisconsin
Social perception; intergroup relations
- G. Terence Wilson, Oscar K. Buros Professor of Psychology, GSAPP; Ph.D.,
SUNY (Stony Brook)
Behavior therapy
- Robert L. Woolfolk, Professor of Psychology, FAS-NB; Ph.D., Texas (Austin)
Behavior therapy

Associate Members of the Graduate Faculty

- Beth Adelson, Assistant Professor of Psychology, FAS-C; Ph.D., Harvard
Applied and theoretical issues in human problem solving; development
of computational models; human-computer interaction based software systems
- Marsha Bates, Assistant Research Professor of Psychology, CAS; Ph.D., Rutgers
Neurocognitive functioning and alcohol
- James R. Bergen, Research Staff, Sarnoff Laboratories, Princeton; Ph.D., Chicago
Human visual processes and machine vision
- Philip Bobko, Professor of Management, SB-NB; Ph.D., Cornell
Research methods; measurement; personnel; organizational behavior
- Angelo S. DeNisi, Professor of Industrial Relations and Human Resources, SMLR;
Ph.D., Purdue
Cognitive processes in performance appraisal; job analysis
- Nancy S. Fagley, Associate Professor of Psychology, GSAPP; Ph.D., Utah
Decision making and cognitive processes of professional psychologists
- Daniel B. Fishman, Professor and Director of Psychological Services, GSAPP;
Ph.D., Harvard
Planning and evaluation of mental health delivery systems
- Barbara Forisha-Kovach, Professor of Psychology, FAS-NB; Ph.D., Maryland
Organizational psychology
- Michael A. Gara, Associate Professor of Psychiatry, UMDNJ-RWJMS;
Ph.D., Rutgers
Personal identity; identity and psychopathology; person perception
- Melvin Lee Gary, Associate Professor of Psychology, FAS-NB; Ph.D., Ohio State
Prejudice; cognitive styles and social perception
- William K. Hallman, Assistant Professor of Human Ecology, FAS-N; Ph.D.,
North Carolina
Risk perception; risk communication; individual and community responses
to environmental hazards
- Jan S. Handleman, Educational Director of Douglass Developmental Disabilities
Center, FAS-NB; Ed.D., Rutgers
Education and treatment of autistic persons
- Deane F. Johnson, Research Associate in Psychology, FAS-NB; Ph.D.
Oregon (Portland)
How ecology and hormones affect feeding, social, and reproductive behavior
- Harry R. Kissileff, Associate Professor of Clinical Psychology; Columbia Medical
School; Ph.D., Pennsylvania
Controls of food intake and food intake-related reward in humans
- James W. Langenbucher, Assistant Professor of Alcohol Studies, CAS;
Ph.D., Rutgers
Diagnosis/nosology of substance use disorders; socioeconomics and addictions
treatment policy
- Sandra Leiblum, Associate Professor of Psychology, UMDNJ-RWJMS;
Ph.D., Illinois
Female sexuality; menopause; infertility
- Robert Matthews, Professor of Philosophy, FAS-NB; Ph.D., Cornell
Psycholinguistics; formal models of language acquisition
- Michael H. Miller, Professor of Psychiatry, UMDNJ-RWJMS; Ph.D., Illinois
Institute of Technology
Neuroanalytical correlates of cognitive performance
- Jonathan Morgenstern, Assistant Research Professor, CAS; Ph.D., New York
Alcoholism; treatment processes
- Mark Roffman, Adjunct Associate Professor of Psychiatry, UMDNJ-RWJMS;
Ph.D., Rhode Island
Psychopharmacology
- Michael R. Solomon, Associate Professor of Marketing, SB-NB; Ph.D.,
North Carolina (Chapel Hill)
Effects of material symbolism on self-concept, social identity, and person
perception; psychology of fashion; dyadic interactions in consumption settings

Margaret W. Sullivan, Adjunct Associate Professor of Pediatrics, UMDNJ-RWJMS; Ph.D., Rutgers
Socialization of infant/anger; technology as an intervention with developmentally disabled infants and preschoolers

James T. Walkup, Assistant Professor of Psychology, GSAPP; Ph.D., New School for Social Research
Serious mental illness; combined mental and physical disorders; disability

Michael Wogan, Associate Professor of Psychology, FAS-C; Ph.D., North Carolina Group psychotherapy

John Worobey, Associate Professor of Nutritional Sciences, CC; Ph.D., Pennsylvania State
Socioemotional development; infant nutrition and behavior

Adjunct Members of the Graduate Faculty

James E. Barrett, Assistant Vice President, CNS Research, Wyeth-Ayerst Research; Ph.D., Pennsylvania State
Behavioral and neurochemical research on drug abuse, anxiety, depression; neurochemical correlates of behavioral processes

April Benasich, Assistant Research Professor of Neuroscience, FAS-N/CMBN; Ph.D., New York
Infant perception and cognition; developmental neuropsychology

Elizabeth E. Epstein, Assistant Research Professor of Alcohol Studies, CAS; Ph.D., Connecticut
Individual differences among substance abusers, including family history, personality, and comorbid psychopathology; marital therapy for alcoholic males and their spouses; children of alcoholics

James T. Winslow, Senior Research Pharmacologist, Hoechst-Roussel; Ph.D., Tufts
Behavioral endocrinology and pharmacology

Programs

Areas of specialization include biopsychology and behavioral neuroscience, clinical psychology, cognitive psychology, social psychology, interdisciplinary developmental psychology, and interdisciplinary health psychology.

Part-time students are not accepted into the program. New graduate students must have had an undergraduate course in experimental psychology with laboratory and a course in statistics. There is no language requirement.

Specific course requirements and options are normally established by each area. To the greatest possible extent, students' programs are tailored to their career goals. A minimum of 48 course credits and 24 research credits are required in the Ph.D. program.

In addition to the Ph.D. program in clinical psychology, a Doctor of Psychology (Psy.D.) degree in clinical or school psychology is offered by the Graduate School of Applied and Professional Psychology. This program is described in the catalog of that professional school.

Graduate Courses

16:830:500. SOCIAL PSYCHOLOGY COLLOQUIA (N1)

Required of all first-year social psychology students.
Series of colloquia, lectures, and panel discussions as an introduction to the discipline and profession of social psychology.

16:830:501,502. NONTHESIS RESEARCH (BA,BA)

6:830:503,504. ADVANCED STUDIES IN PSYCHOLOGY (3,3)
A reading and individual study course; students arrange with members of the staff for direction and guidance; regular conferences scheduled and both written and oral reports submitted.

16:830:505. THEORIES AND ISSUES IN DEVELOPMENTAL PSYCHOLOGY (3)

Kramer. Prerequisite: Permission of instructor. Offered in alternate years.
Models and theory in developmental psychology. Emphasis upon metatheoretical and theoretical issues, including theories of cognitive, social, and emotional development.

16:830:506. SOCIAL PSYCHOLOGY (3)

Ashmore
A critical survey of concepts and current research in social psychology. Social perception, attitudes and attitude change, groups.

16:830:507. DEVELOPMENTAL RESEARCH METHODOLOGY (3)

Labouvie. Offered in alternate years.
Survey of descriptive and explanatory research methods for the study of behavioral change and development.

16:830:508. RESEARCH METHODS IN SOCIAL PSYCHOLOGY (3)

Conrada, Wilder
A critical examination of methodological problems in research involving human subjects including personality, social psychology, and health psychology. Topics include measurement, experimental and quasi-experimental design, operationalization, and threats to validity. Applications to students' research problems.

16:830:509. PRACTICUM: FIELD AND APPLIED RESEARCH (3)

Weinstein
Practical issues encountered in nonlaboratory settings; procedures and statistical analyses useful when true experimental designs cannot be employed; developing research proposals to meet needs of an organization; issues involved in consultation.

16:830:510. INTRODUCTION TO INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY (3)

Aiello
An overview of topics in personnel psychology (predictors, criteria, personnel decisions, interviews, training) and organizational psychology (motivation, job satisfaction, supervision, organizational structure).

16:830:511,512. ADVANCED TOPICS IN DEVELOPMENTAL PSYCHOLOGY (3,3)

Selected topics in developmental psychology, emphasizing theory and research. Offered by different faculty members as a special course in their particular area of expertise.

16:830:513. NEUROLINGUISTICS (3)

Stromswold. Prerequisite: Graduate student in psychology, linguistics, neuroscience, or philosophy; or permission of instructor.
Topics include functional neuroimaging studies of language (PET, fMRI, MEG), acquired and developmental language disorders, the relationship between language development and neural development, language acquisition after the critical period.

16:830:514. SENSATION AND PERCEPTION (3)

Theoretical and experimental approaches to the perception of form, motion, depth, texture, and color.

16:830:515. COMPUTATIONAL VISION (3)

Introduction to algorithms for computing environmental shape-from-stimulus cues and regularization procedures for choosing optimally economic solutions as related to the perception of surfaces and objects.

16:830:516. HUMAN INFANCY (3)

Walker-Andrews. Offered in alternate years.
Current theory and research in infant's socioemotional, motor, perceptual, cognitive, and language development.

16:830:517. INTERPERSONAL BEHAVIOR AND GROUP PROCESSES (3)

Observations of the development of an undergraduate self-analytic group used as the basis for the investigation of issues in the psychology of personality, interpersonal behavior, social structure, and the formation of group cultures.

16:830:518. PERSONALITY ASSESSMENT I (3)

Gomly
A survey of the logic and rationale of self-report personality assessment procedures and of experimental research procedures. Includes an informal presentation of multivariate data analysis procedures and a practicum in the use of experimental assessment procedures.

16:830:520. PRINCIPLES OF BIOPSYCHOLOGY (3)

Not open to biopsychology majors.
Survey of current theory and data from the fields of neuropsychology, Pavlovian and operant learning, neuropharmacology, and developmental psychobiology.

- 16:830:521. RESEARCH DESIGN AND ANALYSIS I (3)
Review of basic statistical theory, experimental design, and statistical techniques. Topics include descriptive statistics, probability, z-scores, t-tests, correlation, bivariate regression, one- and two-way analysis of variance, and elementary nonparametric analyses.
- 16:830:522. RESEARCH DESIGN AND ANALYSIS II (3)
Review of advanced topics in design and analysis, with emphasis on one or more of the following: multiple regression, multi-way analysis of variance including mixed designs and repeated measures, analysis of covariance, factor analysis, cluster analysis, and bootstrapping techniques.
- 16:830:523. COMPUTER APPLICATIONS IN PSYCHOLOGY (3)
Designed to introduce psychologists to the use of the computer in the control of experiments, simulation, and complex data analysis.
- 16:830:524. SENSORY PROCESSES (3)
Theory and data on the senses treated behaviorally and psychologically.
- 16:830:525,526. DEVELOPMENTAL SURVEY (1,1)
Three classes taught each term in 1-credit units. These may be elected independently.
A comprehensive review of theory, data, and methods in developmental psychology.
- 16:830:527,528. DEVELOPMENTAL LABORATORY (3,3)
Laboratory observation and experience parallel to coverage in 16:830:525,526 Developmental Survey.
- 16:830:535. LANGUAGE AND COMMUNICATION (3)
Structural properties and processing of language.
- 16:830:537. ADULT DESCRIPTIVE AND EXPERIMENTAL PSYCHOPATHOLOGY (3)
A systematic consideration of descriptive and experimental psychopathology, consisting of class discussion, student presentations, and research critiques.
- 16:830:538. CHILD DESCRIPTIVE AND EXPERIMENTAL PSYCHOPATHOLOGY (3)
Harris
Descriptive and experimental psychopathology of childhood, covering neurotic, psychotic, and antisocial behavior, learning disabilities, child abuse, and mental retardation. Systematic observation of parent and child interviews and evaluations.
- 16:830:540. MATHEMATICAL MODELS OF LEARNING, PERCEPTION, COGNITION (3)
Historical and current status of mathematical models of learning, perception, and cognition.
- 16:830:541. PERSONALITY THEORY (3)
Pervin
Nature, development, and role of theory in personality; major contemporary theories and relevant evidence.
- 16:830:542. ATTITUDE ORGANIZATION AND CHANGE (3)
Theories and research data on the formation, structure, and alternation of attitude.
- 16:830:543. CONDITIONING AND LEARNING (3)
Principles and applications of Pavlovian conditioning, instrumental learning, and stimulus control. Topics include conditioned drug tolerance, learned helplessness, and cognitive processes in animal behavior.
- 16:830:544. BEHAVIOR ANALYSIS (3)
Principles and application of operant conditioning; perspectives on the history and philosophy of science. Ethological perspectives.
- 16:830:545. EXPERIMENTAL ANALYSIS OF BEHAVIOR (3)
A survey of historical development and current concepts in operant conditioning.
- 16:830:546. MEMORY AND ATTENTION (3)
A survey of current theories and research in memory and attention.
- 16:830:547. COMPUTATIONAL MODELS OF COGNITION (3)
Computational approaches to cognition. Historical development of approach; formalisms, tools, and methodological challenges.
- 16:830:550. LANGUAGE DEVELOPMENT (3)
Offered in alternate years.
Theory and research on the acquisition of speech and language by young children.
- 16:830:551. PERSONALITY AND SOCIAL DEVELOPMENT (3)
Ogilvie. Offered in alternate years.
Theory and research on personality and social development.
- 16:830:552. PERCEPTUAL DEVELOPMENT (3)
Walker-Andrews. Offered in alternate years.
Effects of early rearing conditions, phylogenetic development, and development of children's and infants' perception of objects, persons, spatial arrays, pictures, and symbols.
- 16:830:553. SPECIAL TECHNIQUES IN BEHAVIOR THERAPY (3)
Research on and applications of a number of behavioral strategies in psychotherapy. Concentrates on individual, adult, outpatient psychotherapy, treatment of couples, families, and the use of small groups.
- 16:830:554. DEVELOPMENT OF COGNITIVE PROCESSES (3)
Offered in alternate years.
Cognitive development, including memory, language, and thinking.
- 16:830:556. HUMAN AND ANIMAL AGGRESSION (3)
Gandelman
An attempt to define aggressive behavior and to examine its function.
- 16:830:558. PSYCHOPHARMACOLOGY: THEORY AND PRACTICE (3)
Walsh
The neural, neurochemical, and behavioral bases of psychopharmacology. Peripheral and central nervous neurotransmission mechanisms, animal experimental methods, and the application of these methods to human problem areas in the behavioral effects of drugs, including learning, activity, dyskinesia, psychosis, tolerance, abuse, aggression, anxiety, and behavioral toxicology.
- 16:830:560. REGULATORY MECHANISMS OF BEHAVIOR (3)
Collier
The problem of behavior as part of the organism's regulatory mechanisms; the nature of and the physiological basis for hunger and thirst, the concepts of reinforcement, deprivation, and regulation.
- 16:830:566. ASSESSMENT AND TREATMENT OF ALCOHOL ABUSE AND ALCOHOLISM (3)
McCrary
Theory and research on alcohol problems, alcohol abuse, and alcohol dependence; models to conceptualize how people change; approaches to assessment; models of treatment. Experiential component.
- 16:830:567,568. NERVOUS SYSTEM AND BEHAVIOR I, II (3,3)
Welsh, West
Neural bases of reinforcement, motor behavior, and ingestive behavior.
- 16:830:572. CLINICAL PROSEMINAR I (3)
Woolfolk, Pervin
Basic philosophical issues, current theories of personality, and issues in personality research as they relate to clinical phenomena.

16:830:573. CLINICAL PROSEMINAR II (3)

Wilson. Open only to clinical psychology students. Introduction to issues, methods, and findings in contemporary experimental clinical psychology. Recent research presented and analyzed. Students read, digest, and analyze the clinical research literature and begin to devise their own research.

16:830:579. BIOPSYCHOLOGY OF BEHAVIORAL DEVELOPMENT (3)

Gandelman
Underlying processes that determine the course of behavioral and physiological development.

16:830:580. HISTORY AND SYSTEMS OF PSYCHOLOGY (3)

Rosenberg
Philosophical and scientific antecedents of modern psychology. Psychological systems of psychology, including structuralism, fundamentalism, behaviorism, gestalt, psychoanalysis. Recurrent issues in the history of psychology.

16:830:590. ETHOLOGY (3)

Lore
A critical examination of the theories and research of contemporary ethologists. Emphasis on the evolution and development of behavior in mammals.

16:830:591. CURRENT TOPICS IN PSYCHOLOGY (BA)

Prerequisite: Permission of instructor.
Review of recent developments within psychology.

16:830:602. PSYCHOLINGUISTICS (3)

Language comprehension and production, including syntactic and semantic analyses.

16:830:603,604. ASSESSMENT OF INFANCY AND EARLY CHILDHOOD (3,3)

Survey of theory and techniques used in diagnostic testing of infants and preschool children. Emphasis on Gesell, Cattell, and Bayley infant scales, Stanford-Binet, WPPSI, and other tests for preschool children.

16:830:607. PSYCHOLOGICAL MEASUREMENT (3)

Basic psychometric theory, including item weighting and analysis; foundations of reliability and validity determination; special correlational problems.

16:830:609. SOCIAL PSYCHOLOGY OF WORK (3)

Prerequisite: Permission of instructor.
Major dimensions of the experience of working (e.g., job content, worker participation, technology, and stress) and the implications of work in other life domains (social class and family life).

16:830:610. SOCIAL PSYCHOLOGY OF ORGANIZATIONS (3)

A social psychological analysis of major approaches to organizations, e.g., classical and open systems, and major topics, e.g., roles, environment, decision making, leadership, communications, health, conflict, and change.

16:830:611. SEMINAR: PERCEPTION (3)

Selected topics on theory and research in perception.

16:830:612. SEMINAR: SOCIAL PSYCHOLOGY (3)

Prerequisites: 16:830:506, 508, or permission of instructor.
Each section reviews an area of current research interest in social psychology. Topics vary and may include cardiovascular health psychology, health and social behavior, stress and illness, and social cognition.

16:830:613. SEMINAR: CONFLICT AND CONFLICT RESOLUTION (3)

Brown, Kressel. Prerequisites: 16:830:506, 508, or permission of instructor.
A critical examination of major theoretical and empirical approaches to the study of conflict.

16:830:615. TOPICS IN SOCIAL COGNITION (3)

Prerequisites: 16:830:506, 546, or permission of instructor. Offered in alternate years.
An examination of current theoretical and empirical approaches to social behavior from a cognitive orientation.

16:830:616. SEMINAR: PERSONALITY (3)

Prerequisite: 16:830:541 or permission of instructor.
A critical examination of theories of personality, with particular attention to the relationship between emotion and thought.

16:830:620. SEMINAR: THE DYNAMICS OF SMALL GROUPS (3)

Cohen, Epstein
Examination of the processes operating in several types of groups including families, work groups, adult psychotherapy groups, and children's groups. Includes participation in an experiential group, lectures, and the opportunity to plan and practice consultation and intervention skills with an ongoing group.

16:830:622. INTRODUCTION TO SURVEY RESEARCH (3)

Explores all stages in the survey process, e.g., research design, question construction and survey layout, sampling, interviewing, coding, analysis, and report writing. Covers face-to-face interviews plus mail and telephone surveys.

16:830:627,628. ADVANCED TOPICS IN DEVELOPMENT (3,3)

Intensive consideration of problems, methods, data, and theory in selected areas of development.

16:830:631,632. SEMINAR: PROBLEMS OF EXPERIMENTAL PSYCHOLOGY (3,3)

Critical examination of the literature on a relatively circumscribed topic of current research interest in experimental psychology.

16:830:634. PSYCHOPHARMACOLOGY TECHNIQUES (3)

Wagner
A laboratory/lecture course dealing with the behavioral and neurochemical procedures employed by neuropsychopharmacologists.

16:830:635. SEMINAR: SELECTED TOPICS IN LEARNING (3)

A detailed examination of limited research problem areas in learning.

16:830:636. NEUROENDOCRINE RESPONSES TO STRESS (3)

Pohorecky
Psychological factors initiating stress, physiological correlates of stress, and pathological consequences of stress.

16:830:637,638. SEMINAR: COGNITION (3,3)

Selected topics in cognition and cognitive science, including language, memory, attention, problem solving, thinking, and learning.

16:830:639. COGNITIVE ASSESSMENT (3)

The integration of various means of assessment and the communication of assessment findings; recent theory, research, principles of measurement, and sociocultural factors relevant to individual cognitive assessment; the administration and scoring of individual intelligence tests, interpretation of findings, use of findings for intervention.

16:830:641. SEMINAR: THINKING (3)

Treats in depth the literature of circumscribed topics in thinking.

16:830:642. SEMINAR IN BEHAVIOR THERAPY (3)

Franks. Considerable familiarity with the behavioral literature plus some practical experience presumed.
Focal and substantive issues in behavior therapy surveyed by way of closely monitored student participation in a small group. Writing skills, critical thinking, and scholarship stressed. Supplementary individual tutorials arranged.

16:830:645. MULTIMODAL BEHAVIOR THERAPY (3)

Lazarus

Traces the evolution of "broad-spectrum" to "multimodal" behavior therapy. Delineates the BASIC ID rationale with precise and specific intervention strategies across each modality. Emphasizes the application of multimodal methods to a variety of cases in different settings.

16:830:646. SEMINAR: PROBLEMS IN BEHAVIORAL NEUROSCIENCE (3)

Current problems in the physiological determinants of behavior. Preparation and presentation of student papers.

16:830:649. SOCIAL LEARNING THEORY (3)

Wilson. Requires knowledge of experimental approach to abnormal behavior, behavioral assessment, and methodology and design.

A critical approach to the basic theoretical and experimental underpinnings of behavior therapy within the context of social learning theory.

16:830:650. BEHAVIORAL TREATMENT OF ADDICTIVE BEHAVIOR (3)

Wilson

Seminar combining exposure to the behavioral literature on obesity and alcoholism with continuing analysis of clinical cases carried by participating students.

16:830:651,652. PRACTICUM IN CLINICAL PSYCHOLOGY I, II (3,3)

Second-year students in the clinical Ph.D. program see clients in the program's Psychological Clinic.

16:830:653. SEMINAR: PROBLEMS IN CLINICAL PSYCHOLOGY (3)

Current issues relevant to the technical, as contrasted with the professional, aspects of clinical psychology.

16:830:655,656. PRACTICUM IN CLINICAL PSYCHOLOGY III, IV (3,3)

Third-year students in the clinical Ph.D. program participate one day a week in a mental health or other human service agency.

16:830:657,658. INTERNSHIP IN CLINICAL PSYCHOLOGY (0,0)

Prerequisites: 16:830:655,656, and permission of instructor.

Required of candidates for the Ph.D. in clinical psychology.

Eleven months of supervised clinical experience in an approved psychological installation.

16:830:659. PRACTICUM IN BEHAVIOR CHANGE (3)

Prerequisite: Two years of graduate study in clinical psychology.

Advanced survey of current status of behavior modification research; practicum in behavior procedures.

16:830:660. PRACTICUM IN DEVELOPMENTAL PSYCHOLOGY (3)

Application of the principles of developmental psychology to a practical problem of development.

16:830:661. NEUROSCIENCE INTERNSHIP (3)

Wagner

Supervised research experience in an industrial setting.

