1974/75 GRADUATE BULLETIN

STATE UNIVERSITY OF NEW YORK AT
STONY BROOK

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Contents

Graduate students at Stony Brook may specialize in any of the following fields. Page numbers refer the reader to the graduate department or program in which the particular area of specialization is offered.

1974–75 Academic Calendar

Fall Semester 1974

August 25, Sunday	Foreign Students Must Arrive
August 25–September 2 Sunday–Monday	Foreign Student Orientation
August 26, Monday	All Residence Halls Open
August 27–28, Tuesday–Wednesday	Graduate Student Registration
August 28–30, Wednesday–Friday	Undergraduate Student Registration
August 28–August 31 Wednesday–Saturday	Undergraduate Student Orientation
September 2, Monday	Labor Day Recess
September 3, Tuesday	Classes Begin—Late Registration Period Begins
September 13, Friday	End of Late Registration Period—All Students (Including Graduate and CED Students) Last Day to Add a Course—Undergraduates
September 17–September 18 Tuesday–Wednesday	Rosh Hashanah Recess (No Classes from 4:00 p.m. Monday, September 16 to 8:00 a.m. Thursday, September 19th)
September 26, Thursday	Yom Kippur Recess (No Classes from 4:00 p.m. Wednesday, September 25th to 5:00 p.m. Thursday, September 26th)
September 27, Friday	Last Day for Graduate Students to Add or Drop a Course Last Day to File for December Graduation for All Students Who Have Not Applied Previously for this Graduation Date Last Day for Graduate Students to File Degree Cards in the Graduate School Office for December Graduation
October 4, Friday	Last Day for Undergraduate Students to Drop Courses Without Withdrawing from the University Last Day for Undergraduates to Change Courses to or from Pass/No Credit

November 1, Friday	Last Day for Removal of Incompletes and NR (no record) grades from Spring Semester and Summer Session for All Students
November 6–November 8 Wednesday–Friday	Advance Registration for Spring Semester for Graduate and Undergraduates Students (Except for CED Students)
November 27, Wednesday	Thanksgiving Recess Begins at Close of Classes
December 2, Monday	Classes Resume
December 16, Monday	Last Day of Classes—Last Day to Withdraw from the University
December 17, Tuesday	Final Examinations Begin
December 20, Friday	Last Day for Graduate Students to Submit Theses and Dissertations for December Graduation
December 21, Saturday	Final Examinations End—Fall Semester Ends
December 22, Sunday	Residence Halls Close Final Grades Due in Registrar's Office 72 Hours After Scheduled Examination or Last Class Meeting
December 23, Monday	Last Day for Departments to Submit Completion Statements for December Masters and Doctoral Candidates

Spring Semester 1975

January 6, Monday	All Residence Halls Open
January 7, Tuesday	Foreign Students Must Arrive
January 8–January 10 Wednesday–Friday	Final Registration for Graduate and Undergraduate Students
January 9–January 12 Thursday–Sunday	Undergraduate Student Orientation
January 13, Monday	Classes Begin—Late Registration Period Begins
January 24, Friday	End of Late Registration Period—All Students (Including Graduate and CED Students) Last Day to Add a Course—Undergraduates
January 31, Friday	Last Day to File for May Graduation for All Students Who Have not Applied Previously for this Graduation Date
February 7, Friday	Last Day for Gradute Students to Add or Drop a Course

February 14, Friday	Last Day for Graduate Students to File Degree Cards in the Graduate School Office for May Graduation
	Last Day for Undergraduate Students to Drop Courses Without Withdrawing from the University
	Last Day for Undergraduates to Change Courses to or from Pass/No Credit
March 14, Friday	Last Day for Removal of Incompletes and NR (No Record) grades from Fall Semester for All Students
March 22, Saturday	Spring Recess Begins at Close of Classes
March 31, Monday	Classes Resume
April 21, Monday	Last Day for Graduate Students to Submit Theses and Dissertations for May Graduation
April 21–April 23 Monday–Wednesday	Advance Registration for Fall Semester for Graduate and Undergraduate Students (Except CED Students)
May 9, Friday	Last Day of Classes—Last Day to Withdraw from the University
May 12, Monday	Final Examinations Begin
	Last Day for Departments to Submit Completion Statements for May Doctoral Candidates
May 16, Friday	—Final Examinations End—Spring Semester Ends
May 18, Sunday	Commencement
	Final Grades Due in Registrar's Office 72 Hours After Scheduled Examination or Last Class Meeting
May 19, Monday	Last Day for Departments to Submit Completion Statements for May Masters Candidates

Summer Sessions I 1975

May 19, Monday	Registration of All Non-CED Students (CED Students See Special Instructions Issued Separately From This *Bulletin*)
May 20, Tuesday	Classes Begin—Late Registration Period Begins
May 22, Thursday	Late Registration Period Ends—All Students (Including CED Students)
	Last Day to Add a Course
May 26, Monday	Holiday—Classes in Session at Discretion of Instructor

May 30, Friday	Last Day for Undergraduates to Change Courses to or From Pass/No Credit
June 13, Friday	Last Day to Drop a Course Without Withdrawing From the Summer Session
June 27, Friday	Summer Session I Ends Last Day to File for August Graduation For Students Who Have Not Applied Previously for this Graduation Date Last Day for Graduate Students to File Degree Cards in the Graduate School Office for August Graduation Final Grades Due in the Registrar's Office 72 Hours After Last Class Meeting

Summer Session II 1975

July 7, Monday	Registration of All Non-CED Students (CED Students See Special Instructions Issued Separately from this *Bulletin*)
July 8, Tuesday	Classes Begin—Late Registration Period Begins
July 10, Thursday	Late Registration Period Ends—All Students (Including CED Students) Last Day to Add a Course
July 18, Friday	Last Day for Undergraduates to Change Courses To or From Pass/No Credit
August 1, Friday	Last Day to Drop a Course Without Withdrawing From the Summer Session
August 15, Friday	Summer Session II Ends Final Grades Due in Registrar's Office 72 Hours After Last Class Meeting Last Day for Graduate Students to Submit Theses and Dissertations for August Graduation
August 22, Friday	Last Day for Departments to Submit Completion Statements for August Masters and Doctoral Candidates

Students enrolled in undergraduate and graduate programs in Health Sciences Center follow a different academic calendar geared to the demands of professional education.

General Information

Introduction

The State University of New York at Stony Brook is one of four university centers in the state university system. The State University at Stony Brook was founded in 1957 at Oyster Bay, Long Island. It was originally intended as a center for the education of secondary school teachers of mathematics and science. In 1960 it was designated as a university center and given the mandate to develop undergraduate and graduate programs through the Ph.D. in the humanities, sciences, social sciences, and engineering. In 1962, the University moved to a new and larger campus at Stony Brook, originally consisting of a 480-acre tract given to the state for this purpose by Ward Melville.

Location

Located on the north shore of Long Island, Stony Brook is 60 miles east of New York City. A pattern of four- and six-lane highways and the Long Island Rail Road provide the campus with proximity to the cultural, scientific and industrial resources of the nation's largest city. The University is only a few minutes south of the beaches of Long Island Sound and approximately 20 miles north of the Atlantic Ocean.

The Stony Brook Campus

Today the campus consists of 1100 acres, with 75 completed buildings serving all the academic disciplines. These include 26 residential colleges or dormitories—all coeducational and all grouped in quadrangles surrounded by wooded areas at the edges of the campus. The University Housing Office can provide current information on the possible availability during 1974-75 of campus housing for married students.

A Fine Arts Center is under construction and a new Graduate Biology Building is scheduled to open in the near future. Development of permanent facilities for the six schools and University Hospital in Stony Brook's Health Sciences Center is well underway on a 200 acre site adjacent to the main campus.

The Ashley Schiff Memorial Preserve, 12 acres of woods located behind the site of the Biological Sciences Building, separates the south campus from the central campus. The single-story buildings of the south campus provide a flexible, supplementary academic area, easily adaptable for classroom, laboratory, and office use as the need arises. They presently provide temporary quarters for the University's Health Sciences Center.

Students and Programs

Graduate study is offered in 23 of Stony Brook's present 28 academic departments, as well as in five of the six schools of the Health Sciences Center, and the Center for Continuing Education. The Ph.D. degree is offered through 19 departments, the M.A. through 14 and the M.S. through seven. There are also two interdisciplinary M.S. programs, an M.Mus. (master in music) and a terminal M.A. designed specifically for teachers in biology, chemistry, English, French, history, mathematics, philosophy, physics, sociology, or Spanish. In the Health Sciences Center, the M.D. degree is offered by the School of Medicine, the D.D.S. by the School of Dental Medicine, the M.S. degree by the School of Social Welfare and the M.S. degree by the School of Allied Health Professions. The evening Continuing Education program, primarily for working adults, offers the degree of Master of Arts in Liberal Studies (M.A./L.S.). At the undergraduate level, Stony Brook has 26 departmental-major programs and interdisciplinary programs leading to the bachelors degree, plus five non-degree programs.