16:830:701,702. RESEARCH IN PSYCHOLOGY (BA,BA)

PUBLIC HEALTH 832

Degree Program Offered: Doctor of Philosophy

Director of Graduate Program: Dr. George Rhoads, EOHSI, 681 Frelinghuysen Road, P.O. Box 1179, Busch Campus (732/445-0195)

Codirector: Dr. Michael Greenberg, Civic Square Building (732/932-0387, ext. 673) or EOHSI, 681 Frelinghuysen Road, P.O. Box 1179, Busch Campus (732/445-0196)

Application and General Information: 732/445-0199

Members of the Graduate Faculty

Michael A. Gallo, Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Albany Medical College

Metabolism of xenobiotics; hormone carcinogenesis; receptor action
Michael Gochfeld, Clinical Professor of Environmental and Community Medicine, UMDNJ-RWJMS; M.D., Albert Einstein, Ph.D., New York
Medical surveillance; biomonitoring

Karen Denard Goldman, Assistant Professor of Urban Studies and Community Health, EJBSPPP; Ph.D., New York
Community health education; training; curriculum

Bernard D. Goldstein, Chairperson and Professor of Environmental and Community Medicine and Professor of Medicine, UMDNJ-RWJMS; and Director, Environmental Occupational Health Sciences Institute; M.D., New York
Toxicity of oxidant air pollutants and benzene; environmental health policy

Dennis M. Gorman, Assistant Professor of Sociology, FAS-NB; Ph.D., Essex
Substance abuse prevention

Lois A. Grau, Associate Professor of Clinical Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Wisconsin (Milwaukee)
Gerontology; long term care; health services utilization

Michael R. Greenberg, Professor of Urban Studies and Community Health, EJBSPPP; Ph.D., Columbia
Geography of mortality, morbidity, and risk factors; hazardous waste management

Howard Kipen, Associate Professor of Environmental and Community Medicine and Director of Occupational Medicine, UMDNJ-RWJMS; M.D., California (San Francisco); M.P.H., Columbia

Clinical epidemiologic studies of occupational asthma and disease diagnosis
Paul J. Lioy, Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Rutgers

Human exposure to toxic substances from single and multiple media; health effects of ozone

Richard M. Lynch, Assistant Professor of Urban Studies and Community Health, EJBSPPP; Ph.D., C.I.H., UMDNJ-RWJMS and Rutgers

Industrial hygiene ergonomics; occupational safety and ergonomics

George Rhoads, Endowed Professor of Environmental and Community Health, UMDNJ-RWJMS; M.D., Harvard

Epidemiology of perinatal, environmental, and noninfectious health problems
William E. Strawderman, Professor of Statistics, FAS-NB; Ph.D., Rutgers

Decision and estimation theory and linear models
Daniel Wartenberg, Associate Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., SUNY (Stony Brook)

Epidemiologic methods; geographic patterns of disease

Clifford P. Weisel, Associate Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Rhode Island

Human exposure to organic compounds and trace metals

Nicholas Wright, Associate Professor of Environmental and Community Medicine, UMDNJ-RWJMS; M.D., New York; M.P.H., Michigan

Maternal health, fertility, and AIDS in third world countries

Associate Members of the Graduate Faculty

Ronald Cody, Associate Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ed.D., Rutgers
Statistical research design

Karen Erstfeld, Assistant Professor of Environmental Sciences, CC; Ph.D., Michigan

Biomarkers; bioavailability; environmental fate of chemicals

Audrey R. Gotsch, Professor of Environmental and Community Medicine, and Chief, Division of Consumer Health Education, UMDNJ-RWJMS; Dr.P.H., Columbia

Attitudes and practices of consumers and health professionals regarding health risks

Bob Hamer, Associate Professor of Psychiatry, UMDNJ-RWJMS; Ph.D., North Carolina (Chapel Hill)

Biostatistics; psychiatry; clinical trials

Jane Lewis, Assistant Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Dr.P.H., Texas

Planning, implementation, and promotion of programs

Sandra Mohr, Assistant Professor of Environmental and Community Medicine, UMDNJ-RWJMS; M.D., Kansas

Ergonomic problems; chemical inhalation

Michele Ochser, Assistant Professor of Urban Studies and Community Health, EJBSPPP; Ph.D., Columbia

Environmental and occupational health policy

Mark Robson, Executive Director of Rutgers Environmental and Occupational Health Services Institute; Ph.D., Rutgers

Pesticide use; policy; regulation and alternative pest control

Dona F. Schneider, Associate Professor of Urban Studies and Community Health, EJBSPPP; Ph.D., Rutgers

Geographic distribution of mortality, disease, and high risk behavior among children and young adults

Lynn Waishwell, Assistant Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Southern Illinois (Carbondale)

Needs assessment; multicultural issues; models of health behavior change

Bryan William, Assistant Professor of Environmental and Community Medicine, UMDNJ-RWJMS; Ph.D., Pennsylvania State University
Education and sociobehavioral assessment; epidemiology; risk communication
Nancy Wolff, Assistant Professor of Urban Studies and Community Health, EJBSPPP; Ph.D., Iowa State University
Organization; financing, distribution, and costs of mental health services

Programs

Graduate study in public health has been developed as a joint degree between the University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School and Rutgers, The State University of New Jersey, with participation of faculty from both institutions. In addition, highly qualified scientists and administrators from industry, government, and public institutions participate in the teaching program.

The Ph.D. degree requires 72 credit hours. The areas of concentration are environmental and occupational health, epidemiology, and quantitative methods, and health education and behavioral sciences.

Admission to the following UMDNJ–RWJMS courses for Rutgers students requires the completion of the Graduate Exchange Program Form available from the registrar's offices at UMDNJ–RWJMS or Rutgers. In addition to these graduate courses, other courses specific to the candidate's specialty area are offered through various programs at Rutgers. Contact the office of the New Jersey graduate program in public health at UMDNJ–RWJMS for a listing of specific track courses and other options in public health.

A master's level program and a Dr.P.H. degree are also offered in public health through the Edward J. Bloustein School of Planning and Public Policy and UMDNJ–RWJMS.

Graduate Courses

CORE-5511-001. (F) HEALTH CARE ORGANIZATION AND ADMINISTRATION (3)

Grau. Required core course.

Overview of health care in the United States: social, political, and economic issues; organization and financing of health care services—the private practice of medicine and health maintenance organizations; ethical, legal, and policy issues; trends in health care organization in the U.S.

CORE-5520-001. (S) PRINCIPLES OF EPIDEMIOLOGY (3)

Schneider, Wartenberg, community experts. Required core course.
Introduction to the definitions, language, and approaches of epidemiologists.

EPQM-5521-001. EPIDEMIOLOGICAL RESEARCH METHODS (3)

Wartenberg
Methods and logistics in the design and conduct of epidemiological research.

EPQM-5522-001. INFECTIOUS DISEASE EPIDEMIOLOGY (3)

Rhoads
Properties, characteristics, and mechanisms of transmission of infectious disease; investigation of outbreaks of infectious disease.

EPQM-5523-001. EPIDEMIOLOGY OF CHRONIC DISEASES (3)

Rhoads
Characteristics of selected chronic diseases. Students learn to design studies to investigate chronic diseases and approaches to primary and secondary prevention.

CORE-5531-001. (F) ENVIRONMENTAL HEALTH (3)

Erstfeld, Gochfeld. Required core course.
The variety of ways in which environmental factors influence human health, the state of environmental factors that influence human health, and the state of technology available for managing such factors and preventing disease; the physiological interaction of man and his environment; air, water, physical factors, biological factors, and social factors. Special topics include asbestos, lead and mercury, radiation, noise, organic solvents, biocides, particulate air pollution, toxic wastes, water treatment, and topics such as neurobehavioral and reproductive hazards; community perceptions of, and responses to, hazards.

CORE-5541-001. INTRODUCTION TO BIOSTATISTICS AND BIOCUMPUTING (3)

Cody, Hamer, Schneider, Strawderman. Prerequisite: Pretest.
Required core course.

A brief introduction to fundamental concepts in descriptive and inferential statistics and to quantitative and computer methods. Basic methods, including t-test, chi-square, nonparametric tests, F-tests.

EPQM-5548-001. BIOCUMPUTING I (3)

Cody. Prerequisites: CORE-5541-001; knowledge of MS-DOS.
Essential features and use of operating systems. Use of SAS to solve database and statistical problems. Spreadsheet and database packages.

EPQM-5544-001. BIOCUMPUTING II (3)

Cody. Prerequisites: CORE-5541-001, 5548-001.
Advanced uses of SAS and SPSSx, including reorganizing data files, and reading data from tapes and disks.

CORE-5550-001. HEALTH EDUCATION AND BEHAVIORAL SCIENCE (3)

Goldman
Learning and behavioral sciences theories that provide the framework for the practice of health education and interventions.

ENOH-5582-001. ENVIRONMENTAL AND OCCUPATIONAL EPIDEMIOLOGY (3)

Gochfeld, Kipen, Mohr. Prerequisite: CORE-5520-001.
Specific epidemiologic approaches to understanding the causation of occupational and environmental health diseases.

ENOH-5586-001. ENVIRONMENTAL RISK ASSESSMENT (3)

Gallo, Gochfeld. Prerequisite: CORE-5541-001.
Concepts, language, and methods of risk assessment; role of risk assessment in individual and social decision making.

ENOH-5588-001. HISTORY OF OCCUPATIONAL DISEASE AND ENVIRONMENTAL HEALTH (3)

The development of ideas and practices in the prevention of workplace exposures and occupational diseases.

ENOH-5589-001. ADVANCED ENVIRONMENTAL HYGIENE MEASUREMENTS (4)

Weisel. Prerequisites: 2 years college chemistry, CORE-5541-001, and a course in air sampling and analysis or principles of industrial hygiene.
Fundamental concepts of data interpretation, quality assurance, and "hands on" use of equipment and monitoring procedures in the field.

ENOH-5590-001. OCCUPATIONAL HEALTH PRACTICES (2)

Practical experience leading to certification in spirometry/audiometry.

ENOH-5593-001. (S) ADVANCED PRINCIPLES OF OCCUPATIONAL HEALTH (3)

Gochfeld, Kipen, Mohr
Workplace hazards, occupational diseases, industrial hygiene, and medical surveillance. Design, implementation, administration, and evaluation of programs.

ENOH-5594-001. ENVIRONMENTAL AND OCCUPATIONAL TOXICOLOGY (3)

Gallo. Prerequisite: Organic chemistry or biochemistry.
The basic language and principles of toxicology, and the mechanisms by which xenobiotics damage living systems at the molecular, cellular, tissue, and organ levels.

ENOH-5595-001. ENVIRONMENTAL EXPOSURE MEASUREMENTS AND ASSESSMENT (2)

Lioy. Prerequisites: Calculus, biostatistics, principles of air pollution.
Development of skills for designing exposure studies and basic mathematical tools for estimating exposures.

ENOH-5599-001. PRINCIPLES OF INDUSTRIAL HYGIENE (3)

Lynch. Prerequisite: CORE-5531-001.

Skill development for evaluating exposures causing occupational health problems. Emphasis on mathematical techniques to estimate exposures to chemicals, physical agents, and ergonomic hazards facing employees.

ENOH-5600-001. INTERFACE BETWEEN SCIENCE AND ENVIRONMENTAL POLICY (1)

Goldstein. Prerequisite: CORE-5531-001.

Overview of the health effects of air pollutants with emphasis on the setting of quality standards.

ENOH-5601-001. READINGS/RESEARCH TOPICS IN ENVIRONMENTAL HEALTH TRACK (1-3)

ENOH-5602-001. PESTICIDES AND PUBLIC HEALTH (1)

Robson. Five-week course.

Introduction to the toxicological, health effects, exposure, and policy issues surrounding the use of pesticides in agricultural and residential settings.

EPQM-5595-001. CLASSIC PAPERS IN PUBLIC HEALTH (1)

Schneider. Prerequisites: CORE-5541-001, 5520-001.

Books, essays, journal articles, and public documents that have had a profound impact on public health.

HEBS-5550-001. RESEARCH TOPICS IN HEALTH EDUCATION (1-3)

Individual, in-depth study of specific topic of interest.

HEBS-5551-001. HEALTH EDUCATION PLANNING (3)

Goldman. Prerequisite: CORE-5550-001.

Introduction to development of health education and health promotion programs.

HEBS-5553-001. MODIFYING HEALTH BEHAVIORS: STRATEGIES FOR CHANGING INDIVIDUALS AND ENVIRONMENTS (3)

Williams

Concepts, strategies, and skills for modifying health-related behaviors and for influencing environments and cultures to provide more health support.

HEBS-5555-001. METHODOLOGIES AND MATERIALS IN HEALTH EDUCATION (3)

Lewis. Prerequisites: CORE-5550-001; HEBS-5551-001 or 5553-001.

Selection and evaluation of appropriate health education methodologies and materials for achieving program goals and objectives.

HEBS-5556-001. SEMINAR IN HEALTH EDUCATION TOPICS (1-3)

Forum to address timely public health problems.

HEBS-5563-001. INTRODUCTION TO SURVEY RESEARCH (3)

Prerequisite: CORE-5541-001.

Major methods and techniques in the use of surveys for program development, evaluation, and research.

HCOA-5517-001. HEALTH SERVICES RESEARCH EVALUATION (3)

Prerequisites: CORE-5511-001, 5520-001, 5541-001.

Systematic approaches to the evaluation of health services programs, building on prior knowledge of research methods in biostatistics and epidemiology and issues in health services administration.

HCOA-5614-001. HEALTH CARE POLICY (3)

Ochsner. Prerequisite: CORE-5511-001.

Understanding of health care politics and policy in the U.S. through examination of American political values, government structure and process, and the goals of the relevant stakeholders.

PUBLIC POLICY 833

Degree Program Offered: Master of Science

Director of Graduate Program: Professor Cliff Zukin,
Edward J. Bloustein School of Planning and Public Policy,
Civic Square Building, College Avenue Campus
(732/932-2499, ext. 716)

Members of the Graduate Faculty

Philip Burch, Research Professor of Public Policy, EJBSPPP/CGS; Ph.D., Rutgers
American government; public policy analysis; elites; interest groups
Raphael J. Caprio, Vice President for Continuous Education and Outreach
and Professor of Public Administration, GS-N; Ph.D., Rutgers
Alternative delivery models of public service including privatization, outsourcing,
and interlocal agreements
Robert A. Catlin, Professor of Public Policy, EJBSPPP; Ph.D., Claremont
Housing and community development; planning administration; planning and
minority group communities
Henry Coleman, Associate Professor of Public Policy, EJBSPPP/CGS;
Ph.D., Princeton
Public policy
David H. Guston, Assistant Professor of Public Policy, EJBSPPP; Ph.D.,
Massachusetts Institute of Technology
Science and technology policy; public policy; role of experts
Henry Raimondo, Professor of Public Policy, EJBSPPP/EIP; Ph.D., Wisconsin
State and local public finance; urban economics
Kelly Robinson, Assistant Professor of Public Policy, EJBSPPP/CUPR; Ph.D.,
Massachusetts Institute of Technology
Environmental policy; regional economic development
Alan Rosenthal, Professor of Public Policy, EJBSPPP/EIP; Ph.D., Princeton
American political institutions; state politics and legislatures
Carl E. Van Horn, Chairperson of Department and Professor of Public Policy,
EJBSPPP/EIP; Ph.D., Ohio State
Public policy; American political institutions; employment policy
Cliff Zukin, Professor of Public Policy, EJBSPPP/EIP; Ph.D., Ohio State
Public opinion; survey research; mass media

Associate Member of the Graduate Faculty

Harris Effross, Research Professor of Public Policy, EJBSPPP/CGS; Ph.D., Rutgers
State, county, and municipal governments

Adjunct Members of the Graduate Faculty

Bari Anhalt Erlichson, Assistant Professor of Public Policy, EJBSPPP/CGS;
Ph.D., Stanford
Education policy and politics; political institutions; race, ethnicity,
and representation
Alan Gibbs, Professor of Public Policy, EJBSPPP/NTI; M.A., Illinois
Public management; transportation; human services
Sanford Jaffe, Lecturer in Public Policy, EJBSPPP/CNCR; L.L.B., Harvard
Negotiation and conflict resolution
Linda Stamato, Lecturer in Public Policy, EJBSPPP/CNCR; M.A., Rutgers
Negotiation and conflict resolution

Program

The Department of Public Policy, in close affiliation with the Eagleton Institute of Politics, offers a course of study leading to the Master of Science degree in public policy through the Graduate School–New Brunswick. A joint degree program is also offered with the School of Law–Camden, leading to the Juris Doctor and Master of Science degrees.

The master's degree program in public policy is designed to prepare students for careers in government, politics, and public affairs. A distinctive feature of the program is its emphasis on political institutions in the making and implementation of public policy. The program attracts high-quality students and has a strong record of placing its graduates in professional positions in the field of public affairs. Of its 546 graduates, 33 percent are employed in government, 25 percent in politics and public affairs, and the remainder in the private sector, including business, banking, and the law.

The department engages several high-ranking or former high-level government officials, such as former Governor Jim Florio, to teach courses. In addition, the Eagleton Institute of Politics and the department offer programs throughout the year featuring as speakers prominent leaders and political thinkers who offer their observations and analyses of the political scene.

The M.S. in public policy is a 30-credit program. Normally students will already have some relevant work experience. Students are expected to complete 15 credits in required courses: 16:833:534, 540, 592, 593, 634. The remaining 15 credits consist of five elective courses in a specialization, such as public finance, education policy, campaigns and elections, and policy-making institutions and processes. Students may complete the M.S. program on a full-time or part-time basis. Individuals may enroll in up to 12 credits of work as nondegree students.

Rutgers' School of Law–Camden and the Department of Public Policy offer a joint-degree program for students interested in law and politics. The three and one-half year program leads to a Juris Doctor degree and a Master of Science in public policy. Students spend one year in New Brunswick studying public policy and politics and two and one-half years studying law in Camden. Students may begin the joint-degree program either in public policy or at the law school. To be accepted into the joint-degree program, students must apply to and be admitted separately by the School of Law–Camden and by the graduate program in public policy.

The Department of Public Policy also offers a Master of Public Policy (M.P.P.) degree as well as a joint Bachelor of Arts or Bachelor of Science/Master of Public Policy degree with Douglass College through the Edward J. Bloustein School of Planning and Public Policy. For further information regarding these degrees, please contact the department at 732/932-2499, extension 716.

Graduate Courses

16:833:520. LEGISLATIVE POLICYMAKING (3)

Exploration of legislatures as political institutions responsible for policymaking in the American states. Consideration of the role of legislators, lobbyists, governors, and the media.

16:833:521. MASS MEDIA, PUBLIC OPINION, AND PUBLIC POLICY (3)

Role and impact of the mass media, the nature and expression of public opinion, and how these feed into the development and implementation of public policy in the American political system.

16:833:522. PUBLIC POLICY ADVOCACY (3)

Role and process of organized advocacy by private interests in the formation and implementation of public policy. Strategies and methods used to influence the policy process.

16:833:523. NEW JERSEY POLITICS AND POLICY (3)

Influence of the political process on public policy. Comparisons with other states.

16:833:525. DECISION MAKING FOR PUBLIC POLICY (3)

Changes in policy making over the last several decades. Examples include the environment, welfare reform, law enforcement, and health care. The budget as a policy-making “engine” at both the federal and state levels.

16:833:526. EMPLOYMENT AND TRAINING POLICY (3)

Federal and state programs and policies designed to help the unemployed with emphasis on the problems of adult workers. The politics surrounding these policies and the effectiveness of government strategies to help the unemployed. Practices and policies in other advanced industrial nations.

16:833:533. RESEARCH DESIGN FOR PUBLIC POLICY (3)

Scientific method of study, the processes of conceptualization and measurement, and “experimental design,” or how social programs are structured so they may be effectively studied.

16:833:534. DATA ANALYSIS FOR PUBLIC POLICY (3)

Quantitative techniques employed to analyze public policy programs and problems, including univariate, bivariate, and multivariate analysis.

16:833:540. STATE AND LOCAL PUBLIC FINANCE (3)

Theory and practice of state-local public finance; link between regional economy and subnational governments; fiscal federalism; major state-local spending programs; revenues, including property, sales, and income taxes and gambling; intergovernmental grants.

16:833:541. ISSUES IN STATE AND LOCAL FISCAL POLICY (3)

Contemporary state-local policy areas, such as revenue forecasting and the budget process, privatization of public services, education finance, health care/medicaid, welfare reform, and economic development. Relevant economic research and alternative policy options.

16:833:542. STATE AND LOCAL ECONOMIC DEVELOPMENT THEORIES AND POLICIES (3)

Introduction to theories and policies for regional economic development used at the subnational scale within the United States. Proposed and current economic development programs from New Jersey and elsewhere in theoretical and historical context.

16:833:543. ECONOMICS AND PUBLIC POLICY (3)

Basic microeconomic analysis with applications to current policy issues. Models of consumer and firm behavior applied to issues such as assistance programs for low-income individuals, tax incentives for firms and workers, and environmental regulation. Public goods, externalities, and the role of government in economic markets.

16:833:550. EDUCATION POLICY AND POLICYMAKING: THE FEDERAL AND STATE LEVELS (3)

Development, implementation, and effects of federal and state education policy; key policy issues as cases for the exploration of political, policy design, and implementation issues.

16:833:551. ISSUES IN EDUCATION FINANCE (3)

Legal, political, economic, and equity issues in public school finance. Topics include sources of revenue, school finance formulas, the allocation of education resources, the equity and adequacy of school finance systems, school finance litigation, and the politics of school finance reform.

16:833:570. THE ROLE OF EXPERTS IN THE POLICY PROCESS (3)

Interrelations of technical expertise with policymaking in various institutional settings. Case studies in environmental, health, economic, and science and technology policy.

16:833:571. PUBLIC MANAGEMENT (3)

Fundamental tasks and responsibilities of management in the public sector, with an emphasis on the external and internal environments in which managers implement public policy.

16:833:572. NEGOTIATION AND PUBLIC POLICY (3)

Nonadversarial concepts and techniques of conflict resolution—negotiation, mediation, consensus-building dialogues—considered in public contexts, from courts, prisons, and schools to other institutional and noninstitutional settings. Issues include controversial subjects such as siting resource recovery plants, implementing economic redevelopment plans, enacting environmental protection measures, and devising grievance mechanisms.

16:833:573. CAMPAIGNS AND PUBLIC POLICY (3)

Overview of modern political campaigning. The campaign as a process occurring within a political context.

16:833:592. PUBLIC POLICY FORMATION (3)

Formulation and implementation of public policy, with emphasis on federal policymaking, models for policy choice, and intergovernmental policy problems. Analysis of the formulation and implementation of a governmental program.

16:833:593. POLICY ANALYSIS AND EVALUATION (3)

Strategies and methods of public policy analysis and evaluation: developing a research strategy, choosing measures, analyzing data, and communicating results.

16:833:634. POLICY RESEARCH SEMINAR (3)

Participation in a directed research project that applies analytical techniques of policy analysis and evaluation or survey research to public policy problems.

16:833:670. INDEPENDENT STUDY IN PUBLIC POLICY (3)

16:833:671. INTERNSHIP IN PUBLIC POLICY (3)

16:833:680. SEMINAR IN PUBLIC POLICY (3)

Selected problems in American public policy. Topics include environmental policy; politics on the World Wide Web; race, politics, and the news media; education policy.

QUATERNARY STUDIES 841

Program Offered: Certificate in Quaternary Studies

Director of the Certificate Program in Quaternary Studies:

Professor Gail M. Ashley, Department of Geological Sciences,
239A Wright-Rieman Laboratories, Busch Campus
(732/445-2221, 2044); e-mail: gmas Ashley@rci.rutgers.edu

Participating Faculty

The following members and associate members of the graduate faculty, identified more fully under their respective programs, are among those who participate in the certificate program in Quaternary Studies:

G. Ashley, Geological Sciences
R. Blumenschine, Anthropology
L. Burckle, Geological Sciences
S. Cachel, Anthropology
C. Feibel, Anthropology
J. Harris, Anthropology
D. Lieberman, Anthropology
S. Madry, Geography
J. Miller, Environmental Sciences
K. Miller, Sr., Geological Sciences
R. Olsson, Geological Sciences
N. Psuty, Geography
D. Robinson, Geography
E. Russell, Ecology and Evolution
K. Scott, Ecology and Evolution
M. Seidl, Geological Sciences
R. Sherrell, Environmental Sciences

Certificate Program

Students with an interest in interdisciplinary study of the earth and its inhabitants during the last few million years may pursue, in the course of their regular program of studies toward an advanced degree, a special concentration in Quaternary studies. Participating graduate programs are anthropology, ecology and evolution, environmental sciences, geography, and geological sciences. Those who fulfill the requirements below are awarded a Certificate in Quaternary Studies, signifying special achievement in this field, along with the master's or doctoral degree in the student's major discipline. Students must fulfill all degree requirements in their major program of study, including two courses in other participating programs that focus on the Quaternary period. In addition, the certificate requires enrollment for one semester in the Quaternary Studies Seminar. If a thesis is required for the degree, it should focus on the Late Cenozoic or Quaternary time period.

Graduate Course

16:841:501. QUATERNARY STUDIES SEMINAR (3)

A multidisciplinary (geology, geography, biology, meteorology, oceanography, paleontology, and soils) course focused on specific questions or problems related to the Quaternary time period.

RADIATION SCIENCE (see Environmental Sciences 375)

RUSSIAN, CENTRAL AND EAST EUROPEAN STUDIES 859

Program Offered: Certificate in Russian, Central and East European Studies

Director of the Certificate Program: Professor Joanna Regulska,
Center for Russian, Central and East European Studies,
172 College Avenue, College Avenue Campus (732/932-8551)

Participating Faculty

The following members of the graduate faculty, identified more fully under the subject headings indicated, are among those who participate in the certificate program in Russian, Central and East European Studies:

Helmut Anheier, Sociology
Jerome Aumente, Communication, Information, and Library Studies
Seymour Becker, History
József Böröcz, Sociology
David Foglesong, History
Ziva Galili, History
Peter Golden, History
Jan Kubik, Political Science
Joan Marter, Art History
Gerald Pirog, Comparative Literature
Stephen Reinert, History
Joanna Regulska, Geography
Robert Stuart, Economics
Gabor Vermes, History

Certificate Program

Students with a special interest in Russia or in Central and/or Eastern Europe may pursue, in the course of their regular program of studies toward an advanced degree, a special concentration in Russian, Central and East European Studies. Students who fulfill the following requirements may be awarded a Certificate in Russian, Central and East European Studies upon completion of their degree. In many cases, the certificate requirements may also be used to satisfy the student's own graduate degree requirements.

Certificate Requirements

1. Completion of three courses (9 credits) in Russian, Central and East European subjects, with a grade of B or better, in disciplines other than that of the student's degree program. Of these three courses, no more than two can be in any one discipline; only one can be in the 300–400 level, subject to approval by the program's director.
2. Completion of a year-long seminar (6 credits) offered by the Center for Russian, Central and East European Studies.
3. Completion of a major research paper under the guidance of two participating faculty members.
4. Proof of proficiency in one of the languages of the region. Language tests are administered by the Center for Russian, Central and East European Studies.

Only students already admitted to a degree program in the Graduate School–New Brunswick may participate in the certificate program. Courses in Russian, Central and East European Studies are offered by participating faculty through their departments and graduate programs. Further information is available from the director of the certificate program.

Graduate Courses

16:859:501,502. RUSSIAN, CENTRAL AND EAST EUROPEAN STUDIES SEMINAR (3,3)

Year-long seminar that examines the political, economic, and social transition in Russia and in Central and Eastern Europe from various perspectives. Theme of the seminar changes annually. Taught by Rutgers faculty members and visiting faculty from the region.

SOCIAL WORK 910

Degree Program Offered: Doctor of Philosophy

For information about the program: Contact Professor Bernard Neugeboren, Associate Dean for Academic Affairs, School of Social Work, 536 George Street, College Avenue Campus (732/932-6967)

Members of the Graduate Faculty

Ann A. Abbott, Associate Professor of Social Work, SSW; Ph.D., Bryn Mawr College
Professional values/socialization; female substance abuse; health reform

Eleanor L. Brilliant, Professor of Social Work, SSW; D.S.W., Columbia
Social policy, organizations, women, and international philanthropy

Michael J. Camasso, Associate Professor of Social Work, SSW; Ph.D., Pennsylvania State
Public welfare; child welfare; developmental disabilities

Stephen Crystal, Research Professor of Social Work and Sociology, SSW/IHHCPAR; Ph.D., Harvard
AIDS; long-term care; homelessness; longitudinal data analysis

Mary Edna Davidson, Dean and Professor of Social Work, SSW; Ph.D., Brandeis
Child welfare; advocacy research; equity analysis of public social policy

Miriam Dinerman, Professor of Social Work, SSW; D.S.W., Columbia
Social work education; women; international social welfare; social policy regarding women and health policy

Paul Glasser, Professor of Social Work; Ph.D., North Carolina
Family theory; marital and family therapy; small group theory and practice

Marsel A. Heisel, Associate Professor of Social Work, SSW; Ed.D., Rutgers
Aging in the developing world; women in developing countries

David Mechanic, University Professor and René Dubos Professor of Behavioral Sciences; Ph.D., Stanford
Medical sociology; evaluation research and social policy

Kathleen J. Pottick, Associate Professor of Social Work, SSW/IHHCPAR; Ph.D., Michigan
Child and adolescent mental health and psychiatric service delivery systems

Albert R. Roberts, Professor of Administration of Justice, SSW; D.S.W., Maryland
Juvenile justice; family violence; crisis intervention and victim assistance programs

Elfriede G. Schlesinger, Professor of Social Work and Sociology, SSW; Ph.D., Rutgers
Ethnicity; health care; social work theory; developmental disabilities

Jerome C. Wakefield, Professor of Social Work, SSW/IHHCPAR; D.S.W., California (Berkeley)
Conceptual and theoretical foundations of mental health services

Associate Members of the Graduate Faculty

Marcia Abramson, Associate Professor of Social Work, SSW; Ph.D., Iowa
Ethical issues; health care; AIDS

Gloria Bonilla-Santiago, Associate Professor of Social Work, SSW; Ph.D., CUNY
Migrant women, women and leadership, poverty and policy, particularly with Latinas/Hispanics

Sandra Burman, Assistant Professor of Social Work, SSW; Ph.D., Illinois
Substance abuse treatment; motivation and strategies of self-recovery

Irene R. Bush, Assistant Professor of Social Work, SSW; D.S.W., Hunter College
Child welfare; social work knowledge development; qualitative methodologies

Donald T. Dickson, Professor of Social Work, SSW; Ph.D., Michigan
Law; child welfare; mental health; administration

Patricia C. Dunn, Associate Extension Specialist in Social Work, SSW/GSE; Ed.D., Rutgers
Alcohol and other drugs; teaching methodology; developmental disabilities

Elane M. Gutterman, Assistant Professor of Social Work, SSW/IHHCPAR; Ph.D., Columbia
Dangerousness and hospitalization among youths in crisis

M. Katherine Kraft, Assistant Professor of Social Work, SSW; Ph.D., Bryn Mawr College
Drug treatment outcomes; service utilization; barriers to access to health

Edward Lowenstein, Associate Professor of Social Work, SSW; Ph.D., Michigan
Interpersonal dynamics

Raymond Sánchez Mayers, Associate Professor of Social Work, SSW; Ph.D., Brandeis
Financial management in nonprofits; administrative issues; Hispanic issues

Bernard Neugeboren, Professor of Social Work, SSW; Ph.D., Brandeis
Mental health policy; administration; environmental practice

Paul W. Speer, Assistant Professor of Social Work, SSW/CAS; Ph.D., Missouri (Kansas City)
Community organizing; substance abuse prevention; individual and organizational empowerment

Allison Zippay, Assistant Professor of Social Work, SSW; Ph.D., California (Berkeley)
Poverty and employment policy; community development; social networks

Programs

Programs in social work leading to the degree of Doctor of Philosophy are administered by the Graduate School–New Brunswick in cooperation with the School of Social Work. Those leading to the degree of Master of Social Work are conducted by the School of Social Work and are described in the separate catalog of that professional school.

The doctoral program in social work gives special emphasis to two areas of theory development and research: social policy analysis and administration and direct intervention in interpersonal situations. The Ph.D. program prepares students for careers in teaching, research, and leadership.

Applications for September admission should be completed by May 1; no later than March 1 if applying for assistantships. Transcripts of grades, Graduate Record Examination scores, and three letters of recommendation are required to complete an application. Applicants must also submit evidence of passing, within the previous two years, a statistics course that meets program requirements. Supplementary material in the form of published papers or other examples of written work may also be submitted, but is not required. All applications must include a statement regarding career plans and a preference for either social policy analysis or direct intervention.

Admission requirements for students in the direct practice area include the M.S.W. degree; two years of post-master's experience in social work are preferred. Students in the area of social policy analysis and administration are required to hold an M.S.W. or an equivalent degree in a related field. Students with an M.S.W. transfer 18 credits toward the Ph.D. Transfer credits from other master's degrees are evaluated on a case-by-case basis.

It is the curriculum policy of the doctoral program in social work that students should be able to develop their own programs of study. Preparation includes: 3 credits of graduate-level statistics; 9 credits of graduate-level research methodology; 6 to 9 credits of social work major; 6 to 9 credits of elective courses and 3 credits of work in social science or another discipline outside social work. Upon satisfactory completion of course work, students take qualifying exams. Upon approval of a dissertation proposal, students are admitted to candidacy. Students are required to register for a minimum of 24 research credits while working on the dissertation. A total of 72 credits are required for the Ph.D.

The Ph.D. program permits students to meet its residence requirements by registering for a minimum of 30 credits of approved course work within two consecutive academic years. Registration for dissertation research is not counted toward these 30 credits. There is no language requirement.

Formal admission to the program is on a matriculated basis. However, students considering applying to the program may register for up to 6 credits of course work through the nondegree graduate study program. Nonmatriculated students may register for courses only if they have an M.S.W. or other appropriate master's degree, obtain permission from the instructor of the course and the program director, and are deemed to be fully qualified for the work of the course.

Graduate Courses

16:910:637. (S) ADVANCED RESEARCH METHODS (3)

Prerequisite: 16:960:532.

Knowledge and skills needed to carry out independent doctoral-level research in the field of social work. Identification and study of state-of-the-art concerns centering on issues of design and measurement; qualitative and quantitative formulations; data gathering, processing, analysis, and interpretation.

16:910:638. (F) RESEARCH STRATEGIES I (3)

Prerequisite: 16:910:637.

Analytic and measurement strategies fundamental to multivariate model testing in policy, administration, and direct practice research. Topics include tabular and log-linear analysis, multiple regression, analysis of covariance, and analysis of variance in its principal forms. Multiple indicators and measurement approaches such as exploratory and confirmatory factor analysis.

16:910:639. (S) RESEARCH STRATEGIES II (3)

Prerequisite: 16:910:638.

General conceptual issues in the use of multivariate, quantitative methods. Use of multiple dependent variables, nonlinear relationships, mediator effects, instrument variables, and multilevel analysis.

16:910:644. (S) CURRENT PERSPECTIVES (3)

Prerequisite: 16:910:687.

Theories and models of intervention used in social work direct practice. Applications.

16:910:646. (S) FAMILY THEORY AND PROGRAM DEVELOPMENT (3)

The study of family theory and its relationship to program development at different levels of practice and social planning. Geared toward both a policy planning and intervention perspective, as well as sociological interest in socialization and the study of deviance.

16:910:647. (F) SOCIAL POLICY ANALYSIS (3)

Paradigms, methods, and strategies for the analysis of policy from social work, economics, sociology, political science, public administration, policy sciences, and planning.

16:910:649. (F) MENTAL HEALTH POLICY (3)

Major issues in mental health policies and programs in socio-environmental context.

16:910:650. (S) PROBLEMS IN HEALTH AND SOCIAL POLICY (3)

Selected critical issues in the delivery of human services; application of social research to policy. The policy research process. Topics may include care of the aging and the health policy challenge posed by the AIDS epidemic.

16:910:682. (F) ADVANCED INDIVIDUAL STUDIES
IN SOCIAL WELFARE (3)

Provides an opportunity to study in greater depth, and on an individualized basis, various areas of social policy, social planning, social administration, or direct intervention.

16:910:683. (S) ADVANCED INDIVIDUAL STUDIES
IN SOCIAL WELFARE (3)

Provides an opportunity to specialize in a specific area of policy analysis, social planning, social administration, or direct intervention, on an individualized basis.

16:910:684. (F) SOCIAL WORK EDUCATION FOUNDATIONS (3)

Issues and trends in social work education; other professional education; historical development; learning theory. Principles of curriculum building and evaluation.

16:910:687. (S) THEORY DEVELOPMENT IN SOCIAL WORK
DIRECT PRACTICE (3)

The relative place and contribution of theoretical conceptualization, "practice wisdom," and descriptive and prescriptive research.

16:910:694. (S) SOCIAL WORK ORGANIZATIONS (3)

The applicability of organizational theories and concepts from the social sciences for analysis of human service organizations; strategies and performance with clients and constituents. Criteria and procedures for organizational assessment and case studies of social welfare organizations in the public and private sector used on various paradigms for critical analysis of organizational culture, environmental interactions, resource dependency, policy impact, and program implementation.

16:910:701,702. RESEARCH IN SOCIAL WORK (BA,BA)

Independent research study related to proposed dissertation with assistance of appropriate faculty. Dissertation seminar. Research internship.

SOCIOLOGY 920

Degree Programs Offered: Master of Arts, Doctor of Philosophy
Director of Graduate Program: Professor Eviatar Zerubavel,
Lucy Stone Hall, Livingston Campus (732/445-4030)

Members of the Graduate Faculty

Helmut K. Anheier, Associate Professor of Sociology, FAS-NB; Ph.D., Yale
Comparative sociology; social networks; organizations
Sarane S. Boocock, Professor of Education, FAS-NB; Ph.D., Johns Hopkins
Children; education; cross-national studies
József Böröcz, Associate Professor of Sociology, FAS-NB; Ph.D., Johns Hopkins
Historical; comparative; economic; leisure; migration; stratification
Karen A. Cerulo, Associate Professor of Sociology, FAS-NB; Ph.D., Princeton
Culture; communications; deviance; methods
Lee Clarke, Associate Professor of Sociology, FAS-NB; Ph.D., SUNY
(Stony Brook)
Organizations; technology and risk
Ira J. Cohen, Associate Professor of Sociology, FAS-N; Ph.D., Wisconsin
Social theory; sociology of everyday life
Jeanette Covington, Associate Professor of Sociology, FAS-NB; Ph.D., Chicago
Deviance/criminology
Stephen Crystal, Professor of Social Work, SSW; Ph.D., Harvard
Social policy; social gerontology; AIDS
Nancy DiTomaso, Professor of Management, GSM; Ph.D., Wisconsin
Organizations; theory; economy and society
Lucile Duberman, Associate Professor of Sociology, FAS-N; Ph.D., Case
Western Reserve
Marriage; family
William A. Firestone, Professor of Educational Theory, Policy, and
Administration, GSE; Ph.D., Chicago
Education; policy implementation; qualitative methods; organizations
Judith J. Friedman, Associate Professor of Sociology, FAS-NB; Ph.D., Michigan
Urban communities; environment; demography
Judith M. Gerson, Associate Professor of Sociology, FAS-NB; Ph.D., Cornell
Gender; work; social theory
Ted G. Goertzel, Professor of Sociology, FAS-C; Ph.D., Washington
Political stratification; social welfare
Sherry Gorelick, Associate Professor of Sociology, FAS-NB; Ph.D., Columbia
Education; ethnicity
Cathy Greenblat, Professor of Sociology, FAS-NB; Ph.D., Columbia
Research methods; simulation; sexuality; development
Stephen Hansell, Associate Professor of Sociology, FAS-NB; Ph.D., Chicago
Medical; social psychology; education
Clayton A. Hartjen, Associate Professor of Sociology, FAS-N; Ph.D., New York
Criminology and deviant behavior
Irving L. Horowitz, University Professor and Hannah Arendt Distinguished
Professor of Sociology and Political Science; Ph.D., Buenos Aires
Political; social policy; international change
Allan V. Horwitz, Professor of Sociology, FAS-NB; Ph.D., Yale
Deviance and social control; mental illness; law
Ellen L. Idler, Associate Professor of Sociology, FAS-NB; Ph.D., Yale
Health; aging; religion
John C. Leggett, Associate Professor of Sociology, FAS-NB; Ph.D., Michigan
Labor; gender; race; class; survey research; political
Paul Lerman, Professor Emeritus of Social Work, SSW; D.S.W., Columbia
Youth policy; social welfare policy; law and social policy
Donald Light, Professor of Sociology and Community Medicine, UMDNJ-SOM;
Ph.D., Brandeis
Comparative health care; social policy; professions
John L. Martin, *Assistant Professor of Sociology, FAS-NB; Ph.D.,
California (Berkeley)*
Culture/belief; religion; numerical analysis of qualitative data
Leslie McCall, Assistant Professor of Sociology, FAS-NB; Ph.D., Wisconsin
Gender; work and labor markets; theory
David Mechanic, University Professor and René Dubos Professor of Behavioral
Sciences; Ph.D., Stanford
Medical; social psychology; psychiatry
Martin Oppenheimer, Associate Professor of Sociology, FAS-NB;
Ph.D., Pennsylvania
Social movements; American working class
Ann P. Parelius, Associate Professor of Sociology, FAS-NB; Ph.D., Chicago
Education; marriage and family
Robert J. Parelius, Associate Professor of Sociology, FAS-NB; Ph.D., Chicago
Education
David Popenoe, Professor of Sociology, FAS-NB; Ph.D., Pennsylvania
Family and community; comparative social systems
Patricia A. Roos, Professor of Sociology, FAS-NB; Ph.D., California (Los Angeles)
Stratification; work; gender
Sarah Rosenfield, Associate Professor of Sociology, FAS-NB; Ph.D., Texas
Medical sociology; mental illness

Thomas Rudel, Professor of Sociology, CC; Ph.D., Yale
Development; environment; human ecology

D. Randall Smith, Associate Professor of Sociology, FAS-NB; Ph.D., Johns Hopkins
Methodology; statistics

Shirley A. Smoyak, Professor of Urban Studies and Community Health, EJBSPPP;
Ph.D., Rutgers
Seriously mentally ill adults and children

Jackson Toby, Professor of Sociology, FAS-NB; Ph.D., Harvard
Criminology; deviance; theory; education

Chaim I. Waxman, Professor of Sociology, FAS-NB; Ph.D., New School
for Social Research
Religion; ethnicity; social welfare

Helene R. White, Professor of Sociology, FAS-NB; Ph.D., Rutgers
Alcohol and drugs; deviance

Richard Williams, Associate Professor of Sociology, FAS-NB; Ph.D.,
SUNY (Binghamton)
Social construction of identities (race and ethnic); mass communications
(television news)

Robert E. Wood, Associate Professor of Sociology, FAS-C; Ph.D.,
California (Berkeley)
Political economy of international development

Benjamin D. Zablocki, Professor of Sociology, FAS-NB; Ph.D., Johns Hopkins
Methodology; statistics; collective behavior

Eviatar Y. Zerubavel, Professor of Sociology, FAS-NB; Ph.D., Pennsylvania
Cognitive sociology; sociology of time; social memory; everyday life

Associate Members of the Graduate Faculty

Dennis M. Gorman, Assistant Professor of Sociology, CAS; Ph.D., Essex
Substance abuse prevention; risk factor research and program evaluation

Drew Humphries, Associate Professor of Sociology, FAS-C; Ph.D.,
California (Berkeley)
Criminology; law and society

Valerie R. Johnson, Assistant Professor of Alcohol Studies, CAS; Ph.D., Rutgers
Alcohol and drug studies

Charles A. Nanry, Professor of Industrial Relations and Human Resources, SMLR;
Ph.D., Rutgers
Theory; work and occupations; communications

Programs

The aim of the program is to prepare students for scholarly research and for teaching. The program is designed for students who seek the Ph.D. degree; an M.A. degree is typically granted in the process of obtaining a Ph.D. degree.

Requirements for the Ph.D. degree include 21 research credits, a writing seminar (3 credits), and 48 credits of approved course work (including courses used to satisfy the requirements for the M.A. degree). Students transferring from other institutions may transfer up to 24 credits. Of the 48 credits, 6 must be in theory, 6 in methods, and 6 in statistics. Students must also complete three qualifying papers of publishable quality (or two such papers and a qualifying examination in one area of specialization), a writing seminar, the defense and approval of a dissertation proposal, and complete and defend a doctoral dissertation.

Students generally receive the M.A. degree when they have completed 30 credits of approved course work (with at least 3 credits in methods, 3 credits in statistics, and 6 credits in theory) and one of the qualifying papers required for the Ph.D. Up to 12 credits may be transferred from other institutions upon petition and approval.

Applications for September admission should be submitted no later than February 1 by students seeking financial assistance; otherwise by May 1. Official transcripts, a writing sample, and three letters of recommendation are required. The Graduate Record Examination (GRE) is also required, but applicants need not take the advanced test in sociology. Students for whom English is not the first language must take the TOEFL examination unless their undergraduate degree was obtained in the United States.

Graduate Courses

16:920:501,502. SOCIOLOGICAL RESEARCH METHODS I, II (3,3)
The logic, design, and implementation of research to test sociological hypotheses. First term: fundamentals of research design, sampling, and measurement. Second term: data collection, data management, and exploratory data analysis, including an introduction to computer techniques. Laboratory exercises required.

16:920:503,504. SELECTED SOCIOLOGICAL PROBLEMS (3,3)
Prerequisite: Permission of instructor. For graduate students wishing to pursue advanced work. By arrangement.

16:920:505,506. INDIVIDUAL STUDIES IN SOCIOLOGICAL THEORY (3,3)
Prerequisite: Permission of instructor. For graduate students wishing to pursue advanced work in fields where no advanced courses are provided. By arrangement.

16:920:510. RESEARCH PRACTICUM IN POLITICAL SOCIOLOGY AND DEVELOPMENT (3)
Projects in the practice of research in the areas of political sociology and development from the perspective of historical materialism.

16:920:511,512. PROSEMINAR IN SOCIOLOGY (3,3)
Selected special topics in sociology.

16:920:515. CLASSICAL SOCIOLOGICAL THEORY (3)
Discussion of the major figures who shaped sociological theory from the mid-nineteenth century to the first three decades of the twentieth century.

16:920:516. CONTEMPORARY SOCIOLOGICAL THEORY (3)
Survey of the dominant lines of theoretical development in contemporary sociology.

16:920:520. COMPARATIVE AND HISTORICAL METHODS (3)
Philosophical, theoretical, and methodological issues involved in sociological explanations of the development of social systems over time.

16:920:521. SOCIOLOGY OF EDUCATION (3)
An analysis of the educational system of the U.S. and its relation to other social systems. Major focus on the ideology of the system, the interrelationship of various occupations, and special problems of urban schools.

16:920:523. SOCIOLOGY OF HEALTH (3)
The social correlates of health and illness in the U.S.; major social roles and organizational structures concerned with health and medical care.

16:920:524. SOCIOLOGY OF ORGANIZATIONS (3)
Basic survey of the sociology of organizations with emphasis on current developments.

16:920:528. MARRIAGE AND THE FAMILY (3)
A review of the basic concepts and research in the field of marriage and the family.

16:920:531. URBAN DEVELOPMENT AND COMMUNITY CHANGE (3)
Survey of literature and issues in sociological analysis of local communities, neighborhoods, towns, suburbs, cities, and metropolitan areas. Includes historical and comparative perspectives.

16:920:535. PROFESSIONS (3)
The development and functions of professions in advanced industrial societies. Alternative theories of professionalism evaluated against the background of sociological studies of different professions, such as medicine, law, social work, psychology, education, nursing, engineering, management and planning, the clergy, and the artistic professions.

16:920:541-542. ANALYSIS OF SOCIOLOGICAL DATA I, II (3,3)
Prerequisite for 16:920:542: 16:920:541 or permission of instructor.
The application of classical and modern statistical techniques to the analysis of sociological data. Problems of optimal fitting of technique to level and quality of data emphasized. First term: bivariate techniques, up to and including the analysis of variance. Second term: multivariate techniques, multiple regression, and the general linear model. Laboratory exercises required.

16:920:550. PRACTICUM IN TEACHING SOCIOLOGY (3)
Trains sociology graduate students to teach, with a specific emphasis on clear presentations, logical argument, and day-to-day pedagogical issues.

16:920:567. SOCIOLOGY OF ALCOHOL USE (3)
Overview of social issues and research.

16:920:570,571,572,573. SPECIAL TOPICS IN SOCIOLOGY (3,3,3,3)

16:920:602. CULTURE, SYMBOLS, AND SOCIAL INTERACTION (3)
Examines several dimensions of the complex interaction between the social and cultural spheres. Specifically, we will focus on: the ways in which norms, gestures, and symbols structure interpersonal encounters; the symbol systems that make possible large-scale interaction between social members; the ways in which social structure orders interactions; and the ways in which technology can mediate social interactions.

16:920:607. SEMINAR IN ORGANIZATIONS (3)
The development of theories and research models concerned with organizations.

16:920:611. CRIMINOLOGY AND CORRECTIONS (3)
Theories of criminality and methods of treatment and prevention within the context of the general analysis of deviance and social control.

16:920:612. SOCIAL DEVIANCE AND SOCIAL CONTROL (3)
Conditions under which people tend to conform or deviate; probable consequences of deviance and social control for both deviants and conformists.

16:920:613. THE SOCIOLOGY OF AGE (3)
Theory of age stratification, age structure of the society, aging of individuals, connections between aging and various social processes and social institutions.

16:920:614. SEMINAR IN RACE AND ETHNIC RELATIONS (3)
Analysis of race and ethnic relations from a comparative perspective; contemporary theory, issues, and problems.

16:920:615. SEMINAR IN QUALITATIVE RESEARCH METHODS (3)
Discussion and guided practice in the collection and analysis of qualitative data. Major attention on research designs employing participant observations and/or in-depth interviewing. Case studies reviewed; collection and analysis of data from a field research study.

16:920:616. SEMINAR IN SOCIAL STRATIFICATION (3)
Fundamental features of social stratification in both its structural and dynamic aspects and in terms of its consequences for society and for the individual.

16:920:618. SOCIOLOGY OF GENDER (3)
Cross-cultural and historical analysis of gender roles; gender in modern society; gender roles and social institutions; work, family, religion, politics, and education. A range of theoretical and empirical approaches included.

16:920:625. WOMEN AND DEVELOPMENT (3)
A cross-cultural analysis of the role of women in the contemporary development process.

16:920:627. SOCIOLOGY OF SOCIALIZATION (3)
The study of socialization as a concept and as a process; the socialization of children and adults; variations in socialization among cultures, socioeconomic status groups, and types of social groups.

16:920:629. DEVELOPMENT AND UNDERDEVELOPMENT (3)
Interdisciplinary perspectives on processes of development, with focus on phenomena of class and politics.

16:920:631. SOCIOLOGY OF MENTAL ILLNESS (3)
The study of the epidemiology of psychiatric disorders, help-seeking processes for mental illness, social responses to the mentally ill, and social policy issues in the mental health field.

16:920:632. SOCIOLOGY OF WORK (3)
The meaning and organization of work; the division of labor; who does what and how; interactions among occupations; and the quality of work life in industrial societies.

16:920:633. SEMINAR IN SOCIAL SCIENCE DATA ANALYSIS (3)
Prerequisite: 16:920:542 or permission of instructor.
Advanced topics in the quantitative reduction and analysis of data generated by research in the various social sciences. Topics chosen from, but not limited to, the following: loglinear analysis, structural equations models, panel analysis, network analysis, time series analysis, and continuous time process models. The first several sessions focus on developing the basics of matrix algebra upon which most of these techniques rely.

16:920:640. SOCIOLOGICAL PERSPECTIVES ON FEMINIST THEORY (3)
Detailed examination of major feminist theories with an emphasis on contemporary feminist thought.

16:920:645. DRUGS AND SOCIETY (3)
Examination of the causes and consequences of illegal drug use, how drugs came to be criminalized, the current system of drug prohibition in the U.S., and alternatives to prohibition such as decriminalization and legalization.

16:920:646. (S) COGNITIVE SOCIOLOGY (3)
The social context of thinking, focusing on specific cognitive processes: classifying, framing, symbolizing, time-reckoning, perceiving, attending, remembering, and making sense. Draws on sociology of knowledge, phenomenological sociology, ethnomethodology, sociology of science, symbolic interactionism, semiotics, symbolic anthropology, and linguistics.