Stony Brook's total 1973-74 enrollment was about 13,000 students, of whom about 4500 were graduate students. Of these, about 2200 were in continuing education, 300 were part-time degree candidates and 2000 were full-time candidates, the majority for the Ph.D. degree. Total Health Sciences Center enrollment was 839.

Accreditation

As part of the State University of New York, Stony Brook is accredited by the Middle States Association of Colleges and Secondary Schools. The College of Engineering is accredited by the Engineer's Council for Professional Development. The Department of Chemistry is accredited by the American Chemical Society.

Organization of the Graduate School

Under the direction of the Office of the Vice President for Academic Af-

fairs, the Graduate School administration rests with the Dean of the Graduate School and his administrative staff in conjunction with the Graduate Council, comprised of faculty, students, and administrators. The chairman and the secretary of the Graduate Council are elected by the Council from among its elected members. The membership of the Council includes the Vice Presdent for Academc Affairs, *ex officio,* the Dean of the Graduate School, one faculty member elected from and by each of the following groups: Arts and Humanities, Behavioral Sciences, Biological Sciences, Engineering Sciences, Mathematical Sciences, Physical Sciences, Social Sciences, and two faculty members elected from the Health Sciences. In addition, one faculty member chosen from and by the CED Policy Committee; one faculty member of the Library elected by the library faculty; one elected member of the Executive Committee designated by the Executive Committee; four graduate student members with no more than one from any graduate department (three chosen by the Graduate Student Council, and one chosen by the CED Graduate Student Council). Elected faculty members shall serve for three years with staggered terms. Among other duties detailed in the "Faculty By-Laws," the Council must approve all graduate programs before their submission to the SUNY Central Office and the State Department of Education.

Each department exercises a large measure of responsibility for its graduate program. Under the general responsibility of the department chairman, each department has a departmental committee on graduate students and a graduate program director who administers departmental graduate activities. Under the guidance of the Graduate Council, individual departments select graduate applicants and recommend them for admission to the Dean of the Graduate School. The departments are responsible also for the nomination of students and applicants for fellowships, traineeships and assistantships, as well as for the administration of graduate programs, including course work, supervised research, teaching apprenticeships, and graduate examinations. It is the departments which certify to the Graduate School that the student has completed all degree requirements.

University Health Service

The University Health Service, located in the Infirmary, primarily concerns itself with student health needs. It is available to faculty and staff only on an emergency basis. There is a registered nurse on duty in the Infirmary 24 hours a day. During the week there are scheduled hours for physicians; a physician is on call at other times. For information or help, call the Infirmary at 4-2273 (4-CARE).

Campus Activities

A wide variety of lectures, seminars, concerts, exhibits, theatrical performances, and movies are scheduled regularly during the academic year.

Some recent speakers at Stony Brook have included Norman Mailer, author; R. D. Laing, psychiatrist; Daniel Ellsberg, Pentagon critic; Peter Goldmark, communications research pioneer; Geraldo Rivera, newscaster; Betty Friedan, feminist; Dick Gregory, black humorist; and Carlos Castaneda, author. There is a continuing round of solo and group concerts by outside professionals and by students and faculty; and there are continuing exhibitions of works by artists on and off campus. Movies —both vintage and avant-garde—are shown regularly on campus.

Graduate students have access to all campus recreational facilities and are welcome to organize their own intramural leagues, as they have done from time to time in football and basketball. These leagues are distinct from undergraduate leagues and are informally organized, usually by graduate student volunteers and often on a departmental basis.

Student Services

The Division of Student Affairs offers many services to both graduate and undergraduate students. Located in the Administration Building, the Office of the Vice President for Student Affairs is the central administrative office of the Division. In addition to the services below, the Division also includes the Office of Records, Office of University Housing, and Financial Aid Office.

Psychological Services

Personal counseling for students is available through Psychological Services, located in Social Science B, jointly sponsored by Student Affairs and the Psychology Department. The Mental Health Unit of University Health Services also offers student counseling by appointment.

Stony Brook Union

The Stony Brook Union provides facilities which include a cafeteria-ballroom, buffet service dining room and lounge, bookstore, auditorium, post office, meeting and conference rooms, recreation area, craft shops, photography darkroom, student activities offices, lounges, bowling alleys, and billiards room to serve the University community.