16:920:701,702. RESEARCH IN SOCIOLOGY (BA,BA)
Prerequisite: Candidacy for Ph.D. required of all students engaged in Ph.D. dissertation research.

16:920:703. WRITING SEMINAR (3)
Sharpen writing and publishing skills as professional sociologists. Writing and rewriting doctoral qualifying papers and dissertation proposals.

SPANISH 940

Degree Programs Offered: Master of Arts, Master of Arts for Teachers, Doctor of Philosophy
Director of Graduate Program: Professor Margaret H. Persin,
104A Carpender House, Douglass Campus (732/932-9323)

Members of the Graduate Faculty

Mary Lee Bretz, Professor of Spanish, FAS-NB; Ph.D., Maryland
Nineteenth- and twentieth-century Spanish literature
Frank N. Dauster, Professor Emeritus of Spanish, FAS-NB; Ph.D., Yale
Contemporary Spanish-American literature; drama; poetry
Mary S. Gossy, Associate Professor of Spanish, FAS-NB; Ph.D., Harvard
Golden age prose, narrative, feminist theory, reader-response, psychoanalysis
Carl Kirschner, Professor of Spanish, FAS-NB; Ph.D., Massachusetts
Spanish linguistics; syntax; semantics; bilingualism in the United States
Tomás Eloy Martínez, Professor of Spanish-American Literature, FAS-NB;
M.A., Paris Institute
Contemporary Spanish-American narrative; Latin-American studies; film theory;
colonial Spanish-American literature
Gabriela Mora, Professor of Spanish, FAS-NB; Ph.D., Smith
Nineteenth- and twentieth-century Spanish-American literature; literary theory
Carlos Raúl Narváez, Associate Professor of Spanish-American Literature,
FAS-NB; Ph.D. Columbia
Twentieth-century Spanish-American and Caribbean literature; poetry; novel;
contemporary literary theory

Margaret H. Persin, Professor of Spanish, FAS-NB; Ph.D., Indiana
 Twentieth-century Hispanic poetry; literary theory
 Susana R. Rotker-Martínez, Associate Professor of Spanish, FAS-NB; Ph.D.,
 Maryland (College Park)
 Nineteenth- and twentieth-century Spanish-American literature and culture;
 literary theory
 Thomas M. Stephens, Associate Professor of Spanish, FAS-NB; Ph.D., Michigan
 Hispanic ethno- and sociolinguistics, lexicography
 Phyllis Zatlín, Professor of Spanish, FAS-NB; Ph.D., Florida
 Contemporary Spanish film and theater/novel; translation studies

Associate Members of the Graduate Faculty

Conrado Guardiola, Associate Professor of Spanish, FAS-NB; Doctor en
 Filosofía y Letras, Zaragoza
 Medieval Spanish literature
 Jorge Marcone, Assistant Professor of Spanish, FAS-NB; Ph.D., Texas
 Contemporary Spanish-American literature; literacy and orality; regionalism;
 critical theory
 Dámaris M. Otero-Torres, Assistant Professor of Spanish, FAS-NB; Ph.D.,
 California (San Diego)
 Golden age literature and culture; gender studies and literary theory
 Marcy Schwartz, Assistant Professor of Spanish, FAS-NB; Ph.D., Johns Hopkins
 Twentieth-century Spanish-American literature
 Adolf Snaidas, Associate Professor of Spanish, FAS-NB; Ph.D., Rutgers
 Spanish-American literature

Programs

The department offers several options for advanced study. The M.A./Ph.D. option in Spanish is intended to prepare students for careers of research and teaching in the field of Hispanic studies. The M.A. Option in Translation prepares students for careers in the fields of commerce, industry, and the judicial system. The M.A.T. program is designed for individuals already teaching Spanish at the secondary or junior college level. Both the M.A. Option in Translation and the M.A.T. are terminal degrees.

The M.A./Ph.D. program deals primarily with Spanish and Spanish-American literature and culture and may include course work in Lusó-Brazilian literature, translation, and linguistics. This program is open to applicants whose academic record and GRE scores give evidence of distinction. Doctoral candidates are required to complete 54 credits of course work beyond the bachelor's degree, of which 12 constitute a major field of concentration. An optional minor field may be taken either inside or outside the department. Candidates must also pass a written qualifying examination and complete 24 credits of research. The proposal for the doctoral thesis must be handed in at the time of the written examinations.

Six of the 30 credits required for the M.A. may be devoted to a research problem if the candidate elects to write a thesis, in which case an oral defense of the thesis is required. Candidates wishing to continue toward the Ph.D. are screened at the time of the M.A. examination. Exceptional students who are nominated by the faculty for the accelerated program are given the opportunity to bypass the master's examination and proceed directly to the 24 credits of Ph.D. course work.

Credit for graduate work taken at other institutions may be accepted in partial fulfillment of the course requirements; this normally may be no more than the equivalent of one year of course work (24 credits) at Rutgers. Candidates must demonstrate a reading knowledge of two foreign languages chosen from among German, Latin, and the Romance languages other than Spanish. This language requirement must be satisfied before the student is admitted to the qualifying examination.

The doctoral qualifying examination is a written examination based on reading lists covering the student's major and minor fields of concentration and two more general areas of study. Once the student has fulfilled the course and language requirements and passed this qualifying examination, he or she is admitted to candidacy for the Ph.D. and may then proceed with the preparation of the dissertation.

The Master of Arts Option in Translation provides advanced training for translators and interpreters who are or will be preparing for careers in legal, commercial, medical, technical, and social service fields. Applicants are admitted on the basis of academic record, GRE general test scores, and a personal statement submitted

in English and in Spanish. The 24 credits of course work may include theory and practice of translation and interpretation, linguistics, literature, culture, and literary theory. There is a foreign language requirement and a 6-credit thesis, which is a translation.

The M.A.T. program is designed for individuals already teaching Spanish. Applicants are admitted on the basis of prior academic and/or professional performance. Scores from the GRE are not required for admission. The 30 credits of course work may include language, linguistics, methodology, literature, and culture.

Admission

In order to be admitted to the graduate program in Spanish and the Graduate School–New Brunswick, applicants must meet the following criteria: have received a baccalaureate degree from an accredited institution, submit a completed application form, present a minimum of three letters of recommendation, pay a \$40 application fee, and submit supporting documentation, such as TOEFL scores, GRE scores, and/or a textual analysis. It is highly recommended that candidates have some life experience or study abroad in a Spanish-speaking environment.

Normally students who seek entrance to the Spanish graduate programs have an undergraduate degree in Spanish. It is unusual, though not entirely impossible, for undergraduate majors of curricula other than Spanish to seek entrance. A candidate for admission to the graduate program whose undergraduate preparation does not fall within the parameters of a conventional undergraduate degree in Hispanic studies may be directed to take a limited number of undergraduate or graduate courses on a nonmatriculated basis to make up any deficiencies while the decision for admission is held in abeyance. Only upon completion of this remedial work will the final decision be made. If the courses taken on a nonmatriculated basis were on the graduate level, and the student is subsequently accepted for admission to the program, those credits will count toward the graduate degree.

The Graduate School–New Brunswick must approve admission to the graduate program in the Department of Spanish and Portuguese. Normally, the department requires its candidates to have maintained a cumulative grade-point average of 3.0 or better during the junior and senior undergraduate years, and a grade-point average of 3.5 in the major field of study. GRE scores are required for admission to all programs except for the M.A.T. Foreign students must also submit TOEFL scores.

Graduate Courses

Approximately six courses from the following list are offered each term.

16:940:501. (F) METHODOLOGY OF TEACHING AND RESEARCH (3)
 Bretz, Kirschner, Persin. Required of all candidates for the standard M.A. degree exclusive of translation option, and of all teaching assistants.

Methods of teaching Spanish to English speakers at secondary and university levels. Methodology of research in Spanish including study of library resources and introduction to theoretical issues.

16:940:503,504. ADVANCED GRAMMAR AND STYLISTICS (3,3)
 Ph.D. students do not receive degree credits for these courses.

Selected problems of advanced style and grammar, with special emphasis on idiomatic usage, themes, essays, oral presentations.

16:940:505. (F) SPANISH CULTURE AND CIVILIZATION (3)
 Ph.D. students do not receive degree credit for this course.

The land and the people of Spain. The national character and its historical and cultural evolution through the present.

16:940:506. (S) CULTURE AND CIVILIZATION IN LATIN AMERICA (3)

Ph.D. students do not receive degree credit for this course.

Emphasis on major sociological, geographical, and cultural factors.

16:940:507,508. MAIN CURRENTS OF SPANISH LITERATURE (3,3)

Ph.D. students do not receive degree credit for these courses.

A critical study of texts exemplifying the principal currents of Spanish literature from the Middle Ages to the present.

- 16:940:511. (F) HISTORY OF THE SPANISH LANGUAGE (3)
Stephens
Development of the Spanish language from its origins to the present. Relationship of external history to linguistic development.
- 16:940:513,514. MEDIEVAL LITERATURE (3,3)
Guardiola
Major works of medieval literature including epic poetry, mester de clerecía, prose, and lyric poetry.
- 16:940:517. (F) DRAMA OF THE GOLDEN AGE (3)
Otero-Torres
Development of dramatic literature from its origins through the seventeenth century.
- 16:940:520. (F) THE PICARESQUE GENRE IN SPAIN (3)
Gossy
Origins, growth, and decline; such works as *El Lazarillo de Tormes*, Mateo Alemán's *Guzmán de Alfarache*, *La Picara Justina*, Quevedo's *El Buscón*, Vicente Espinel's *La Vida de Marcos de Obregón*, Cervantes's *Novelas ejemplares*.
- 16:940:521. (S) POETRY OF THE GOLDEN AGE (3)
Otero-Torres
The poetical world of the period. Analysis and literary significance of the most representative poets: Garcilaso, Fray Luis de León, Herrera, Lope de Vega, Góngora, and Quevedo.
- 16:940:522. (S) BALLADRY OF SPAIN (3)
Guardiola, Persin
How Spanish ballads originated, grew, and multiplied over the world. Different themes and styles. Their significance as sources of other literature. Analysis of several "romanceros" including Menéndez Pidal's *Flor nueva de romances viejos*.
- 16:940:523. (F) DON QUIXOTE (3)
Gossy
Critical study of Cervantes' masterpiece; analysis of its importance within the Golden Age and across the centuries.
- 16:940:525. (S) NEOCLASSICISM (3)
Major works of the eighteenth century including Feijóo, Jovellanos, Moratín, and Cadalso.
- 16:940:527. (F) ROMANTICISM (3)
Bretz
Poetry, prose, and theater of the romantic period. Relation of Spanish romanticism to other European literature.
- 16:940:529. (F) REALISM AND NATURALISM (3)
Bretz
Spanish literature of the latter part of the nineteenth century, with emphasis on the novel.
- 16:940:531. (S) SPANISH MODERNISM (3)
Bretz, Persin
Study of representative authors from early twentieth century Spain and the problem of such classifications as "Generation of 1898," "Modernismo," and "Novecentismo."
- 16:940:533. (F) PROSE FICTION OF THE TWENTIETH CENTURY (3)
Zatlin
Selected novels and short stories of the pre- and post-civil war period. The vanguardistas, social realism, the new novel.
- 16:940:535. (S) SPANISH POETRY OF THE TWENTIETH CENTURY (3)
Persin
Application of contemporary critical methods to poets of the Generation of 1927 and postwar period.
- 16:940:537. (F) TWENTIETH-CENTURY SPANISH THEATER (3)
Zatlin
Benavente, Valle-Inclán, García Lorca, Buero Vallejo, Mihura, the *Generación Realista*, and the *Nuevos Autores*. Relationships to the Hispanic tradition and to currents in modern theater.
- 16:940:539. (S) SPANISH WOMEN WRITERS OF THE NINETEENTH AND TWENTIETH CENTURIES (3)
Bretz, Persin, Zatlin
Application of contemporary feminist criticism to selected poetry, prose, and plays.
- 16:940:541. (F) MODERN SPANISH ESSAY (3)
Bretz
Study of the essay in Spain through representative writers from the eighteenth, nineteenth, and twentieth centuries.
- 16:940:542. SPANISH LITERATURE INTO FILM (3)
Zatlin
Spanish novels and plays compared to their film counterparts. Theoretical consideration of narrative strategies of cinema and television in relation to narrative or theatrical techniques of the source texts.
- 16:940:543. (F) COLONIAL SPANISH-AMERICAN LITERATURE (3)
The development of new world literature as an independent entity.
- 16:940:545. (S) NINETEENTH-CENTURY SPANISH-AMERICAN LITERATURE (3)
Mora, Rotker
Regionalism, romanticism, and the Wars of Independence; precursors of modernism.
- 16:940:547. (F) MODERNISM IN SPANISH AMERICA (3)
Aching, Mora, Rotker
The development of modernism with special emphasis on poetry. Darío, Parnassianism, and symbolism; French influence and the autochthonous contribution. The evolution of modernism toward postmodernism.
- 16:940:549. (F) CONTEMPORARY SPANISH-AMERICAN POETRY (3)
Narváez
Spanish-American poetry as an autonomous linguistic and artistic product incorporating literature in Spanish into modern world literature as part of a general renaissance in culture.
- 16:940:551,552. CONTEMPORARY SPANISH-AMERICAN NOVEL (3,3)
Mora, Narváez, Marcone, Schwartz
The accepted masterpieces of contemporary writing in Spanish America. Relation of this American novel to the genre in Europe and Spain in particular.
- 16:940:553. (S) CONTEMPORARY SPANISH-AMERICAN SHORT STORY (3)
Mora
Tendencies in the modern short story, with particular emphasis on the postmodern period. Realism and fantasy; the short story as a document and as a social instrument.
- 16:940:555. (S) CONTEMPORARY SPANISH-AMERICAN THEATER (3)
The Spanish-American theater renaissance in the twentieth century. The origins of the rural theater in Argentina; the experimental theater and the revolutionary theater in Mexico. Postwar movements. Particular emphasis on the works of Florencio Sánchez, Rodolfo Usigli, and the younger playwrights.
- 16:940:556. (S) SPANISH-AMERICAN THOUGHT FROM PRE-INDEPENDENCE THROUGH MODERNISM (3)
Rotker
Consideration of texts that figure in the Spanish-American debate concerning the Enlightenment, the movement toward independence, and the eventual development of Spanish-American modernism.
- 16:940:557. (S) TWENTIETH-CENTURY SPANISH-AMERICAN ESSAY (3)
Rotker
Consideration of representative essayists of the twentieth century; their impact on literary and cultural development of Spanish America.

16:940:562. (S) APPROACHES TO THE TEACHING OF HISPANIC LITERATURE (3)

Bretz, Persin

Current approaches to literature and methods of teaching literature to introductory-level students.

16:940:563. (F) THEORY AND PRACTICE OF TRANSLATION (3)

Zatlin. Prerequisites: 01:940:401,402, or permission of graduate director.

Introduction to translation studies. Application of linguistic and literary theory to translation. Problems of equivalence. Translation quality assessment. Practice in nonliterary and literary translation, including narrative, poetry, and theater.

16:940:579. (F) TRANSLATION WORKSHOP (3)

Zatlin. Prerequisite: 01:940:402 or equivalent.

Intensive practice in advanced translation, Spanish to English and English to Spanish. Nonliterary and literary texts. Individual and group projects, with emphasis on translation into the native tongue.

16:940:584. (S) SPANISH SYNTAX (3)

Kirschner

Structuralism, transformational-generative grammar, case grammar, and generative semantics.

16:940:585. (S) SPANISH PHONOLOGY (3)

Spanish phonetics, phonology, and morphology within the structuralist, generative, and natural generative frameworks.

16:940:586. (S) DIALECTOLOGY AND BILINGUALISM OF THE SPANISH-SPEAKING WORLD (3)

Kirschner, Stephens

Theoretical issues of dialectology and bilingualism and applications to the Spanish of Spain, Spanish America, and the U.S. Spanish language contact areas throughout the world.

16:940:590. (F) MAIN CURRENTS IN PORTUGUESE LITERATURE (3)

Critical study of texts exemplifying principal currents of Portuguese literature from the Middle Ages to the present.

16:940:591. (S) TOPICS IN PORTUGUESE LITERATURE (3)

Major sixteenth-century poets and writers, such as Gil Vicente, Luís De Camões, Bernardim Ribeiro.

16:940:595. (S) MODERNISM IN BRAZILIAN LITERATURE (3)

Critical readings of the major poets and writers, such as Mario de Andrade, Oswald de Andrade, Manuel Bandeira.

16:940:599. INDEPENDENT STUDY IN SPANISH (3)

Staff. Prerequisite: One term of course work.

Intensive study of a specific area of peninsular or Latin American literature or language not covered in regularly scheduled classes. First-term students normally not eligible. Permission of the graduate director and the faculty member directing the study required. Students limited to one independent study course during their degree program.

16:940:612. (S) SEMINAR: LITERARY THEORY (3)

Gossy, Mora, Persin. Required of Ph.D. candidates.

Current critical theory applied to Hispanic texts starting with Russian formalism and including phenomenological, structuralist, psychoanalytical, sociological-Marxist, reader-response, and deconstructionist, as well as other poststructuralist approaches.

16:940:613. (S) SEMINAR: MEDIEVAL LITERATURE (3)

16:940:617. (F) SEMINAR: DRAMA OF THE GOLDEN AGE (3)

16:940:619. (F) SEMINAR: NOVEL OF THE GOLDEN AGE (3)

16:940:620. (F) SEMINAR: NONFICTION OF THE GOLDEN AGE (3)

16:940:621. (F) SEMINAR: POETRY OF THE GOLDEN AGE (3)

16:940:623. (S) SEMINAR: CERVANTES (3)

16:940:629. (F) SEMINAR: REALISM AND NATURALISM (3)

16:940:631. (F) SEMINAR: GENERATION OF 1898 (3)

16:940:633. (S) SEMINAR: NOVEL OF THE TWENTIETH CENTURY (3)

16:940:635. (S) SEMINAR: POETRY OF THE TWENTIETH CENTURY (3)

16:940:637. (S) SEMINAR: THEATER OF THE TWENTIETH CENTURY (3)

16:940:645. (F) SEMINAR: NINETEENTH-CENTURY SPANISH-AMERICAN LITERATURE (3)

16:940:647. (S) SEMINAR: MODERNISM IN SPANISH AMERICA (3)

16:940:649. (F) SEMINAR: POETRY OF SPANISH AMERICA (3)

16:940:651. (S) SEMINAR: NOVEL OF SPANISH AMERICA IN THE TWENTIETH CENTURY (3)

16:940:653. (S) SEMINAR: SHORT STORY OF SPANISH AMERICA IN THE TWENTIETH CENTURY (3)

16:940:655. (F) SEMINAR: CONTEMPORARY SPANISH-AMERICAN THEATER (3)

16:940:659,660. SEMINAR: ADVANCED TOPICS IN HISPANIC LITERATURE (3,3)

16:940:701,702. RESEARCH IN SPANISH (BA,BA)

Interdisciplinary Graduate Course

16:617:510. INTRODUCTION TO LITERARY THEORY (3)

An introduction to contemporary literary theory, including formalism, structuralism, poststructuralism, feminism, psychoanalysis, cultural studies, and other approaches. Readings of theoretical texts and applications to short literary texts from a variety of literatures.

STATISTICS 960

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Kesar Singh, 504 Hill Center
for the Mathematical Sciences, Busch Campus (732/445-2693)

Members of the Graduate Faculty

Robert H. Berk, Professor of Statistics, FAS-NB; Ph.D., Harvard
Sequential and nonparametric methods; large sample theory

Javier F. Cabrera, Associate Professor of Statistics, FAS-NB; Ph.D., Princeton
Statistical computing

Arthur Cohen, Professor of Statistics, FAS-NB; Ph.D., Columbia
Statistical inference; decision theory; linear models

Ramanathan Gnanadesikan, Professor of Statistics, FAS-NB; Ph.D.,
North Carolina

Graphical methods; multivariate analysis; robust procedures

Richard F. Gundy, Professor of Statistics, FAS-NB; Ph.D., Chicago

Probability theory

Johannes H.B. Kemperman, Professor Emeritus of Mathematics and Statistics,
FAS-NB; Ph.D., Amsterdam

Probability and statistics; mathematical analysis

Regina Y. Liu, Professor of Statistics, FAS-NB; Ph.D., Columbia

Nonparametric methods in multivariate data analysis in statistics

Joseph I. Naus, Professor of Statistics, FAS-NB; Ph.D., Harvard

Applied probability; data quality control; clustering

Douglass A. Penfield, Professor of Statistics, GSE; Ph.D., California (Berkeley)
Educational statistics

Herbert Robbins, State of New Jersey Professor Emeritus of Mathematical

Statistics, FAS-NB; Ph.D., Harvard

Sequential analysis; empirical Bayes; biostatistics

Harold B. Sackowitz, Professor of Statistics, FAS-NB; Ph.D., Columbia

Statistical inference and decision theory; acceptance sampling

Lawrence Shepp, Professor of Statistics, FAS-NB; Ph.D., Princeton

Pure and applied probability tomography

Kesar Singh, Professor of Statistics, FAS-NB; Ph.D., Indian Statistical Institute

Inference; nonparametrics; asymptotic efficiencies; large deviations

William E. Strawderman, Professor of Statistics, FAS-NB; Ph.D., Rutgers

Decision theory; inference; multivariate statistics

Henry Teicher, Professor Emeritus of Statistics, FAS-NB; Ph.D., Columbia

Probability theory; statistical inference

J. Richard Trout, Professor of Statistics and Computer Science, CC; Ph.D., Rutgers

Regression analysis; design and analysis of experiments

David E. Tyler, Professor of Statistics, FAS-NB; Ph.D., Princeton

Multivariate analysis; robust statistics; asymptotic inference; psychometrics

Yehuda Vardi, Chairperson and Professor of Statistics, FAS-NB; Ph.D., Cornell

Development of general statistical methodologies for real life problems;
image tomography, image restoration and reconstruction and statistics

Zhiliang Ying, Professor of Statistics, FAS-NB; Ph.D., Columbia
Survival analysis; biostatistics; asymptotic theory
Cunhui Zhang, Professor of Statistics, FAS-NB; Ph.D., Columbia
Probability and mathematical statistics

Associate Members of the Graduate Faculty

Jeffrey K. Smith, Professor of Educational Statistics and Measurement, GSE;
Ph.D., Chicago
Educational statistics
Minge Xie, Associate Professor of Statistics, FAS-NB; Ph.D., Illinois
Robustness; experimental design; biostatistics

Programs

The faculty of applied and mathematical statistics offers both the M.S. and Ph.D. degrees. The M.S. degree may be earned with an emphasis in either the applied area or the theoretical area. The Ph.D. program is a continuation of the M.S. program that emphasizes theory. Thirty credits of course work, a final examination, and an essay are required for the M.S. degree; 48 credits of course work and a dissertation are required for the Ph.D. degree. Research for the dissertation begins after successful completion of the qualifying examinations, the first taken at the end of the first year and the second usually taken in the second or third year, depending on the student's background. All Ph.D. candidates are required to demonstrate proficiency in one foreign language relevant to their field or in computer programming relevant to statistics. Ph.D. students are urged to spend at least one full academic year in residence on campus, although there is no formal residence requirement. The Master of Philosophy is available to doctoral candidates.

The graduate programs in statistics and in industrial and systems engineering jointly offer two master of science degree options in quality assurance sciences. Statistics offers an option in quality management and productivity. The required core courses include 16:960:582, 583 Theory of Statistics I, II; 16:960:563 Regression Analysis; 16:960:591 Advanced Design of Experiments; 16:960:540, 541 Statistical Quality Control I, II; 16:960:542 Life Data Analysis; 16:540:580 Quality Management; and 16:960:590 Design of Experiments. See the listing under Industrial and Systems Engineering for information concerning the option in quality and reliability engineering.

An entering Ph.D. student should have a good background in mathematics, including advanced calculus and linear algebra; these latter subjects, however, are not required to gain admission. Each student selects his or her program in conference with a department adviser. There are a wide range of course offerings and areas of research. These include statistical inference, estimation theory, operations research, hypothesis testing, decision theory, biostatistics, empirical Bayes and Bayes Methods, regression analysis, analysis of variance, experimental design, multivariate analysis, nonparametric statistics, sequential analysis, quality control theory, time series analysis, applied probability, stochastic processes, and probability theory, including stopping rules and martingales. Information on recommended course sequences for degrees is available upon request from the office of the graduate director. See also Operations Research in this chapter.

Graduate Courses

16:960:501. (F) STATISTICAL THEORY FOR RESEARCH WORKERS I (3)

Not open to graduate students in statistics.
Designed to strengthen the statistical background for research workers. Concepts of randomness and probability; frequency distributions; expectations, derived distributions, and sampling; estimation and significance testing.

16:960:502. (S) STATISTICAL THEORY FOR RESEARCH WORKERS II (3)

Prerequisite: 16:960:501 or 511. Not open to graduate students in statistics.
A continuation of 16:960:501. The principles and practices of experimental design as applied to mathematical models; the analysis of variance; factorial designs; the analysis of matched groups and repeated measurements on the same group; the analysis of qualitative data.

16:960:511. (F) STATISTICAL METHODS IN SOCIAL WORK (3)
For students in the School of Social Work.

Introduction to descriptive and inferential statistics. Frequency distributions and cross-classification techniques; analyzing qualitative and quantitative data; measures of central tendency and dispersion; measures of association, correlation, and regression; probability modeling, sampling distribution, confidence intervals, hypothesis tests.

16:960:531, 532. STATISTICAL METHODS IN EDUCATION (3,3)
Penfield. For students in the Graduate School of Education.

First term: Graphing, descriptive measures of central tendency and variability, introduction to correlation and regression, probability theory, the normal curve, sampling, point estimation, interval estimation, and elementary hypothesis testing. Second term: Principles and practices of experimental design; z-test, t-test, chi-square tests, F-test, and analysis of variance.

16:960:540. (F) STATISTICAL QUALITY CONTROL I (3)
Prerequisite: 01:960:484 or equivalent.

Construction and analysis of control charts for variables and attributes; histogram analysis; use and evaluation of Dodge-Romig and Military Standards acceptance sampling plans.

16:960:541. (S) STATISTICAL QUALITY CONTROL II (3)
Prerequisites: 16:960:540, 582, 590.

Introduction to state-of-the-art methods in statistical quality control including economic design and Bayesian methods in process control, Taguchi's method and statistical tolerancing.

16:960:542. (F) LIFE DATA ANALYSIS (3)

Prerequisites: One year of calculus, 01:960:484 or equivalent.
Statistical methodology for survival and reliability data. Topics include life table techniques; competing risk analysis; parametric and nonparametric inferences of lifetime distributions; regressions and censored data; Poisson and renewal processes; multistate survival models and goodness-of-fit test. Statistical software used.

16:960:555. (F) NONPARAMETRIC STATISTICS (3)

Prerequisite: 16:960:582 or permission of instructor.
Introduction and survey of distribution-free approaches to statistical inference. Fisher's method of randomization, distribution-free test procedures for means, variances, correlations, and trends; rank tests; relative efficiency, asymptotic relative efficiency, and normal-score procedures; binomial, hypergeometric distributions, and combinatorial run theory. Other topics include tests of goodness-of-fit including the Kolmogorov-Smirnov and chi-square tests, contingency table analysis, tolerance sets, and Tchebycheff-type inequalities. Emphasis on applications.

16:960:563. (S) REGRESSION ANALYSIS (3)

Prerequisite: 16:960:590 or permission of instructor.
Review of basic statistical theory and matrix algebra; general regression models, computer application to regression techniques, residual analysis, selection of regression models, response surface methodology, nonlinear regression models, experimental design models, analysis of covariance. Emphasis on applications.

16:960:567. (S) APPLIED MULTIVARIATE ANALYSIS (3)

Prerequisite: 01:960:484 or equivalent.
Methods of reduction of dimensionality, including principal components, factor analysis, and multidimensional scaling; correlation techniques, including partial, multiple, and canonical correlation; classification and clustering methods. Emphasis on data analytic issues, concepts, and methods (e.g., graphical techniques) and on applications drawn from several areas including behavioral management, and physical and engineering sciences.

16:960:575. (F) ACCEPTANCE SAMPLING THEORY (3)

Prerequisite: 16:960:540, or 01:960:483, 484, or permission of instructor.
Selection, operation, and statistical behavior of sampling plans. Dodge-Romig plans; continuous, chain, and skip-lot plans; variable sampling plans. Economic analysis and study of sampling systems.

16:960:576. (S) SURVEY SAMPLING (3)

Prerequisite: 16:960:582 or equivalent.

Introduction to the design, analysis, and interpretation of sample surveys. Types of sampling covered include simple random sampling, stratified random sampling, systematic sampling, cluster sampling, and multistage sampling. Methods of estimation described to estimate means, totals, ratios, and proportions. Development of sampling designs combining a variety of types of sampling and methods of estimation, and detailed description of sample size determinations to achieve goals of desired precision at least cost.

16:960:580. BASIC PROBABILITY (3)

Prerequisite: One year of calculus. Credit given for only one of 16:960:580, 582, 592.

Discrete probability spaces, combinatorial analysis, occupancy and matching problems, basic distributions, probabilities in a continuum; random variables, expectations, distribution functions, conditional probability and independence; coin tossing, weak law of large number, deMoivre-Laplace theorem.

16:960:582. INTRODUCTION TO METHODS AND THEORY OF PROBABILITY (3)

Prerequisite: One year of calculus. Credit given for only one of 16:960:580, 582, 592.

Emphasis on methods and problem solving. Topics include probability spaces, basic distributions, random variables, expectations, distribution functions, conditional probability and independence, sampling distributions.

16:960:583. METHODS OF INFERENCE (3)

Prerequisite: 16:960:582. Credit not given for both 16:960:583 and 16:960:593.

Theory of point and interval estimation and hypothesis testing. Topics include sufficiency, unbiasedness, and power functions. Emphasis on application of the theory in the development of statistical procedures.

16:960:584. (F) BIostatistics I (3)

Prerequisites: One year of calculus, 01:960:484 or equivalent.

Statistical techniques for medical and pharmaceutical data. Specialized statistical techniques of estimation and hypothesis testing for determination of biological response in bioassay, including variability of quantile responses, dosage response curves, probit and logit analysis, measures and comparison of toxicity testing, statistical techniques for analysis of medical and vital statistics, comparing rate tables, evaluating effectiveness and risks, techniques of follow-up investigations.

16:960:585. (S) BIostatistics II (3)

Prerequisite: 01:960:484 or equivalent.

Techniques for analysis of contingency tables, including tables with ordered categories, and an introduction to discriminant analysis, using data from the social and medical sciences; BMDP and SAS used in analysis of data.

16:960:586,587. INTERPRETATION OF DATA I, II (3,3)

Prerequisite: 01:960:484 or equivalent.

Use of various computer-based techniques, including graphical, to understand and interpret data sets. Exposure to, and intuitive understanding of, some basic techniques for the analysis of multivariate, categorical, and time-series data as well as other miscellaneous applications of statistical procedures.

16:960:590. DESIGN OF EXPERIMENTS (3)

Prerequisite: 01:960:484 or permission of instructor.

Fundamental principles of experimental design; completely randomized variance component designs, randomized blocks, Latin squares, incomplete blocks, partially hierarchic mixed model experiments, factorial experiments, fractional factorials, response surface exploration.

16:960:591. ADVANCED DESIGN OF EXPERIMENTS (3)

Prerequisite: 16:960:590. Recommended: 16:960:563.

Strategy of experimentation, screening designs, factorial designs, response surface methodology, evolutionary operation, mixture designs, incomplete blocking designs, computer-aided experimental designs, and design optimality criteria.

16:960:592. THEORY OF PROBABILITY (3)

Prerequisite: Advanced calculus or permission of instructor. Credit given for only one of 16:960:580, 582, 592.

Emphasis on proofs and fundamental concepts. Topics include probability spaces, basic distributions, random variables, expectations, distribution functions, conditional probability and independence, sampling distributions.

16:960:593. THEORY OF STATISTICS (3)

Prerequisite: 16:960:592 or permission of instructor. Credit not given for both 16:960:583 and 16:960:593.

Theory of point and interval estimation and hypothesis testing. Topics include sufficiency, unbiasedness, Bayes methods, and power functions. Emphasis on fundamental concepts underlying the theory.

16:960:595. INTERMEDIATE PROBABILITY (3)

Prerequisites: Advanced calculus, 16:960:592 or equivalent.

Central limit theorem. Borel-Cantelli lemma, strong law of large numbers; convolutions, generating functions, recurrent events, random walks on line, plane and 3-space, ruin of a gambler, simple time-dependent processes and/or Markov chains.

16:960:652. (F) ADVANCED THEORY OF STATISTICS I (3)

Prerequisites: 16:960:593, real variables.

Theories of statistical inference and their relation to statistical methods. Sufficiency, invariance, unbiasedness, decision theory. Bayesian procedures, likelihood procedures.

16:960:653. (S) ADVANCED THEORY OF STATISTICS II (3)

Prerequisite: 16:960:652.

Hypothesis testing, point and confidence estimation robustness, sequential procedures.

16:960:654. (F) STOCHASTIC PROCESSES (3)

Prerequisite: 16:960:595.

Selected topics from the theory of the Markov processes, queueing theory, birth and death processes, martingale theory, and Brownian motion and related topics. Measure theoretic notations as well as ideas from classical analysis used as needed.

16:960:655. (S) ADVANCED NONPARAMETRIC STATISTICS (3)

Prerequisites: 16:960:593, 595, or permission of instructor.

Rank-testing and estimation procedures for the one- and two-sample problems; locally most powerful rank tests. Criteria for unbiasedness; permutation tests. Exact and asymptotic distribution theory; asymptotic efficiency. Rank correlation; sequential procedures; the Kilmogorov-Smirnov test. Emphasis on theory.

16:960:663. (F) REGRESSION THEORY (3)

Prerequisites: 16:960:593, vector spaces and matrices.

Least-squares methods of testing and estimation in multiple regression; geometric interpretation of least-squares; Gauss-Markov theorem. Confidence, prediction, and tolerance intervals in regression. Orthogonal polynomials; harmonic regression. Weighted least-squares. Analysis of variance; simultaneous inference procedures (multiple comparisons). Emphasis on theory.

16:960:664. (S) ADVANCED TOPICS IN REGRESSION AND ANOVA (3)

Prerequisite: 16:960:663.

Development of linear classification models; general results of components of variance for balanced designs; polynomial regression models (response surfaces); crossed models for combined qualitative and quantitative factors; reduced regression models; nonlinear regression computational and statistical procedures.

16:960:667. (S) MULTIVARIATE STATISTICS (3)

Prerequisites: 16:960:593, vector spaces and matrices, or permission of instructor. Multivariate, marginal, and conditional distributions. Multivariate normal; characterizations and parameter estimation. Wishart distribution; Hotelling's T2 statistic; multivariate linear model; principal component analysis correlations. Multivariate classification; matrices and discriminate methods. Emphasis on theory.

16:960:680. (F) ADVANCED PROBABILITY THEORY I (3)

Prerequisites: Real variables, 16:960:581 or equivalent. Measure of theoretic foundations of probability theory, conditional expectations, sums of independent random variables including the strong law of large numbers, law of the iterated logarithm, and Lindeberg-Levy theorem; Spitzer's lemma.

16:960:681. (S) ADVANCED PROBABILITY THEORY II (3)

Prerequisite: 16:960:680 or equivalent. Selected topics may include theory of martingales and applications, stationary processes, and the ergodic theorem; weak convergence of probability distributions; Prokhorov's theorems and Brownian motion; invariance principle.

16:960:682,683. INDIVIDUAL STUDIES IN STATISTICS (3,3)

16:960:687,688. SEMINAR IN APPLIED AND MATHEMATICAL STATISTICS (3,3)

Prerequisite: Permission of instructor. Measure, outer measures, and extensions. Measurable functions. Integration on a measure space. Lebesgue and Radon-Nikodym theorems, Hahn and Jordan decompositions. Product spaces and Fubini's theorem. Riesz representation theorem in spaces. Conditional probability. Topological and especially metric spaces, Euclidean spaces, Banach spaces. Differentiation, Hilbert spaces.

16:960:689. (F) SEQUENTIAL METHODS (3)

Prerequisites: 16:960:593, 595. The sequential probability ratio test; approximations for the stopping boundaries, power curve, and expected stopping time; termination with probability one, existence of moments for the stopping time; Wald's lemmas and fundamental identity; Bayes character and optimality of the SPRT. Composite hypotheses: weight-function and invariant SPRTs. Sequential estimation, including fixed-width confidence intervals and confidence sequences.

16:960:690,691. SPECIAL TOPICS (3,3)

Prerequisite: Permission of instructor. Topics, which change on a rotating basis, include large sample theory, time series analysis, Bayesian statistics, robustness, and sequential analysis.

16:960:701,702. RESEARCH IN STATISTICS (BA,BA)

TOXICOLOGY 963

Degree Programs Offered: Master of Science, Doctor of Philosophy

Director of Graduate Program: Professor Kenneth R. Reuhl,

EOHSI Building, Busch Campus (732/445-6909)

Members of the Graduate Faculty

Alan Appleby, Professor of Radiation Science, CC; Ph.D., Durham (England)
Radiation science

Joanna Burger, Professor of Biology, FAS-NB; Ph.D., Minnesota
Heavy metal dynamics in estuarine ecosystems

John L. Colazzi, Professor of Pharmacy and Dean of the College of Pharmacy, CP;
Ph.D., Purdue
Pharmacokinetics

Allan H. Conney, New Jersey Professor of Pharmacology, CP; Ph.D., Wisconsin
Experimental therapeutics and drug metabolism

Keith R. Cooper, Professor of Microbiology, CC; Ph.D., Rhode Island
Xenobiotic metabolism in aquatic animals; animal models

John L. Falk, Professor of Psychology, FAS-NB; Ph.D., Illinois
Behavioral mechanisms and drugs of abuse; animal models of alcoholism

Michael A. Gallo, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., Albany Medical College

Food additives; phototoxins; dermatotoxicology; dioxin; molecular biology
of estrogen receptors

Michael Gochfeld, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., CUNY (Queens)

Environmental toxicology; behavioral development and occupational medicine

Bernard D. Goldstein, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; M.D., New York

Air pollutants; benzene hematotoxicity

Diane E. Heck, Assistant Research Professor of Pharmacology and Toxicology, CP;
Ph.D., Rutgers

Biology of nitric oxide

Michael M. Iba, Associate Professor of Toxicology, CP; Ph.D., Illinois
Metabolic and molecular basis of arylamine carcinogenesis;

developmental toxicology

Sungchul Ji, Associate Professor of Pharmacy, CP; Ph.D., SUNY (Albany)
Mechanisms of liver injury; noninvasive biophysical probes

Stanley E. Katz, Professor of Microbiology, CC; Ph.D., Rutgers
Agriculture; pesticides; food additives

Frederick C. Kauffman, Professor of Pharmacology, CP; Ph.D., Illinois
Influence of intermediary metabolism on xenobiotic metabolism; neurotoxicology

Howard Kipen, Associate Professor of Environmental and Community
Medicine, UMDNJ-RWJMS; M.D., California (San Francisco)

Occupational health

Samuel Kuna, Visiting Professor of Toxicology, CP; Ph.D., New York
Anesthetics

Debra L. Laskin, Professor of Toxicology, CP; Ph.D., Medical College
of Virginia

Immunology; immunotoxicology; monoclonal antibodies; flow cytometry

Jeffrey D. Laskin, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., SUNY (Buffalo)

Carcinogenesis and differentiation in cell culture

Edmond J. LaVoie, Professor of Medical Chemistry, CP; Ph.D., SUNY (Buffalo)
Metabolism and structure-activity studies of pharmacological agents

Paul J. Lioy, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., Rutgers

Air pollution exposure, measurement, and assessment

Herbert E. Lowndes, Professor of Pharmacology and Toxicology, CP;
Ph.D., Cornell

Neurotoxicology

William J. Nicklas, Professor of Neurology and Pharmacology, UMDNJ-RWJMS;
Ph.D., Fordham

Excitotoxicity; mitochondrial toxicity; ischemia; animal models of alcoholism

Larissa A. Pohorecky, Professor of Neuropharmacology, CAS; Ph.D., Chicago
Alcohol and psychological stress on brain monoamines and behavior

Ronald D. Poretz, Professor of Biochemistry, CC; Ph.D., SUNY (Buffalo)
Inherited susceptibility to neurotoxicants; drug delivery; cancer prevention
and therapy

Susan R. Quinones, Assistant Professor of Environmental and Community
Medicine, UMDNJ-RWJMS; Ph.D., UMDNJ/Rutgers

Extracellular matrix biology and involvement in benzene-associated autoimmunity

Kenneth R. Reuhl, Professor of Pharmacology and Toxicology, CP;
Ph.D., Wisconsin

Developmental neuropathology and neurotoxicology

David J. Riley, Professor of Medicine, UMDNJ-RWJMS; M.D., Maryland
Respiratory physiology; respiratory toxicology, effects of oxidants on tissue
metabolism and molecular biology

Joseph D. Rosen, Professor of Food Science, CC; Ph.D., Rutgers
Mutagenesis; mycotoxins

Carl P. Schaffner, Professor of Microbial Chemistry, WIM; Ph.D., Illinois
Antibiotics; microbiology, chemical structure and modification, chemotherapy,
mode of action, metabolism, pharmacology, toxicology, prostate diseases

Karen M. Schaich, Associate Professor of Food Science, CC; Sc.D., Massachusetts
Institute of Technology

EPR studies of free radicals; lipid oxidation; co-oxidation of macromolecules

Robert Snyder, Chairperson and Professor of Pharmacology and Toxicology, CP;
Ph.D., SUNY Upstate Medical Center (Syracuse)

Benzene; bone marrow disease; drug metabolism; carcinogenesis

Paul E. Thomas, Professor of Chemical Biology and Pharmacognosy, CP; Ph.D.,
Ohio State

Antibody probes of the regulation and membrane topology of cytochrome P-450

Thresia Thomas, Associate Professor of Molecular Genetics, UMDNJ-RWJMS;
Ph.D., Indian Institute of Science

Hormones and breast cancer; cyclins; polyamines

Michel B. Toledano, Assistant Professor of Pharmacology and Toxicology, CP;
M.D., Ph.D., Paris VII

Oxidative stress responses and cellular signaling by redox reactions

George Wagner, Professor of Psychology, FAS-NB; Ph.D., Chicago
Neural and behavioral toxicology

Thomas J. Walsh, Assistant Professor of Psychology, FAS-NB; Ph.D., Syracuse
Hippocampal function; animal models of CNS diseases; trophic factors

Judith Weis, Professor of Zoology, FAS-NB; Ph.D., New York
Environmental factors; pollutants; estuarine organisms
Eric H. Weyand, Associate Professor of Medicinal Chemistry, CP; Ph.D., Virginia
Polytechnic Institute
Drug metabolism
Gisela Witz, Professor of Environmental and Community Medicine,
UMDNJ-RWJMS; Ph.D., New York
Benzene metabolism, tumor promotion, oxygen radical toxicity
Chung S. Yang, Professor of Pharmacognosy, CP; Ph.D., Cornell
Nitrosamines, carcinogenesis, molecular biology of cytochrome P-450

Associate Members of the Graduate Faculty

Carol R. Gardner, *Assistant Research Professor of Pharmacology and Toxicology,*
CP; Ph.D., Texas Woman's
Immunotoxicology; immunology; and radiation biology
Peter C. Kahn, Associate Professor of Biochemistry, FAS-NB; Ph.D., Columbia
Carcinogens; Agent Orange
Gail Zeevalk, Assistant Professor of Neurology, UMDNJ-RWJMS; Ph.D., CUNY
Mitochondrial toxins; energy metabolism; glutamate receptors;
excitotoxicity ischemia

Programs

The joint graduate program in toxicology is a cooperative effort of the Graduate School–New Brunswick and the Graduate School of Biomedical Sciences of the University of Medicine and Dentistry of New Jersey. Faculty members from both universities participate in the training of graduate students.

For the program leading to the Master of Science, a minimum of 29 course credits and a thesis based on a minimum of 6 credits are required. Master's degree students may earn the degree on a part-time basis.

The program leading to the Doctor of Philosophy in toxicology offers a general curriculum in the first year after which students may specialize in tracks such as biochemical toxicology; carcinogenesis and molecular biology; neurotoxicology and developmental toxicology; environmental toxicology; and cell and immunotoxicology. Candidates are required to complete a minimum of 35 credits of course work, a minimum of 24 research credits, and a dissertation, bearing in mind that a minimum of 72 credits is required for the Ph.D. The program features a weekly invited speaker lecture series highlighted by the Annual Morton J. Rodman Distinguished Lectureship in Pharmacology, the Samuel Kuna Distinguished Lectureship in Toxicology, and the Scala Lectureship featuring advances in basic research by an industrial toxicologist. Doctoral students are required to complete at least two consecutive terms as full-time resident students.

Requirements for admission include the Graduate Record Examination general test, subject test scores for biology or chemistry, and completed course work in physical chemistry, organic chemistry, physics, physiology, and calculus. Additional requirements may be imposed depending upon the applicant's background.

Graduate Courses

16:963:501,502. GENERAL TOXICOLOGY I, II (4,4)
Cooper, Snyder. Prerequisites: 16:115:503,504; 16:761:501,502; or equivalent.
Basic principles of toxicology, organ toxicology, toxicology of specific chemical agents and radiation, and overview of environmental and industrial toxicology and safety evaluation.

16:963:504. (S) GENERAL TOXICOLOGY LABORATORY (2)
Cooper, J. Laskin. Prerequisite: 16:963:501. Corequisite: 16:963:502.
Introduction to the basic laboratory activities in toxicology. Emphasis on state-of-the-art techniques for safety evaluation of chemicals.

16:963:505. (F) BIOCHEMICAL TOXICOLOGY (3)
Iba, Witz, Yang. Prerequisites: 16:115:503,504, permission of instructor.
Metabolism and electrophilic reactions of subsequent toxic metabolites studied with emphasis on kinetics, mutagenesis, carcinogenesis, and organ toxicity.

16:963:601,602. SEMINAR IN TOXICOLOGY (1,1)
Students present reports on current topics in toxicology; during the first two years, a minimum of two reports a year are required, and thereafter, one per year.

16:963:603. ADVANCED PROBLEMS IN TOXICOLOGY (BA)
Prerequisites: Permission of adviser and graduate director.

16:963:605,606. ADVANCED GENERAL PHARMACOLOGY I, II (4,4)
Kauffman. Prerequisites: 16:115:503,504 and 16:761:501,502, or equivalent and permission of instructor.

Stresses active participation by the students, who are required to enter into formal discussions of assigned readings from the research literature, in addition to topics in prescribed textbooks. For every therapeutic class, discussion emphasizes the historical and research milestones in the development of important therapeutic agents; chemistry including structure-activity relationships, metabolism, toxicity, and adverse effects; and interactions with other xenobiotics.

16:963:631. TOXICOLOGICAL PATHOLOGY (3)
Cooper, Reuhl

Stresses morphological effects of chemical agents in cells and organs. Includes chemical and pathological correlates in laboratory animal models.

16:963:701,702. RESEARCH IN TOXICOLOGY (BA,BA)

Related Graduate Course

16:215:555. ECOLOGICAL RISK ASSESSMENT (3)

URBAN PLANNING AND POLICY DEVELOPMENT 970

Degree Programs Offered: Master of Science, Doctor of Philosophy
Director of Graduate Program: Professor Hooshang Amirahmadi,
33 Livingston Avenue (732/932-3822)

Members of the Graduate Faculty

Hooshang Amirahmadi, Professor of Urban Planning, EJBSPPP; Ph.D., Cornell
Third world development (regional/national); global economic restructuring
Clinton J. Andrews, Assistant Professor of Urban Planning, EJBSPPP; Ph.D.,
Massachusetts Institute of Technology
Energy and environmental planning; regulatory reform; planning methods
Richard K. Brail, Professor of Urban Planning, EJBSPPP; Ph.D., North Carolina
Transportation; computer applications; quantitative analysis
Robert W. Burchell, Professor, CUPR; Ph.D., Rutgers
Empirical analysis in housing; land use; municipal finance
Salah El-Shakhs, Professor of Urban Planning, EJBSPPP; Ph.D., Harvard
Comparative urbanization and urban development
Susan S. Fainstein, Professor of Urban Planning, EJBSPPP; Ph.D., Massachusetts
Institute of Technology
Urban political economy; planning theory; urban redevelopment
Brent Friedlander, *Associate Professor of Urban Planning, EJBSPPP;*
Ph.D., Columbia
Land development; real estate research; physical planning
Norman J. Glickman, State of New Jersey Professor of Urban Planning, EJBSPPP;
Ph.D., Pennsylvania
Urban and regional economics and policy
Michael R. Greenberg, Professor of Urban Planning and Public Health, EJBSPPP;
Ph.D., Columbia
Environmental planning; public health
Briavel Holcomb, Professor of Urban Studies, EJBSPPP; Ph.D., Colorado
Environment and behavior; urban revitalization
James W. Hughes, Professor of Urban Planning and Dean, EJBSPPP;
Ph.D., Rutgers
Housing; demographic and economic analysis
Donald A. Krueckeberg, Professor of Urban Planning, EJBSPPP;
Ph.D., Pennsylvania
Quantitative urban analysis; history and theory
Robert W. Lake, Professor of Urban Planning and Policy Development, EJBSPPP;
Ph.D., Chicago
Urban spatial structure; locational conflict; race and housing

David Listokin, Professor of City and Regional Planning, CUPR; Ph.D., Rutgers
Housing; land use; finance

Ann R. Markusen, State of New Jersey Professor of Urban Planning, EJBSPPP;
Ph.D., Michigan State
Regionaleconomics; political economy; industrial organizations

Anton Nelesens, Associate Professor of Urban Planning, EJBSPPP; M.A., Harvard
Urban design; site and master planning; media presentations

Frank Popper, Professor of Urban Studies, EJBSPPP; Ph.D., Harvard
Land use and environmental planning; U.S. regional development

John R. Pucher, Associate Professor of Urban Planning, EJBSPPP; Ph.D.,
Massachusetts Institute of Technology
Urban transportation; urban and public sector economics

Henry J. Raimondo, Professor of Public Policy, EJBSPPP; Ph.D., Wisconsin
State and local public finance, urban economics

Lisa J. Servon, Assistant Professor of Urban Planning, EJBSPPP; Ph.D.,
California (Berkeley)
Economic development; poverty and social welfare policy; microenterprise and
micro credit programs

Peter Simmons, Professor of Law, SL-N; LL.B., California (Berkeley)
Land use; housing; municipal law

Meredeth Turshen, Associate Professor of Urban Studies, EJBSPPP; Ph.D., Sussex
Political economy of health; third world social policy

Carl Edward Van Horn, Professor of Public Policy, EJBSPPP; Ph.D.,
Ohio State
American political institutions; public policy

Lyna Wiggins, Associate Professor of Urban Studies, CUPR/EJBSPPP;
Ph.D., California Polytechnic
GIS; planning methods; computer applications in planning

Associate Members of the Graduate Faculty

Teuvo M. Airola, Professor of Environmental Planning, CC: Ph.D., Duke
Natural resource planning; GIS

Jerome Aumente, Professor of Journalism and Communications, SCILS,
and Director, Journalism Resources Institute; M.S., Columbia
Mass communications; information planning and policy

Robert A. Catlin, Professor of Urban Planning, FAS-C; Ph.D., Illinois Institute
of Technology
Planning history and theory; housing and community development

Frank Fischer, Professor of Political Science and Public Administration, FAS-N;
Ph.D., New York
Science, technology, and environmental policy

Cathy Stein Greenblat, Professor of Sociology, FAS-NB; Ph.D., Columbia
Qualitative methods; visual sociology; ethnographic and photographic research

John Van Til, Professor of Urban Planning, FAS-C; Ph.D., California (Berkeley)
Voluntary action and citizen participation; urban futures; energy

Programs

The Master of Science in urban planning degree is open to holders of advanced degrees in other disciplines who wish to develop special auxiliary knowledge in planning. All M.S. candidates are also required to take and pass an extensive comprehensive examination during their first term in the program.

A special M.S. degree option in planning for developing countries is also offered for planning professionals holding responsible public or private positions in developing nations. This one-year course in international development planning, which leads to the M.S. degree, is keyed to the needs of practicing professionals in international development holding public or private positions in the United States or abroad. The curriculum consists of a core of four courses in development theory and planning methods, and an opportunity to specialize in either gender issues in development and planning or regional development and developing nations. The 30-credit curriculum is capped by an oral or written comprehensive examination. Students are accepted once per year, in the fall term.

The gender issues in development and planning concentration provides a critique of conventional development policies and encourages students to question underlying assumptions as well as to examine the differing impact of specific policies on women and men. Students gain the analytic and technical skills to reappraise policy concepts and to construct viable alternatives to them. Additional resources for the program come from women's studies, which covers a broad range of subjects from anthropology to zoology, and from the unique women's research centers at Rutgers.

National and regional contexts delineate study in the concentration in regional development and developing nations, whether comparing issues and approaches in developed and developing countries or analyzing the development and evolution of regions and urban settlement systems in nations of the Third World. Alternative

strategies for regional and national development also are evaluated, including problems and processes of modernization and urbanization, spatial development, growth centers and new towns, metropolitan and regional planning, and comparative national urban development regional policies.

The Doctor of Philosophy is an advanced scholarly degree appropriate for students seeking a career in university teaching and research, advanced policy research in the public sector, and more basic research in the private sector. It is the intent of the faculty to admit to the program only those exceptional students who can be expected to successfully complete the program. There is no requirement of full-time residency for doctoral students and no language requirement except at the discretion of the faculty.

Applicants should have already completed a master's degree before applying for admission into the doctoral program. Some exceptional students may be admitted directly into the program with only a bachelor's degree. Usually, however, applicants who have not completed an advanced degree may apply for admission into the doctoral program after satisfactory completion of at least 24 course credits in the master's program. Until such time as they are admitted into the doctoral program, students should consider themselves enrolled only for the master's degree and plan their program accordingly. Students with a master's degree must complete a minimum of 48 credits of course work and 24 credits of thesis research. Up to 24 course credits may be transferred from their master's program, subject to approval of the program faculty. Students who enter the program without a master's degree must complete a minimum of 63 credits of course work.

Applicants to the Ph.D. program must provide evidence of their research abilities and a full résumé in addition to the normal application requirements. Evaluation of applicants will be performed by those faculty members on the Committee on Doctoral Programs (C.D.P.).

Graduate courses completed at other institutions, comprising a part of the program in their field of concentration, may be accepted for credit toward the doctorate, subject to conditions outlined in this catalog and to the judgment of the C.D.P. Such credits (up to 24) normally do not include studio-type courses, independent or directed studies, or master's thesis research. No more than 12 credits of advanced undergraduate courses may be offered toward the doctoral degree.

During the course of study for the doctoral degree the student works closely with a faculty adviser selected by the student, takes at least 9 credits of planning theory courses (including 16:970:624 Planning and Social Theory) and 9 credits of methods of advanced analysis courses (including 16:970:626 Advanced Planning Analysis), and meets frequently with the Committee on Doctoral Programs, which will evaluate the student's progress.

The dual degree program with the Department of Agricultural Economics leads to a Master of Science degree in urban planning and a Master of Science degree in Agricultural Economics. Students are accepted independently for both graduate programs after separate application to each. Students must meet the degree requirements of both programs; however, with proper course selection, 9 credits of course work from each program may be applied to the other degree, thus reducing by one and one-half terms the length of time required to obtain the two degrees.

The Department of Urban Planning and Policy Development also offers the degree of Master of City and Regional Planning (M.C.R.P.) through the Edward J. Bloustein School of Planning and Public Policy. For further information on the M.C.R.P. degree, contact the department at 732/932-3822.

Graduate Courses

16:970:511,512. (S) HISTORY OF PLANNING THOUGHT (3,3)

Krueckeberg
Major ideas in city and regional planning since the early nineteenth century. Topics include utopian thought, European models of city planning, urban technology, the City Beautiful movement, garden cities, housing reform, zoning, regional planning, theories of urban design, national planning, and others. Impact of these ideas on the evolution of planning and urban development in the context of broader intellectual, social, and technological change.

16:970:612. (S) RESEARCH STRATEGIES IN PLANNING (3)
Campbell. Prerequisite: 16:970:515 or permission of instructor.
Development of research strategies for both public policy and scholarly issues. Emphasis on conceptual problem solving, data gathering, and writing. Methods covered include: survey research, social indicators, interviewing, secondary data analysis, case studies, data presentation, and research proposal writing and editing.

16:970:622. (F) THEORY AND POLICY FOR URBAN REDEVELOPMENT (3)
Fainstein
Analysis of the evolution of urban redevelopment activities in the U.S. with comparisons to Western Europe; nature and process of urban decline; role of real-estate industry; public-private partnerships; theoretical interpretations of urban redevelopment.

16:970:624. (F) PLANNING AND SOCIAL THEORY (3)
Fainstein. Required for the Ph.D.; open to others with permission of instructor.
Examination of contemporary social theory as it applies to planning. Theories of modernity and economic restructuring; planning and the market; role of the state; development policy; possibilities for planned social change.

16:970:625. (S) PLANNING AND SOCIAL THEORY II (3)
Fainstein. Required for the Ph.D.
Review of literature in several broad topics in urban and regional studies. Theories of development; regulation theory; urban social movements; pluralism; other topics.

16:970:626. (F) ADVANCED PLANNING ANALYSIS (3)
Krueckeberg. Prerequisite: Permission of instructor.
Doctoral-level study of the urban-focused research methods of use to those undertaking a dissertation. Topics include social science methodology, the application of statistical techniques, and the structure of planning and policy research.

16:970:698,699. SPECIAL STUDIES IN URBAN PLANNING (BA,BA)
Prerequisite: Permission of graduate director.
Field or library independent study projects, guided by a faculty member, leading to the presentation of an essay for the master's degree or for Ph.D. students who have not yet qualified for candidacy.

16:970:701,702. RESEARCH IN URBAN PLANNING (BA,BA)
Thesis research.

The following courses are offered by the Edward J. Bloustein School of Planning and Public Policy in support of its program leading to the degree of Master of City and Regional Planning. They include many courses that form all or part of the curriculum for M.S. and Ph.D. students in urban planning. For further information consult the publications of the Department of Urban Planning of the Bloustein School.

- 34:970:501 Development and Theory of Urban Planning (3)
- 34:970:503 Legal Issues: Revitalization (3)
- 34:970:508 Elements of Physical Planning (3)
- 34:970:509 Urban Economy and Spatial Patterns (3)
- 34:970:510 Graduate Planning Studio (3)
- 34:970:512 History of Planning Thought (3)
- 34:970:515,516 Methods of Planning Analysis I, II (3,3)
- 34:970:517 Survey of Planning Law Principles (3)
- 34:970:520 Municipal Implementation of Planning Programs (3)
- 34:970:523,524 Legal Aspects of Environmental Planning I, II (3,3)
- 34:970:527 Advanced Multivariate Methods (3)
- 34:970:529 Principles of Housing and Community Development Policy (3)
- 34:970:531 Comparative Health-Care Systems (3)
- 34:970:532 Urban Health Problems and Planning (3)
- 34:970:534 Economic Issues for Local Governments: An Overview (3)
- 34:970:537 International Comparative Planning (3)
- 34:970:538 Comparative Metropolitan Planning (3)

- 34:970:541 Planning for New Communities (3)
- 34:970:555 Urban Transportation Policy Analysis (3)
- 34:970:556 Urban Transportation Planning (3)
- 34:970:581 Planning and Gender Development (3)
- 34:970:585 Tourism Planning (3)
- 34:970:591 Computer Applications in Urban Planning and Development (3)
- 34:970:592 Topics in Computer Applications in Urban Planning (3)
- 34:970:601 Workshop in Urban Design (3)
- 34:970:602 Planning Presentation Techniques (3)
- 34:970:603 Housing and Development Planning (3)
- 34:970:604 Land Development Practice (3)
- 34:970:607 Comparative Regional Development (3)
- 34:970:609 Third World Social Policy (3)
- 34:970:611 Urban Planning and Social Policy (3)
- 34:970:613 Economic Development Marketing (3)
- 34:970:614 Seminar in Urban Planning (3)
- 34:970:615,616 Directed Study in Urban Planning (3,3)
- 34:970:617 Planning for Community Health (3)
- 34:970:618 Environmental Planning and Management (3)
- 34:970:619 Political Economy of Urban Planning (3)
- 34:970:620 Local Economic Development Planning (3)
- 34:970:627 Housing Impact Analysis (3)
- 34:970:628 Housing Economics and Markets (3)
- 34:970:630 Projects in Urban Economic Development (3)
- 34:970:635,636 Internship in Urban Planning (3,3)
- 34:970:644 Techniques of Regional Planning (3)
- 34:970:645 Theories of Regional Development (3)
- 34:970:650-670 Seminars in Urban Planning (3 each)

WIRELESS COMMUNICATIONS CERTIFICATE

Program Offered: Certificate in Wireless Communications
Director of the Certificate Program in Wireless Communications:
Professor Jack M. Holtzman, Rutgers University, WINLAB,
P.O. Box 909, Piscataway, New Jersey 08855-0909 (732/445-3849)

Participating Faculty

The following members and associate members of the graduate faculty, identified more fully under their respective programs, represent part of the faculty who participate regularly in the certificate program in wireless communications:

David G. Daut, Electrical Engineering
David J. Goodman, Electrical Engineering
Joseph Hui, Electrical Engineering
Jack M. Holtzman, Electrical Engineering
Narayan Mandayam, *Electrical Engineering*
Christopher Rose, Electrical Engineering
Roy Yates, Electrical Engineering

Certificate Program

The Wireless Information Network Laboratory (WINLAB) offers a Certificate in Wireless Communications. This is in response to a pressing need of the wireless networking community—the shortage of engineers with the knowledge and skills needed to contribute to the growth of this dynamic industry.

The program offers a series of courses providing background in telecommunications with specialized education in wireless communications. There is some flexibility in the program to meet different educational needs. Some may wish to take the two electives as preparation for the three required courses while others will take the electives for more specialized training. The graduate courses are applied towards advanced degree programs subject to the program's requirements. Participating faculty are drawn from members of the graduate faculty in electrical engineering.

WINLAB is an industry/university collaborative venture aimed at furthering the interests of the wireless networking community. Its activities include research, technology evaluation, and education. The Rutgers Department of Electrical and Computer Engineering offers education in wireless networking at the bachelor's, master's, and Ph.D. levels. A student pursuing an advanced degree will be admitted to the certificate program upon approval of the director. Five courses with a minimum GPA of 3.0 are required for the certificate.

Required Courses

- 16:332:543 Communications Networks I (3), or 14:332:458 Telecommunication Networks (3)
 16:332:553 Wireless Access to Information Networks (3)
 16:332:556 Microwave Systems (3)

Elective Courses

- 14:332:450 Principles of Communications Systems (3) (If not previously completed)
 14:332:452 Communications Engineering (3) (If not previously completed)
 14:332:454 Electromagnetic Waves (3) (If not previously completed)
 16:332:527 Digital Speech Processing (3)
 16:332:541 Stochastic Signals and Systems (3)
 16:332:544 Communications Networks II (3)
 16:332:545 Communication Theory (3)
 16:332:547 Digital Communications I (3)
 16:332:548 Digital Communications II (3)
 16:332:551 Fading Communication Channels (3)

WOMEN'S STUDIES 988

Programs Offered: Master of Arts in Women's Studies;
 Certificate in Women's Studies

Director of the Graduate Program in Women's Studies:
 Professor Abena Busia, Voorhees Chapel, Douglass Campus
 (732/932-8246)

Members of the Graduate Faculty

Louise Barnett, Professor of English, FAS-NB; Ph.D., Bryn Mawr College
 American literature
 Mia Elisabeth Bay, Assistant Professor of History, FAS-NB; Ph.D., Yale
 African-American history; American intellectual and cultural history
 Mary Lee Bretz, Professor of Spanish, FAS-NB; Ph.D., Maryland
Nineteenth- and twentieth-century Spanish literature
 Eleanor Brilliant, Professor of Social Work, SSW; D.S.W., Columbia
 Community planning, organizational behavior, and social policy;
 women's leadership
 Charlotte Bunch, Professor of Planning and Public Policy, EJBSPPP, and Director
 of the Center for Women's Global Leadership; B.A., Duke
 Gender and development; women's human rights; violence against women;
 women's global leadership
 Abena Busia, Associate Professor of English, FAS-NB; D.Phil., Oxford
 Black African women in British and American fiction
 Barbara Callaway, Professor of Political Science, FAS-NB; Ph.D., Boston
 Comparative politics (Africa); women and politics
 Susan Carroll, Professor of Political Science, FAS-NB/EIP; Ph.D., Indiana
 Women and politics; mass politics
 Susan Cobble, Associate Professor of Labor Studies, SMLR; Ph.D., Stanford
 Women and work; labor history; union leadership
 Ann Baynes Coiro, Associate Professor of English, FAS-NB; Ph.D., Maryland
 Renaissance and seventeenth-century literature
 Drucilla Cornell, Professor of Law, SL-N; J.D., California (Los Angeles)
 Feminist jurisprudence; critical theory
 Sheila Cosminsky, Associate Professor of Sociology and Anthropology, FAS-C;
 Ph.D., Brandeis
 Cultural and medical anthropology; ethnic relations; Mesoamerica; Africa
 Jeannette Covington, Associate Professor of Sociology, FAS-NB; Ph.D., Chicago
 Deviance/criminology
 Susan Crane, Professor of English, FAS-NB; Ph.D., California (Berkeley)
 Medieval studies

Alice Crozier, Associate Professor of English, FAS-NB; Ph.D., Harvard
 American literature
 Cynthia Daniels, Associate Professor of Political Science, FAS-NB; Ph.D.,
 Massachusetts (Amherst)
 Women and public policy; productive politics; political economy of gender
 Harriet A. Davidson, Associate Professor of English, FAS-NB; Ph.D., Vanderbilt
 Modern and contemporary poetry; critical theory
 Belinda Davis, Assistant Professor of History, FAS-NB; Ph.D., Michigan
 (Ann Arbor)
 Modern European history; Germany; women's history
 Marianne DeKoven, Professor of English, FAS-NB; Ph.D., Stanford
 Modernism; women's studies
 Elin Diamond, Associate Professor of English, FAS-NB; Ph.D., California (Davis)
 Drama and dramatic theory; feminist and literary theory
 M. Josephine Diamond, Associate Professor of French, FAS-NB; Ph.D., Cornell
 Nineteenth- and twentieth-century literature; critical theory
 William C. Donahue, Assistant Professor of German, FAS-NB; Ph.D., Harvard
 Nineteenth- and twentieth-century literature; German-Jewish studies
 Kate Ellis, Associate Professor of English, FAS-NB; Ph.D., Columbia
 Women's studies; eighteenth-century fiction
 Jerry Fliieger, Professor of French, FAS-NB; Ph.D., California (Berkeley)
 Twentieth-century literature; critical theory; women's studies and feminist theory
 Sandy Flitterman-Lewis, Associate Professor of English, FAS-NB; Ph.D.,
 California (Berkeley)
 Feminist cultural analysis with an emphasis on film and literature
 Ziva Galili, Professor of History, FAS-NB; Ph.D., Columbia
 Social, economic, political history of Russia, 1900-1917, especially the revolution
 Lora D. Garrison, Professor of History, FAS-NB; Ph.D., California (Irvine)
 Women and reform movements; recent United States history
 Judith Gerson, Associate Professor of Sociology, FAS-NB; Ph.D., Cornell
 Gender; work; social theory
 Mary Gibson, Associate Professor of Philosophy, FAS-NB; Ph.D., Princeton
 Social/political/feminist/ Marxist philosophy; reproductive practices; autonomy
 John Gillis, Professor of History, FAS-NB; Ph.D., Stanford
 Modern European social history and British history
 Sherry Gorelick, Associate Professor of Sociology, FAS-NB; Ph.D., Columbia
 Education; ethnicity
 Mary Gossy, Associate Professor of Spanish, FAS-NB; Ph.D., Harvard
 Golden-age prose, narrative, feminist theory, reader-response, psychoanalysis
 Cathy Greenblat, Professor of Sociology, FAS-NB; Ph.D., Columbia
 Research methods; simulation; sexuality; development
 Sandra Harris, Professor of Psychology, FAS-NB/ GSAPP; Dean of the Graduate
 School of Applied and Professional Psychology; Ph.D., SUNY (Buffalo)
 Autism
 Mary S. Hartman, Professor of History, FAS-NB; Ph.D., Columbia
 Nineteenth-century France; women's history
 Dorothy Hodgson, Assistant Professor of Anthropology, FAS-NB;
 Ph.D., Michigan
 Cultural anthropology; politics of development; culture and power; gender
 Briavel Holcomb, Professor of Urban Studies, EJBSPPP; Ph.D., Colorado
 Urban revitalization; social and behavioral; women
 Jennifer Jones, Assistant Professor of History, FAS-NB; Ph.D., Princeton
 Medieval and early modern European; France, old regime and revolution;
 European women's history
 Alice Kessler-Harris, Professor of History, FAS-NB; Ph.D., Rutgers
 History of women and labor in the United States; special interest
 in twentieth-century social policy
 Dorothy Ko, Associate Professor of History and Women's Studies, FAS-NB;
 Ph.D., Stanford
 Premodern Chinese women's history
 Renée Larrier, Associate Professor of French, FAS-NB; Ph.D., Columbia
 African and Caribbean literature in French
 T.J. Jackson Lears, Professor of History, FAS-NB; Ph.D., Yale
 American cultural and intellectual history
 Barbara Lee, Professor of Human Resource Management, SMLR; Ph.D., Ohio;
 J.D., Georgetown
 Employment discrimination; disability and work
 Barbara Lewis, Associate Professor of Political Science, FAS-NB;
 Ph.D., Northwestern
 Comparative politics (Africa); women and politics
 Phyllis Mack, Professor of History, FAS-NB; Ph.D., Cornell
 Early modern French and English history; women's history
 Ann Markusen, State of New Jersey Professor of Urban Planning, EJBSPPP;
 Ph.D., Michigan State
 Regional economics; political economy; industrial organizations
 Umberto Mariani, Professor of Italian, FAS-NB; Dott. in Lettere, Pavia
 Nineteenth- and twentieth-century literature
 Joan Marter, Professor of Art History, FAS-NB; Ph.D., Delaware
 Modern art; twentieth-century art; gender studies; museum studies

Leslie McCall, Assistant Professor of Sociology and Women's Studies, FAS-NB; Ph.D., Wisconsin
Gender; work and labor markets; theory

Meredith McGill, Assistant Professor of English, FAS-NB; Ph.D., Johns Hopkins
Nineteenth-century women's poetry; women and the literary marketplace

Karen Mittleman, Assistant Professor of Exercise Science and Sport Studies, FAS-NB; Ph.D., Simon Fraser
Thermoregulation; thermosensitivity; adaptation and endocrine mechanisms

Jennifer Morgan, Assistant Professor of History and Women's Studies, FAS-NB; Ph.D., Duke
Early American history; African-American women's history

Alicia Ostriker, Professor of English, FAS-NB; Ph.D., Harvard
American and modern literature; criticism

Ann Parelius, Associate Professor of Sociology, FAS-NB; Ph.D., Chicago
Education

Gerald Pirog, Associate Professor of Slavic Languages and Literatures, FAS-NB; Ph.D., Yale
Slavic languages and literatures

Joanna Regulska, Associate Professor of Geography, FAS-NB; Ph.D., Colorado
Urban policy; planned-market economy; geography of women

Bruce Robbins, Professor of English, FAS-NB; Ph.D., Harvard
Critical theory; fiction

Patricia Roos, Professor of Sociology, FAS-NB; Ph.D., California (Los Angeles)
Stratification; work; gender

Sarah Rosenfield, Associate Professor of Sociology, FAS-NB; Ph.D., Texas
Medical sociology; mental illness

Bonnie G. Smith, Professor of History, FAS-NB; Ph.D., Rochester
Modern European history; women's history

Carol Smith, Professor of English, FAS-NB; Ph.D., Pittsburgh
The novel; critical theory

Judith Stern, Professor of Psychology, FAS-NB; Ph.D., Rutgers
Sexual and maternal behaviors in animals and women

Heather Strange, Associate Professor of Anthropology, FAS-NB; Ph.D., New York
Cultural anthropology; culture and aging; women's studies; gender issues; Southeast Asia

Antonia Tripolitis, Associate Professor of Religion, FAS-NB; Ph.D., Pennsylvania
Hellenistic Greek literature and thought; patristics; Neoplatonism

Meredeth Turshen, Associate Professor of Urban Planning, EJBSPPP; Ph.D., Sussex
Political economy of health; third world social policy

Cheryl Wall, Professor of English, FAS-NB; Ph.D., Harvard
American and African-American literature

Deborah White, Associate Professor of History, FAS-NB; Ph.D., Illinois
African-American history; women's history

Carolyn S. Williams, Associate Professor of English, FAS-NB; Ph.D., Virginia
Victorian literature; women's studies; cultural studies

Virginia Yans-McLaughlin, Professor of History, FAS-NB; Ph.D., SUNY (Buffalo)
United States cultural history; women's history; history of immigration

Chün-fang Yü, Professor of Religion, FAS-NB; Ph.D., Smith College
History of Buddhism; Chinese intellectual history; social aspects of religion

Linda Zerilli, Associate Professor of Political Science, FAS-NB; Ph.D., California (Berkeley)
Feminist theory; political theory

Associate Members of the Graduate Faculty

Leela Fernandes, Assistant Professor of Political Science and Women's Studies, FAS-NB; Ph.D., Chicago
Women's studies; comparative politics; political economy and cultural studies; South Asia

Jane Junn, Assistant Professor of Political Science, FAS-NB; Ph.D., Chicago
Methodology

Ruth Mandel, Board of Governors Professor of Politics and Director of the Eagleton Institute of Politics; Ph.D., Connecticut
Women's participation in American politics

Caridad Souza, Assistant Professor of Puerto Rican and Caribbean Studies, FAS-NB; Ph.D., California (Berkeley)
Comparative ethnic studies

Adjunct Member of the Graduate Faculty

Barbara Balliet, Associate Director of Women's Studies, FAS-NB; Ph.D., New York
United States social history; women's history

Programs

The interdisciplinary M.A. program in women's studies emphasizes global and multicultural perspectives in the study of women and gender. It centers on a core curriculum in women's studies that consists of four required courses: 16:988:520 Women and Social Change, 16:988:582 Feminist Theories, 16:988:583 Feminist Paradigms, and 16:988:603 Research Methods in Women's Studies. The master's program draws on faculty from some twenty different departments that offer a wide range of gender-related courses. By selecting from a list of cognate courses offered by these departments, each student can develop an individualized interdisciplinary concentration in her or his particular area of interest. Concentrations consist of four elective courses. In addition, each student needs to complete a 6-credit thesis or practicum.

Some students will be able to complete the 30-credit program in one calendar year, with course work concentrated in the fall and spring terms and the final thesis or practicum in the summer. It is also possible to attend part time and complete the degree in up to four years.

Certificate Program

Rutgers is unusual in offering both a graduate certificate in women's studies and Ph.D. concentrations on women and gender in several major disciplines—English, history, sociology, and political science. Whether or not they are in a graduate program with a “women's studies track,” students with a special interest in women's studies may nonetheless pursue, in the course of their regular program toward an advanced degree, a special concentration in women's studies resulting in a graduate certificate in women's studies.

Students who fulfill the requirements are awarded the certificate in women's studies by the Graduate School—New Brunswick upon completion of their degree. The special requirements for the certificate, many of which may also be used to satisfy the student's graduate degree requirements, are as follows: One feminist theory course, two 988 (women's studies) courses, plus one approved cognate course.

Graduate Courses in Women's Studies

16:988:520. WOMEN AND SOCIAL CHANGE (3)

An interdisciplinary study of new women's social movements which examines the dynamics of social and political transformation across cultures.

16:988:525. COLLOQUIUM IN WOMEN'S STUDIES (3)

Prerequisite: Permission of instructor.
Topic varies according to specialization of instructor.

16:988:582. FEMINIST THEORIES (3)

Development of feminist theories from late eighteenth century to the present.

16:988:583. FEMINIST PARADIGMS (3)

Contemporary issues and debates in feminist theory in local and global contexts.

16:988:584,585. WOMEN'S STUDIES PRACTICUM (3,3)

Prerequisite: Permission of instructor.
Field work for M.A. degree candidates.

16:988:590. INDEPENDENT STUDY—ISSUES IN WOMEN'S STUDIES (3)

Prerequisite: Permission of instructor.

16:988:603. RESEARCH METHODS IN WOMEN'S STUDIES (3)

Introduction to methodological issues in women's studies.

16:988:701,702. RESEARCH IN WOMEN'S STUDIES (3,3)

Prerequisite: Permission of instructor.

Graduate Courses in Other Programs

Descriptions for the courses listed below can be found elsewhere in this catalog. Students should inquire at the graduate department offering a particular course to determine the specific topic of the course that term.

Anthropology

- 16:070:510. SOCIAL IMPLICATIONS OF GENDER DIFFERENCES (3)
- 16:070:511. ANTHROPOLOGY OF GENDER (3)
- 16:070:514. LANGUAGE IN CULTURE AND SOCIETY (3)
- 16:070:523. CULTURE AND AGING (3)
- 16:070:516. SEXUALITY IN A CROSS-CULTURAL PERSPECTIVE (3)
- 16:070:546. MEDICAL ANTHROPOLOGY: WOMEN AND CHILDREN'S HEALTH AND HEALING (3)

Comparative Literature

- 16:195:603. DRAMA: FEMINIST THEORY/PERFORMANCE THEORY (3)
- 16:195:607. STUDIES IN NONFICTIONAL PROSE: PROSTITUTE LITERATURE (3)
- 16:195:609. COMPARATIVE LITERATURE AND OTHER FIELDS: WOMEN IN SURREALIST FILMS (3)
- 16:195:613. MINORITY LITERATURES: MINORITY LITERATURE (3)

English

- 16:350:514. BODY/DISCOURSE/POWER: FOUCAULT AND THE QUEERING OF THEORY (3)
- 16:350:526. LITERARY CRITICISM: THE MAJOR TEXTS (FEMINIST TEXTS) (3)
- 16:350:535. TEXTS AND CRITICAL ISSUES IN MEDIEVAL LITERATURE: TEXT AND TABOO 1050-1610 (3)
- 16:350:559. TEXTS AND CRITICAL ISSUES IN EIGHTEENTH-CENTURY LITERATURE: WOMEN WRITERS TO 1800 (3)
- 16:350:602. READINGS IN BRITISH AND AMERICAN LITERATURE: ADVANCED RESEARCH SEMINAR (3)
- 16:350:604. TEXTUAL CRITICISM: WOMEN AND RENAISSANCE LITERATURE (3)
- 16:350:625. SEMINAR: MEDIEVAL LITERATURE (MEDIEVAL WOMEN LITERATURE) (3)
- 16:350:654. SEMINAR: EIGHTEENTH-CENTURY LITERARY CRITICISM AND THEORY (EIGHTEENTH-CENTURY ENGLISH POETRY) (3)
- 16:352:510. STUDIES IN AMERICAN LITERATURE: BOUNDARY CROSSINGS (3)
- 16:352:529. AFRICAN-AMERICAN WRITERS AND AMERICAN LITERATURE: BLACK WOMEN WRITERS (3)
- 16:352:583. INTRODUCTION TO THE STUDY OF WOMEN WRITERS: NINETEENTH-CENTURY AMERICAN WOMEN WRITERS (3)
- 16:352:681. AMERICAN LITERARY WOMEN: CATHER, GLASGOW, WHARTON, STEIN (3)
- 16:352:695. SEMINAR: TWENTIETH-CENTURY AMERICAN WOMEN POETS (3)

French

- 16:420:682. PERSPECTIVES OF CONTEMPORARY CRITICISM (3)

Geography

- 16:450:520. WOMEN IN THE URBAN ENVIRONMENT (3)

German

- 16:470:662. GERMAN FEMINIST WRITERS (3)

History

- 16:510:525. COLLOQUIUM IN THE HISTORY OF WOMEN (3)
- 16:510:529. TOPICS: HISTORY OF SEXUALITY (3)
- 16:510:563. COLLOQUIUM IN AFRICAN-AMERICAN HISTORY (3)
- 16:510:680,681. SEMINAR: WOMEN'S HISTORY (3,3)

Labor and Industrial Relations

- 16:578:541. WOMEN WORKERS AND THE LABOR MOVEMENT (3)
- 16:578:566. WORK AND ALIENATION (3)

Political Science

- 16:790:584. THEMES IN FEMINIST THEORY IN POLITICS (3)
- 16:790:587. PROSEMINAR: WOMEN AND POLITICS (3)
- 16:790:588. GENDER AND MASS POLITICS (3)
- 16:790:589. WOMEN AND POLITICAL LEADERSHIP (3)
- 16:790:590. GENDER AND POLITICAL THEORY (3)
- 16:790:591. GENDER AND PUBLIC POLICY (3)
- 16:790:592. POLITICS, DEVELOPMENT, AND WOMEN (3)
- 16:790:594. WOMEN'S MOVEMENTS IN COMPARATIVE PERSPECTIVE (3)
- 16:790:596. ADVANCED TOPICS IN WOMEN AND POLITICS (3)
- 16:790:635. FRENCH FEMINIST THEORY (3)

Social Work

- 19:910:542. SOCIAL WELFARE POLICY SERVICE II: WOMEN, WORK, AND SINGLE PARENT FAMILIES (3)
- 19:910:585. ISSUES IN SOCIAL POLICY: CHILDREN AND FAMILIES (3)
- 19:910:593. WOMEN'S ISSUES: A PSYCHOSOCIAL VIEW (3)
- 19:910:692. TOPICS IN SOCIAL WORK: FAMILY CULTURE (3)

Sociology

- 16:920:511,512. PROSEMINAR IN SOCIOLOGY (3,3)
- 16:920:528. MARRIAGE AND THE FAMILY (3)
- 16:920:571. SPECIAL TOPICS IN SOCIOLOGY: CONCEPTS AND METHODS IN THE STUDY OF SEXUALITY (3)
- 16:920:618. SOCIOLOGY OF GENDER (3)
- 16:920:625. WOMEN AND DEVELOPMENT (3)
- 16:920:640. SOCIOLOGICAL PERSPECTIVES ON FEMINIST THEORY (3)
- 16:920:646. COGNITIVE SOCIOLOGY (3)

Spanish

- 16:940:539. SPANISH WOMEN WRITERS OF THE NINETEENTH AND TWENTIETH CENTURIES (3)
- 16:940:659. SEMINAR: ADVANCED TOPICS IN HISPANIC LITERATURE: CONTEMPORARY SPANISH-AMERICAN WOMEN WRITERS (3)

Urban Planning and Policy Development

- 34:970:581. PLANNING AND GENDER DEVELOPMENT: GENDER IN DEVELOPMENT AND PLANNING (3)
- 34:970:585. TOURISM PLANNING (3)

Research Centers, Bureaus, and Institutes

The university sponsors many centers, bureaus, and institutes that are the loci of its mission-oriented research. Many of these contain the principal offices of members of the graduate faculty, whose research activity takes place under their auspices. Students enrolled in the Graduate School–New Brunswick may find that their own research activity is located at and funded through these centers, bureaus, and institutes. This chapter lists those that are likely to be sites of graduate student research at the Graduate School–New Brunswick.

Center for Agricultural Molecular Biology (AgBiotech)

Foran Hall
Dudley Road, Cook Campus
New Brunswick, NJ 08903-0231
Telephone: 732/932-8165; Fax: 732/932-6535
day@aesop.rutgers.edu
Peter R. Day, Director

The Center for Agricultural Molecular Biology (AgBiotech), is an integral part of the New Jersey Agricultural Experiment Station. AgBiotech carries out research and training in molecular biology applied to agriculture and the environment and transfers new discoveries into practice and product development. Research on plant systems is concerned with fungal and viral disease resistance, sulfate metabolism, the regulation of plant development, turfgrass transformation, and the use of plants to remedy heavy metal and radionuclide pollution. Bioremediation research also seeks new tools and methods to degrade industrial and other toxic wastes using aerobic and anaerobic microorganisms to minimize pollution on land, freshwater, coastal, and offshore marine environments.

Center for Advanced Biotechnology and Medicine (CABM)

679 Hoes Lane, Busch Campus
Piscataway, NJ 08854
Telephone: 732/235-5300; Fax: 732/235-4850
Aaron J. Shatkin, Director

The Center for Advanced Biotechnology and Medicine (CABM) is jointly administered by Rutgers, The State University of New Jersey, and the University of Medicine and Dentistry of New Jersey, and is designated by the New Jersey Commission on Science and Technology as one of the state's advanced technology centers. In addition to the two universities and the commission, the center's constituencies include the New Jersey pharmaceutical and related biotechnology industries, the National Institutes of Health,

the National Science Foundation, and foundations that support science and technology. The mission of CABM is the advancement of knowledge in the life sciences for the improvement of human health. CABM performs basic research in the areas of cell and developmental biology, molecular genetics, and structural biology to improve the understanding of fundamental life processes. Researchers interact with clinical scientists to bring laboratory discoveries to patient care. CABM faculty train undergraduate, graduate, and postdoctoral students for leadership in science and technology. CABM serves the public interest by enhancing economic development through corporate collaborations in research and education, by technology transfers, and through consultations.

Center for Advanced Food Technology (CAFT)

College Farm and Dudley Roads
P.O. Box 231
New Brunswick, NJ 08903-0231
Telephone: 732/932-8306; Fax: 732/932-8690
Myron Solberg, Director

The Center for Advanced Food Technology (CAFT) is a unique, cooperative research venture between the food industry, academia, and government that strives to create and enhance applications of scientific knowledge and technologies that address the product, process, and manufacturing needs of the food industry. Research programs involve about 120 faculty members and students from eleven university departments. In the Basic Research Program, multidisciplinary, precompetitive, targeted research is performed in the areas of processed food stabilization, physical forces in food systems, in-line sensors for food processing, and quality enhancement of combat rations. The Advanced Manufacturing Technologies Program aims to develop, demonstrate, and assist in commercialization of packaged food manufacturing technologies through research and development involving faculty, staff, and students. The CAFT Technology Extension Program provides individualized product and process development assistance, specialized resources, educational outreach activities, and the development of linkages for international trade. In addition to the three program areas, CAFT has analytical facilities in mass spectrometry and chromatography, rheological measurements and extrusion cooking, and spectroscopy and calorimetry; and a Food Manufacturing Technology Facility, a 31,000 square foot building containing demonstration plant, laboratory, and product development kitchen space; all of which are used for research support as well as for student education.

Center of Alcohol Studies (CAS)

Smithers Hall
Allison Road, Busch Campus
P.O. Box 969
Piscataway, NJ 08855-0969
Telephone: 732/445-2190; Fax: 732/445-3500
Robert J. Pandina, Director

The Center of Alcohol Studies (CAS), the world's oldest alcohol research center, studies the causes and treatment of alcoholism, the diverse actions of alcohol on the body, means to prevent alcohol abuse, and the incidence and

prevalence of normal and problem alcohol consumption and conducts basic research on the causes and biological consequences of alcohol and drug abuse. The CAS includes an Education and Training Division that conducts three summer schools of alcohol and drug studies in addition to other seminars and programs, the CAS Library, a Division of Prevention, a Division of Clinical Services, and a Division of Basic Sciences that encompasses a range of human, animal, and biochemical research. The center offers graduate courses in Alcohol Studies to students enrolled in advanced degree programs at Rutgers who wish to pursue a special concentration in alcohol studies.

Center for Ceramic Research

Busch Campus
P.O. Box 909
Piscataway, NJ 08855-0909
Telephone: 732/445-5900; Fax: 732/445-3258
Dale E. Niesz, Director

The Center for Ceramic Research is an Advanced Technology Center of the New Jersey Commission on Science and Technology and a National Science Foundation Industry/University Cooperative Research Center. It serves as a resource center in ceramic science and engineering for the state of New Jersey and member companies. The center is dedicated to developing advanced ceramic science and engineering and assuring that emerging science and engineering technology is used for commercial and technological development in New Jersey and beyond. The center conducts research in a broad area of ceramic science, engineering, and technology, focusing on the synthesis of advanced materials with the microstructures and nanostructures needed to fulfill the property requirements as well as cost, shape, and reliability requirements of emerging applications.

Center for Cognitive Science (RuCCS)

Psychology Building Addition, Busch Campus
New Brunswick, NJ 08903
Telephone: 732/445-0635; Fax: 732/445-0634
<http://ruccs.rutgers.edu>
Zenon Pylyshyn, Director

The Rutgers Center for Cognitive Science (RuCCS) fosters research activities in cognitive science, focusing on the nature of certain symbolic processes that are constitutive of intelligent performance. The center's goal is to understand such aspects of intelligent performance as perception, language processing, planning, problem solving, reasoning, and learning, in terms of both the computational processes that underwrite these skills and the computational mechanisms that may instantiate them. The center's research is essentially multidisciplinary and is carried on in its own facilities as well as facilities throughout the university. RuCCS also contributes to graduate training through the certificate program in cognitive science.

Center for Computer Aids for Industrial Productivity (CAIP)

CoRE Building, sixth and seventh floors
Frelinghuysen Road, Busch Campus
Piscataway, NJ 08855-1390
Telephone: 732/445-3443; Fax: 732/445-0547
James Flanagan, Director

The Center for Computer Aids for Industrial Productivity (CAIP) is a multidisciplinary Advanced Technology Center sponsored by the New Jersey Commission on Science and Technology, Rutgers, The State University of New Jersey, and thirty industrial and corporate sponsors. CAIP conducts computer applications research in the areas of parallel and distributed computing, machine vision, speech processing, computer-aided design, scientific visualization and quantification and multimedia information systems, and facilitates industry-university technology transfer. CAIP's research mission is to apply the technologies of high-speed scientific computing to the solution of industrial problems. Most of the research is conducted by digital simulation on laboratory workstations networked to CAIP's central computers. Computational resources include an 8-node IBM SP2, a 512-node nCube 2S massively parallel computer, a 50-processor SPARC-cluster, and over 300 workstations.

Center for the Critical Analysis of Contemporary Culture (CCACC)

8 Bishop Place, College Avenue Campus
New Brunswick, NJ 08903
Telephone: 732/932-8426; Fax: 732/932-8683
gelevine@rci.rutgers.edu
George Levine, Director

The Center for the Critical Analysis of Contemporary Culture (CCACC) was established to foster interdisciplinary research and scholarly exchange in the humanities and social sciences. Each year the center focuses on a topic of broad interdisciplinary interest and appoints up to twenty fellows from the full range of university disciplines. The center sponsors lecture series, colloquia, and conferences on important topics of interdisciplinary concern.

Center for Discrete Mathematics and Theoretical Computer Science (DIMACS)

CoRE Building, Busch Campus
P.O. Box 1179
Piscataway, NJ 08855-1179
Telephone: 732/445-5928; Fax: 732/445-5932
Fred S. Roberts, Director

The Center for Discrete Mathematics and Theoretical Computer Science (DIMACS) is a National Science Foundation Science and Technology Center, also supported by the New Jersey Commission on Science and Technology and a consortium of Rutgers and Princeton universities and AT&T Labs, Bell Labs, and Bellcore. DIMACS offers workshops, seminars, and tutorials, hosts postdoctoral fellows and graduate students, and runs precollege and undergraduate programs to address topics of current scientific importance. Recent sample topics include Discrete and Computational Geometry, Complexity Theory of Interactive Computing, Graph Theory and Algorithms, Combinatorial Optimization, Massively Parallel Computing, Mathematical Support for Molecular Biology, Logic and Algorithms, Networks, and Discrete Probability.

Eagleton Institute of Politics

90 Clifton Avenue, Douglass Campus
New Brunswick, NJ 08901
Telephone: 732/828-2210 or 932-9384;
Fax: 732/932-6778
<http://www.rci.rutgers.edu/~eagleton>
Ruth B. Mandel, Director

The Eagleton Institute of Politics is nationally recognized for its education, research, and public service activities in the field of American politics. Eagleton and the Department of Public Policy at the Edward J. Bloustein School of Planning and Public Policy offer a one-year M.S. degree program combining study, practical experience, and interaction with political leaders and policymakers. The institute also houses two specialized research centers—the Center for the American Woman and Politics and the Center for Public Interest Polling/Eagleton Poll. Eagleton offers an undergraduate associates program in collaboration with the Department of Political Science and offers a variety of other programs about American politics and the political process. The institute develops new knowledge and understanding of emerging topics and themes in order to encourage more responsive and effective leadership.

Thomas A. Edison Papers

113 Van Dyck Hall, College Avenue Campus
New Brunswick, NJ 08903
Telephone: 732/932-8511; Fax: 732/932-7554
Robert Rosenberg, Director

The Thomas A. Edison Papers is an institute devoted to the selective publication of the more than five million pages of notebooks, correspondence, patent materials, and legal records of Thomas A. Edison and his associates. The Edison Papers is cosponsored by Rutgers, The State University of New Jersey, the National Park Service, the New Jersey Historical Commission, and the Smithsonian Institution. Ten full-time faculty members associated with the institute do research on Edison and also a broad range of historical issues from the nineteenth and twentieth centuries.

Environmental and Occupational Health Sciences Institute (EOHSI)

681 Frelinghuysen Road, Busch Campus
Piscataway, NJ 08855-1179
Telephone: 732/445-0200; Fax: 732/445-0131
Bernard D. Goldstein, M.D., Director
Mark G. Robson, Ph.D., M.P.H., Executive Director

The Environmental and Occupational Health Sciences Institute (EOHSI) is jointly sponsored by Rutgers, The State University of New Jersey, and the University of Medicine and Dentistry of New Jersey—Robert Wood Johnson Medical School. The institute houses a select group of scientists, physicians, educators, and policy researchers focused on the serious health effects of environmental pollutants. Institute members investigate ways people are exposed to chemicals, study how chemicals react in the body, educate the public

about risks from chemical exposure, and assist in formulating policies to protect human health. EOHSI is comprised of six divisions: toxicology; public education and risk communication; occupational health; exposure measurement and assessment; environmental health; and environmental policy. In 1988, EOHSI became the site of the first National Institutes of Health (NIH) center of excellence in New Jersey, one of only sixteen such centers funded by NIH to facilitate multidisciplinary research on health problems posed by environmental exposures.

Fiber Optic Materials Research Program (FOMRP)

Busch Campus
P.O. Box 909
Piscataway, NJ 08855-0909
Telephone: 732/445-4729; Fax: 732/445-4545
sigel@alumina.rutgers.edu
George H. Sigel, Jr., Director

The Fiber Optic Materials Research Program (FOMRP) involves research projects with a scope ranging from the synthesis of new optical materials by chemical vapor deposition to advanced optical signal transmission and processing. Emphasis has been placed on research that focuses on future and advanced applications of optical fibers, particularly those that extend beyond telecommunications, including research on fiber optics for biomedical applications, design and fabrication of fiber optic sensors, fabrication of fiber optic lasers and optical amplifiers, and the development of infrared transmitting fibers based on halide and chalcogenide glasses as well as crystals and hollow waveguides. The FOMRP seeks to conduct generic research on a cooperative basis with industry and government and to provide a mechanism for technology transfer of its activities.

Institute for Health, Health Care Policy, and Aging Research

30 College Avenue
P.O. Box 5070
New Brunswick, NJ 08903
Telephone: 732/932-8413; Fax: 732/932-6872
David Mechanic, Director

The Institute for Health, Health Care Policy, and Aging Research was established to consolidate and focus the resources of the university on critical health and aging issues facing the nation. It facilitates collaboration among scholars who represent many disciplines, providing them with opportunities to pool their knowledge and expertise in examining multifaceted health problems. Each of the three divisions on health, health policy, and aging provides a range of research and training opportunities to predoctoral students enrolled in degree-granting programs elsewhere in the university and to fellows enrolled in the institute's postdoctoral program. The institute has broad scope but focuses its research efforts in areas where it has particular analytic strength and where it can build on the excellence of academic departments and professional schools at the university.

Rutgers Center for Historical Analysis (RCHA)

88 College Avenue
New Brunswick, NJ 08903
Telephone: 732/932-8701; Fax: 732/932-8708
John W. Chambers II, Director

The Rutgers Center for Historical Analysis (RCHA), a multidisciplinary research center and affiliate of the history department at Rutgers–New Brunswick, provides a setting to discuss issues of broad contemporary relevance in historical perspective. Organizing its annual activities around major themes of inquiry or research projects, the center each year welcomes visiting senior and postdoctoral fellows chosen through an open, international competition, along with a dozen faculty and graduate fellows from within Rutgers. In addition to weekly seminars, the center hosts a variety of public conferences and related cultural events, sponsors the Institute for High School Teachers, and houses *The Journal of the History of Ideas*.

Rutgers Center for the History of Electrical Engineering (IEEE)

39 Union Street, College Avenue Campus
New Brunswick, NJ 08903
Telephone: 732/932-1066; Fax: 732/932-1193

The Rutgers Center for the History of Electrical Engineering (IEEE) is a joint venture between Rutgers, The State University of New Jersey, and the Institute of Electrical and Electronics Engineers, Inc. The center undertakes research, public outreach, and archival work in all aspects of the history of electrical, electronic, and computing technology and their social, political, and cultural contexts. IEEE also awards an annual fellowship and historical paper prize.

Institute of Marine and Coastal Sciences (IMCS)

Cook Campus
P.O. Box 231
New Brunswick, NJ 08903-0231
Telephone: 732/932-6555; Fax: 732/932-8578
J. Frederick Grassle, Director

The Institute of Marine and Coastal Sciences (IMCS) conducts and integrates research efforts on estuarine, marine, and coastal processes for New Jersey and the surrounding region. Current research themes include establishment of Long-Term Ecosystem Observatories (LEOs) fish and shellfish biology and ecology, estuarine and nearshore ecology, biogeochemistry, aquaculture, genetics of marine populations, coastal physical oceanography, coastal geology, hydrothermal vent research, pinelands ecology, and deep-sea research. The institute features advanced field and laboratory facilities such as a real-time satellite remote sensing laboratory, scanning electron microscope, high-performance computers, coastal observation network, and annular flumes to support mesocosm studies of continental shelf communities. IMCS faculty advise students in oceanography, environmental sciences, ecology and evolution, geology, and several areas of engineering.

Center for Nanostructured Materials (CNM)

College of Engineering
Brett and Bowser Roads, Busch Campus
P.O. Box 909
Piscataway, NJ 08855-0909
Telephone: 732/445-2888; Fax: 732/445-3229
Thomas Tsakalakos, Director;
William E. Mayo, Codirector

The Center for Nanostructured Materials (CNM) is jointly supported by the New Jersey Commission on Science and Technology, Rutgers, The State University of New Jersey, and several industry members. CNM's mission is to support forefront research in advanced materials areas and to promote industry-university interactions. Research areas include: chemical and physical synthesis of nanostructured materials, ultrafine powder thin-film technology, and advanced characterization. Equipment at CNM is consolidated into six major facilities: chemical synthesis; physical synthesis; X ray; ion beam; electron microscopy; and modeling and computer simulations.

Center for Packaging Science and Engineering

106A Building 3529, Busch Campus
Piscataway, NJ 08855
Telephone: 732/445-3224; Fax: 732/445-5636
James D. Idol, Director

The Center for Packaging Science and Engineering consists of a research division with four laboratories and an information center for packaging and related fields. The major research thrusts of the center are in packaging science and technologies, covering food and beverage packaging; pharmaceutical, medical, and health care packaging; industrial hard and soft goods packaging; and materials science related to packaging processes and products. The Distribution Packaging Laboratory evaluates package performance in the distribution environments. The Permeation/Leakage Laboratory studies barrier properties of packaging materials. The Materials/Package Laboratory studies mechanical, physical, and chemical properties and performance of packaging materials. The Packaging Machinery Laboratory studies packaging machinery design, operation, and interactions of packaging machinery and packaging materials.

Institute for Research on Women (IRW)

27 Clifton Avenue, Douglass Campus
P.O. Box 270
New Brunswick, NJ 08903-0270
Telephone: 732/932-9072; Fax: 732/932-0861
Marianne DeKoven, Director

Founded in 1976 to provide an exchange of ideas and information among scholars on the New Brunswick campuses, the IRW has taken a leading role both regionally and nationally in enabling and disseminating the new research and writing on women and gender. The institute brings together several hundred university faculty members and graduate students who are working on gender-related subjects; organizes interdisciplinary lectures, seminars, and conferences; and hosts visiting scholars in a range of disciplines. The institute sponsors a graduate student/faculty seminar that focuses on key issues and debates in the history, theory, and practice of feminism as it enters the twenty-first century. The IRW also sponsors an annual graduate student conference.

Laboratory for Surface Modification (LSM)

Serin Physics Laboratories, Busch Campus
P.O. Box 849
Piscataway, NJ 08855-0849
Telephone: 732/445-5185; Fax: 732/445-4991
Theodore E. Madey, Director

The Laboratory for Surface Modification (LSM) provides a focus for research in basic and applied studies of high technology surfaces and interfaces, which involves multidisciplinary research in the disciplines of physics, chemistry, ceramics, materials science, and electrical engineering. Surface modification encompasses a broad spectrum of phenomena that occur at the atomic level on the surface of solids, and advances in this technology have a fundamental impact on the fields of telecommunications, petroleum, superconductivity, computer science, minerals, and chemicals. Research is supported with extensive, state-of-the-art ultrahigh vacuum instrumentation, electronics, and computational facilities. In addition, the laboratory operates a 1.7 MeV Tandem accelerator, complete with Rutherford backscattering and ion channeling capabilities. Another laboratory facility is a Kratos XSAM Surface Analysis system containing X-ray photoelectron spectroscopy, Auger electron spectroscopy, and ion-scattering spectroscopy.

Center for Urban Policy Research (CUPR)

33 Livingston Avenue, Suite 400
New Brunswick, NJ 08901-1982
Telephone: 732/932-3134; Fax: 732/932-2363
Norman J. Glickman, Director

The Center for Urban Policy Research (CUPR) specializes in housing, land use, economic development, and urban poverty issues and is concerned with both the academic quality of urban research and the practical application of research results to policy formulation and implementation. Recently, the center received two large grants from the Ford Foundation to evaluate community development partnerships, to provide training, and to carry out other activities. The center is midway into a four-year contract with the U.S. Department of Housing and Urban Development for research on a variety of topics. One report prepared under this contract, "State of the Nation's Cities" (SoNC), an overview and data analysis of how our cities have changed over the last quarter century, won the United Nations' Best Practices Award at the UN Habitat II conference in Turkey. In other work, CUPR's Rutgers Economic Advisory Service (R/ECON™) provides economic forecasts for businesses and governments. The center publishes a quarterly newsletter; monographs and working papers are published through the CUPR Press.

Laboratory of Vision Research (LVR)

Psychology Building, Busch Campus
Piscataway, NJ 08854
Telephone: 732/445-6660; Fax: 732/445-6715
Bela Julesz, Director

The Laboratory of Vision Research (LVR) has three major objectives: to conduct advanced interdisciplinary research in vision, to establish undergraduate and graduate courses in visual perception and related areas, and to serve as a consulting body to New Jersey and national institutions. Research is focused on early vision, such as texture, stereoscopic depth, and motion perception and some higher processing states, such as the role of focal attention in visual tasks. Practical applications of research conducted in the laboratory include the diagnosis and prevention of stereo blindness, invention of new ways to match large databases to the heuristics of the human observer, and the development of image compression techniques based on the properties of the human visual system.

Waksman Institute of Microbiology

P.O. Box 759
Piscataway, NJ 08855-0759
Telephone: 732/445-3060; Fax: 732/445-5735
Joachim Messing, Director

The Waksman Institute of Microbiology is an internationally recognized center of excellence in molecular genetics. Members of the institute are studying gene expression and signal transduction controlled by a number of environmental and developmental stimuli, using microbe, plant, and animal genetic models. A new focus on structural and computational biology complements these areas of interest. Twenty-one laboratories arranged around four groups (microbial, plant, and developmental genetics; structural biology) equipped with state-of-the-art equipment provide graduate students the opportunity to learn the latest techniques in molecular genetics. In addition, the Waksman Institute houses the Molecular Biology Computing Lab.

Administration

Administrative Offices

Office of the Graduate School–New Brunswick, 25 Bishop Place,
College Avenue Campus (732/932-7034)
Office of Graduate and Professional Admissions, 18 Bishop Place,
College Avenue Campus (732/932-7711)
Cashier, Records Hall, College Avenue Campus (732/932-7044)
Office of the Graduate Registrar, Administrative Services Building,
Busch Campus (732/445-2104, 3556)
Cashier, Administrative Services Building, Busch Campus (732/445-3008)

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Linda G. Schulze, Ph.D., Assistant Dean of the Graduate School–New Brunswick
Barbara Pleva, Administrator for Fellowships and Student Support
Barbara Sirman, Administrator for Degree Certification

Executive Council of the Graduate School– New Brunswick 1996–1997

Dates in parentheses indicate expiration of term of membership.

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Charles Glashauser, Professor of Physics (1998)
Judith Grassle, Professor of Ecology (1997)
Dale Haidvogel, Professor of Marine and Coastal Sciences (1999)
Jack Harris, Professor of Anthropology (1998)
Barbara McCrady, Professor of Psychology (1999)
J. Kenneth Mitchell, Professor of Geography (1997)
Howard Passmore, Professor of Biological Sciences (1998)
Bonnie Smith, Professor of History (1997)
Laura White, Professor of Italian (1999)
Donald Winkelmann, Professor of Pathology (1997) *
Lily Young, Professor of Environmental Sciences (1999)

Student Representatives

Tamas Demeny, Comparative Literature (1997) *
Lisa Zussman, Environmental Sciences (1997) *

Graduate School–New Brunswick Representatives to the University Senate 1996–1997

Dates in parentheses indicate expiration of term of membership.

Carol Bagnell, Associate Professor of Animal Sciences (1999) *
Emily Bartels, Associate Professor of English (1997)
Omer Bartov, Professor of History (1998)
P. Dennis Bathory, Professor of Political Science (1997)
Robert Blumenshine, Associate Professor of Anthropology (1999)
Joanna Burger, Professor of Ecology and Evolution (1997)
Donald Krueckeberg, Professor of Urban Planning (1998)
Paul Panayotatos, Associate Professor of Electrical Engineering (1998)
Henrik Pedersen, Professor of Chemical and Biochemical Engineering (1999) *
Susana Rotker, Associate Professor of Spanish (1998)
Gary L. Taghon, Associate Professor of Marine and Coastal Sciences (1997)
Richard Williams, Associate Professor of Sociology (1999) *

New Brunswick Faculty Council 1996–1997

Stephen Danforth, Professor of Ceramic Science and Engineering (1999)
Patricia Roos, Professor of Sociology (1998)

* Appointed by the dean

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Christine Todd Whitman, Governor of the State

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Roger J. Dennis, Ph.D., Provost

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David Wilson, Ed.D., Associate Provost

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Divisions of the University

ACADEMIC DIVISIONS

Rutgers, The State University of New Jersey, provides educational and research services throughout the state on campuses located in Camden, Newark, and New Brunswick. The principal university center is located in New Brunswick, where Rutgers originated two centuries ago.

Camden

Camden offers programs at three undergraduate colleges and at five graduate schools. With an enrollment of five thousand students, it offers exceptional educational opportunities in addition to providing the advantages and resources associated with a major state university.

Faculty of Arts and Sciences–Camden

Andrew Lees, Ph.D., Acting Dean

Established in 1983 as a result of academic reorganization of the Camden campus, the Faculty of Arts and Sciences–Camden offers academic programs for undergraduate and graduate work in twenty-three arts and sciences disciplines and in a variety of interdisciplinary areas.

School of Business–Camden

Milton Leontiades, Ph.D., Dean

Established in 1988, the School of Business–Camden sets major requirements and teaches all courses leading to the Bachelor of Science degree in the professional areas of accounting and management. The School of Business also sets the major requirements and teaches all courses leading to a Master of Business Administration degree.

Camden College of Arts and Sciences

Andrew Lees, Ph.D., Acting Dean

A coeducational, liberal arts college, CCAS is the successor institution to the College of South Jersey, which was established in 1927 and became part of the state university in 1950.

University College–Camden

Andrew Lees, Ph.D., Acting Dean

University College–Camden is an evening college of liberal arts and professional studies serving part-time students since 1950.

Graduate School–Camden

Andrew Lees, Ph.D., Acting Dean

Graduate programs in the liberal arts were started in Camden in 1971 under the jurisdiction of the Graduate School–New Brunswick. The Graduate School–Camden was established as an autonomous unit in 1981.

School of Law–Camden

Jay M. Feinman, J.D., Acting Dean

Founded in 1926, the School of Law–Camden joined the university in 1950 as the South Jersey Division of the School of Law–Newark. It became an independent unit of the university in 1967. The law school offers a curriculum leading to the degree of Juris Doctor, including advanced study in special areas.

Summer Session–Camden

Thomas Venebles, Ph.D.

The Summer Session, begun in 1913 and established as a division of the university in 1960, offers a wide variety of graduate and undergraduate courses during three sessions in the summer months.

Newark

Newark offers programs at three undergraduate colleges and at four graduate schools. With an enrollment of approximately ten thousand students, it offers strong academic programs, excellent facilities, and an outstanding faculty.

Faculty of Arts and Sciences–Newark

David Hosford, Ph.D., Dean

The Faculty of Arts and Sciences–Newark was established in 1985 to expand and strengthen the instructional program for undergraduate students at the Newark campus. The combined faculties of Newark College of Arts and Sciences and University College–Newark offer courses and academic programs in more than sixty subject areas.

Newark College of Arts and Sciences

David Hosford, Ph.D., Dean

Founded in 1930 as Dana College, this undergraduate, coeducational, liberal arts college became part of Rutgers when the University of Newark was integrated into the state university in 1946.

College of Nursing

Hurdis Margaret Ann Griffith, Ph.D., Dean

The College of Nursing was established in 1956 as an expansion of the university's offerings in the former School of Nursing of the Newark College of Arts and Sciences. Its graduate program is conducted through the Graduate School–Newark.

University College–Newark

David Hosford, Ph.D., Dean

University College–Newark is an evening and weekend college of liberal arts and professional studies serving part-time students since 1934. Within the context of the liberal arts tradition, University College students are offered a full range of courses and curricula, including programs in business and preparation for the professions leading to the degrees of Bachelor of Arts and Bachelor of Science.

Faculty of Management

P. George Benson, Ph.D., Dean

Established in 1993, the Faculty of Management encompasses the Graduate School of Management and the School of Management. The School of Management is an upper-division undergraduate school, founded in 1993, that offers the Bachelor of Science degree jointly with either the Newark College of Arts and Sciences or University College–Newark. Degree programs are available in accounting, finance, management, and marketing. The Graduate School of Management, founded in 1929 as the Seth Boyden School of Business and incorporated into Rutgers in 1946, offers three programs. Two of these programs, management and professional accounting, lead to the Master of Business Administration degree. The third program offers the Ph.D. degree in management jointly with the Graduate School–Newark and the New Jersey Institute of Technology.

Graduate School–Newark

Norman Samuels, Ph.D., Dean

The Graduate School–Newark was established as a separate instructional division of the university with degree-granting authority in 1976.

School of Criminal Justice

Ronald V. Clarke, Ph.D., Dean

The School of Criminal Justice, which opened in 1974, offers a graduate program that provides students with a sound foundation for work in teaching, research, or criminal justice management. The Master of Arts degree is offered through the school, and the Ph.D. degree is offered in conjunction with the Graduate School–Newark.

School of Law–Newark

Roger I. Abrams, J.D., Dean

The university's graduate programs in law originated in other institutions. The New Jersey School of Law, founded in 1908, and the Mercer Beasley School of Law, founded in 1926, merged in 1936 to become the University of Newark School of Law, which became part of Rutgers in 1946.

Summer Session–Newark

Gerald Warshaver, Ph.D.

The Summer Session, begun in 1913 and established as a division of the university in 1960, offers a wide variety of graduate and undergraduate courses during three sessions in the summer months.

New Brunswick

The New Brunswick campus is the largest and most diversified of the university's three campuses with fifteen academic units, eighteen hundred faculty, and thirty-three thousand students enrolled in undergraduate and graduate programs.

Faculty of Arts and Sciences–New Brunswick

Richard F. Foley, Ph.D., Dean

Established in 1981 as a result of academic reorganization of the New Brunswick campus, the Faculty of Arts and Sciences–New Brunswick teaches all arts and science courses for undergraduate and graduate students in degree-granting units and sets the major requirements for all arts and science majors. Organized into disciplines and departments, it offers forty-four undergraduate major programs and twenty-nine graduate programs, which are administered by the Graduate School–New Brunswick.

Douglass College

Barbara Shailor, Ph.D., Dean

Founded in 1918 as the New Jersey College for Women, Douglass is the largest women's college in the nation. While maintaining rigorous standards of instruction in the fundamental disciplines of the liberal arts, Douglass supports and develops programs which link major courses of study to future careers. The college also implements special programs as well as independent activities designed to help women students develop the qualities required for achievement in any field of endeavor.

Livingston College

Arnold Hyndman, Ph.D., Dean

Livingston College opened in 1969 as a coeducational institution dedicated to serving a diverse student body reflecting the racial, ethnic, and socioeconomic composition of today's society. As a college of the liberal arts and professions, Livingston is committed to a multidisciplinary program that brings together a diverse group of students, faculty, and staff in a cosmopolitan community dedicated to learning.

Rutgers College

Carl Kirschner, Ph.D., Dean

Rutgers College was chartered in 1766 and is the original nucleus around which the university developed. Formerly an undergraduate college for men, it is now coeducational. Dedicated to the promotion of excellence in undergraduate education, Rutgers College provides its students with clear guidelines in the pursuit of a liberal arts education.

University College–New Brunswick

Emmet A. Dennis, Ph.D., Dean

University College–New Brunswick is an evening college of liberal arts and professional studies serving part-time students since 1934. Within the context of the liberal arts tradition, University College–New Brunswick students are offered a full range of courses and curricula, including programs in business and preparation for the professions leading to the degrees of Bachelor of Arts and Bachelor of Science.

Cook College

Bruce C. Carlton, Ph.D., Dean

A coeducational and residential college, Cook offers undergraduate programs in various applied disciplines with emphasis on environmental, agricultural, food, and marine sciences. Formerly the College of Agriculture and later the College of Agriculture and Environmental Science, Cook College adopted its present name in 1973. Graduate programs are offered through the Graduate School–New Brunswick.

College of Engineering

Ellis H. Dill, Ph.D., Dean

Instruction in engineering began at Rutgers in 1864, when New Jersey designated Rutgers College to be the State College for the Benefit of Agriculture and Mechanic Arts. The College of Engineering became a separate unit in 1914 and is dedicated to the sound technical and general education of the student. It offers a Bachelor of Science degree in seven disciplines as well as a curriculum in applied sciences. Its graduate programs are conducted through the Graduate School–New Brunswick.

College of Pharmacy

John L. Colaizzi, Ph.D., Dean

First organized in 1892 and incorporated into the state university in 1927, the College of Pharmacy offers a five-year professional program leading to the Bachelor of Science degree and a graduate program leading to the Pharm.D. degree. Other graduate programs leading to advanced degrees through the Graduate School–New Brunswick are also available. In addition, the college sponsors an extension program for the benefit of practicing pharmacists throughout the state.

Mason Gross School of the Arts

Marilyn Feller Somville, Ph.D., Dean

This branch of Rutgers opened in July 1976. The school grants both undergraduate and graduate degrees. Formed to provide an education in the arts of the highest professional caliber, the school offers an M.F.A. degree in visual arts and theater arts; D.M.A., A.Dpl., M.M., and B.Mus. degrees in music; and a B.F.A. degree in visual arts, dance, and theater arts.

School of Business–New Brunswick

P. George Benson, Ph.D., Dean

Approved by the New Jersey Department of Higher Education in 1986, the School of Business–New Brunswick offers both undergraduate and graduate degrees. On the undergraduate level, it is a two-year, upper-division school offering programs in accounting, finance, management, and marketing. The school admits students from Douglass, Livingston, Rutgers, and University colleges in their junior year. The Bachelor of Science degree is jointly awarded by the School of Business–New Brunswick and the undergraduate college. The school's graduate program offers the Master of Accounting degree.

School of Communication, Information and Library Studies

Todd Hunt, Ph.D., Acting Dean

This school was formed in 1982 by a merger of two schools to provide academic programs that focus on various facets of communication and information science. The school offers undergraduate programs of study in communication, and journalism and mass media. Students are admitted to the school in their junior year from the five residential undergraduate colleges in New Brunswick: Cook, Douglass, Livingston, Rutgers, and University colleges. Bachelor of Arts degrees are awarded jointly by the School of Communication, Information and Library Studies and the undergraduate college. At the graduate level, programs are offered that lead to the degree of Master of Library Service, the Master of Communication and Information Studies, and, jointly with the Graduate School–New Brunswick, to the Doctor of Philosophy degree. Courses for in-service librarians are also provided.

Edward J. Bloustein School of Planning and Public Policy

James W. Hughes, Ph.D., Dean

Founded in 1992, the Edward J. Bloustein School of Planning and Public Policy provides focus for all of Rutgers' programs of instruction, research, and service in planning and public policy. The school offers undergraduate programs in urban studies and public health, each leading to the baccalaureate degree. On the graduate level, the school confers Master of City and Regional Planning, Master of Public Health, and Doctor of Public Health degrees; the latter two degrees are offered jointly with the University of Medicine and Dentistry of New Jersey–Robert Wood Johnson Medical School. A dual-degree program in public health and applied psychology leading to the Master of Public Health and Doctor of Psychology degrees is offered with the Graduate School of Applied and Professional Psychology. Programs are also offered that lead to the Master of Science and Doctor of Philosophy degrees in urban planning and policy development; these latter two degrees are conferred by the Graduate School–New Brunswick.

School of Management and Labor Relations

John F. Burton, Ph.D., Dean

The School of Management and Labor Relations, formed in 1994, provides undergraduate instruction in labor studies. At the graduate level, programs are offered that lead to the degrees of Master of Science in Human Resource Management, Master of Arts in Labor and Industrial Relations, and Doctor of Philosophy in Industrial Relations and Human Resources.

Graduate School–New Brunswick

Richard F. Foley, Ph.D., Dean

Graduate programs in the arts and sciences have been offered since 1876. The Graduate School–New Brunswick awards advanced degrees in more than sixty disciplines and is responsible for all Doctor of Philosophy degrees at Rutgers–New Brunswick. The faculty is drawn from virtually all academic divisions of the university.

Graduate School of Applied and Professional Psychology

Sandra L. Harris, Ph.D., Dean

The GSAPP was established in 1974 to train direct-service psychologists who have a special commitment to community involvement. It offers the Doctor of Psychology (Psy.D.) degree in professional psychology with specializations in the areas of clinical psychology, school psychology, and organizational psychology. As of October 1996, the GSAPP will award the Master of Psychology (Psy.M.) degree *en passant* to the doctorate; the Psy.M. is not offered as a terminal degree.

Graduate School of Education

Louise C. Wilkinson, Ed.D., Dean

Courses in education were first offered by Rutgers College in the late nineteenth century. A separate school offering its own curricula was organized in 1924. The GSE offers programs leading to the degrees of Master of Education, Specialist in Education, and Doctor of Education.

School of Social Work

Mary E. Davidson, Ph.D., Dean

Established in 1954 to prepare students for professional social work practice, the SSW offers a two-year graduate curriculum leading to the Master of Social Work degree. Jointly with the Graduate School–New Brunswick, it offers a program leading to the Doctor of Philosophy degree, and its faculty also teaches an undergraduate social work program.

Summer Session–New Brunswick

Thomas A. Kujawski, Ed.M.

The Summer Session, begun in 1913 and established as a division of the university in 1960, offers a wide variety of graduate and undergraduate courses during three sessions in the summer months.

ACADEMIC CENTERS, BUREAUS, AND INSTITUTES

Advanced Food Technology, Center for. Food Science Building, Cook Campus

Agricultural Experiment Station, New Jersey. Martin Hall, Cook Campus

Agricultural Molecular Biology, Center for. Cook Campus

Alcohol Studies, Center of. Smithers Hall, Busch Campus

American Affordable Housing Institute. 33 Livingston Avenue, College Avenue Campus

American Woman and Politics, Center for the. Wood Lawn, Douglass Campus

Animal Behavior, Institute of. Smith Hall, Newark Campus

Art Museum, Jane Voorhees Zimmerli. College Avenue Campus

Biological Research, Bureau of. Nelson Biology Laboratories, Busch Campus

Biostatistics, Institute for. Hill Center, Busch Campus

Ceramic Research, Center for. Engineering Building, Busch Campus

Coastal and Environmental Studies, Center for. Doolittle Hall, Busch Campus

Computer Aids for Industrial Productivity, Center for. Hill Center, Busch Campus

Computer Science Research, Laboratory for. Hill Center, Busch Campus

Controlled Drug-Delivery Research Center. Pharmacy Building, Busch Campus

Crime Prevention Studies, Center for. S.I. Newhouse Center for Law and Justice, Newark Campus

Criminological Research, Institute for. Lucy Stone Hall, Livingston Campus

Critical Analysis of Contemporary Culture, Center for the. 8 Bishop Place, College Avenue Campus

Discrete Mathematics and Theoretical Computer Science, Center for. Hill Center, Busch Campus

Eagleton Institute of Politics. Wood Lawn, Douglass Campus

Economic Research, Bureau of. New Jersey Hall, College Avenue Campus

Edison Papers, Thomas A. Van Dyck Hall, College Avenue Campus

Engineered Materials, Institute for. Engineering Building, Busch Campus

Engineering Research, Bureau of. Engineering Building, Busch Campus

Fiber Optic Materials Research Program. Engineering Building, Busch Campus

Fisheries and Aquaculture Technology Extension Center. Martin Hall, Cook Campus

Government Research, Bureau of. Building 4053, Livingston Campus

Health, Health Care Policy, and Aging Research, Institute for. 30 College Avenue, College Avenue Campus

Historical Analysis, Center for. 88 College Avenue, College Avenue Campus

International Business Education, Center for. Janice H. Levin Building, Livingston Campus

International Conflict Resolution and Peace Studies, Center for. Hickman Hall, Douglass Campus

International Programs. Parker House, College Avenue Campus

Jazz Studies, Institute of. Bradley Hall, Newark Campus

Jewish Life, Center for the Study of. 12 College Avenue, College Avenue Campus

Journalism Resources Institute. 185 College Avenue, College Avenue Campus

Management and Labor Relations, Institute of. Labor Education Center, Cook Campus

Marine and Coastal Sciences, Institute of. Martin Hall, Cook Campus

Materials Synthesis, Center for. Engineering Building, Busch Campus

Mathematical Sciences Research, Center for. Hill Center, Busch Campus

Mathematics, Science, and Computer Education, Center for. Science and Engineering Resource Center, Busch Campus

Molecular and Behavioral Neuroscience, Center for. Newark Campus

Negotiation and Conflict Resolution, Center for. 15 Washington Street, Newark Campus

Operations Research, Center for. Hill Center, Busch Campus

Packaging Engineering, Center for. Engineering Building, Busch Campus

Physics Research, Bureau of. Serin Physics Laboratories, Busch Campus

Plastics Recycling Research, Center for. Engineering Building, Busch Campus

Policy Research in Education, Center for. Wood Lawn, Douglass Campus

Rutgers Cooperative Extension. Martin Hall, Cook Campus

State Politics and Public Policy, Center for. Wood Lawn, Douglass Campus

Surface Modification, Laboratory for. Serin Physics Laboratories, Busch Campus

Urban Policy Research, Center for. Building 4051, Livingston Campus

Waksman Institute of Microbiology. Hoes Lane, Busch Campus

Walt Whitman Center for the Culture and Politics of Democracy. Hickman Hall, Douglass Campus

Wireless Information Network Laboratory. Electrical Engineering Building, Busch Campus

Women, Institute for Research on. Voorhees Chapel, Douglass Campus

Centers Operated Jointly

Biotechnology and Medicine, Center for Advanced. Environmental and Occupational Health Sciences Institute.

Hazardous Substance Management Research Center.

UNIVERSITY LIBRARY SYSTEM

Archibald Stevens Alexander Library. College Avenue, College Avenue Campus

Art Library. Voorhees Hall, College Avenue Campus

Blanche and Irving Laurie Music Library. Mabel Smith Douglass Library, Chapel Drive, Douglass Campus

Camden Arts and Sciences Library. 300 North 4th Street, Camden Campus

Center for Urban Policy Research Library. Building 4051, Livingston Campus

Center of Alcohol Studies Library. Smithers Hall, Busch Campus

Chemistry Library. Wright Chemistry Building, Busch Campus

East Asian Library. 169 College Avenue, College Avenue Campus

Entomology Library. Georges Road Laboratories, Cook Campus

Institute of Management and Labor Relations Library. Labor Education Center, Cook Campus

John Cotton Dana Library. 185 University Avenue, Newark Campus

Justice Henry Ackerson Library of Law and Criminal Justice. 15 Washington Street, Newark Campus

Kilmer Area Library. Livingston Campus

Library of Science and Medicine. Busch Campus

Mabel Smith Douglass Library. Chapel Drive, Douglass Campus

Mathematical Sciences Library. Hill Center, Busch Campus

Physics Library. Serin Physics Laboratories, Busch Campus

School of Law–Camden Library. 5th and Penn Streets, Camden Campus

Stephen S. and Lucy D. Chang Science Library. Foran Hall, Cook Campus

Waksman Institute of Microbiology Library. Busch Campus

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