Office of International Affairs

The Office of International Affairs is located on the third floor of the Administration Building. It assists students and faculty from other countries with problems related to finances, housing, government regulations (including immigration and tax matters), cross-cultural differences, and other general problems. Questions relating to academic problems are usually handled by academic advisors within the individual's school or department. The staff also works with community groups and student organizations to provide a varied program of activities during the year. Included are tours and trips, discussion groups, home hospitality, speaking engagements, and other events.

Veterans Affairs Office

Specialized assistance, support and programming for veterans are coordinated through the Veterans Affairs Office located in the Earth and Space Sciences Building.

Guidance and Career Development

Vocational information, testing services (GRE, MAT, Medical, Dental and Law Boards) and credential gathering services for students are provided by the Guidance Services Bureau and Career Development Office located on the third floor of the Administration Building.

Libraries

The University libraries now have a total collection of more than 785,000 volumes and about 800,000 pieces of micro-text. Besides the Melville Library's general and special collections, University library holdings include some 96,254 volumes in specialized Chemistry, Earth and Space Sciences, Engineering, Physics and Mathematics departmental libraries. An additional 90,000 volumes are held by a separate library for the Health Sciences. The library of the Institute for Advanced Studies of World Religions, based in the Melville Library, has 22,000 reference volumes, many concerned with Buddhism, Islam and Hinduism.

Computing Center

The Computing Center is located in the Engineering Quadrangle. The IBM 310/155 computer complex provides concurrent batch processing for student and faculty research work and for administrative data processing. The Center has increased its services as a regional resource with the PDP-10 computing system, recently added to serve both the University and Long Island institutions and agencies. Short courses in programming are held periodically for all users.

Special Centers and Institutes

The *Marine Sciences Research Center* administers statewide research projects, offers research cruises, and performs studies in oceans, bays, harbors, lakes and a University-owned tidal salt marsh near campus; the *Center for Curriculum Development* generates new kinds of courses for elementary and secondary education; the *Center for Contemporary Arts and Letters* develops campus art holdings and sponsors visits by practitioners and critics of the arts; the *Economic Research Bureau* brings together the university and public and private agencies in regional research efforts of mutual interest; the *Institute for Advanced Studies of World Religions* seeks to facilitate the study and development of world religions and philosophy with emphasis on Buddhism, Islam and Hinduism; The *Institute for Colonial Studies* keeps microfilmed archives of original documents from Western Hemisphere colonies,

including a rich section of materials on Colonial Long Island; the *Institute for Theoretical Physics* has a faculty of a dozen scholars researching all areas of theoretical physics: the *Instructional Resources Center,* in cooperation with faculty members and departments, helps develop more effective teaching methods through the use of computers and other technical aids; and the *Institute for Research in Learning and Instruction* is researching the human learning process, basic instruction, college-level instruction, and economic factors in innovative college instruction.

Admission Requirements

Scholastic Requirements

Applicants may be admitted to the Graduate School to pursue the M.A., M.M., M.S., or Ph.D. degree. To be considered for admission, all students must complete and submit an official graduate application, three letters of reference, scores from the Graduate Record Examination Aptitude Test, and submit two copies of all previous transcripts. To be admitted to the Graduate School, an applicant must have the preparation and ability which, in the judgment of the department and the Graduate School, are sufficient to enable him or her to progress satisfactorily in a degree program. Admission decisions are based primarily on past records and on letters of recommendation. A baccalaureate degree is required, which will ordinarily be in the chosen field of graduate study, and an average grade of B in course work in the major and related areas. In exceptional cases in which these requirements are not met, or if the undergraduate preparation is inadequate, an applicant, if considered to have a reasonable probability of making satisfactory progress in graduate studies, may be admitted provisionally. The department may set conditions which the admitted student must satisfy during the early period of graduate work. Departmental recommendation and Graduate School approval are required for provisional admission. Detailed admission requirements are listed in each department's section of this *Bulletin*. Admission application blanks and additional information may be obtained by writing to the appropriate department, or to: Office of the Graduate School, State University of New York at Stony Brook, Stony Brook, New York 11790. *No application fee is required.*

Foreign Students

All students who are foreign nationals or have taken their higher education in a non-English-speaking country must demonstrate proficiency in English. This can be done by presenting acceptable scores on the Test of English as a Foreign Language (TOEFL). Admission to the Graduate School is contingent upon satisfactory fulfillment of this requirement. A student must have a minimum score of 450 for admission. Exceptions to this requirement are rare, and only with the approval of the Dean of the Graduate School. A 550 minimum score is needed for most forms of support.

Non-U.S. applicants must provide the University with verification that the necessary funds are available to finance their education at Stony Brook. The University will provide forms for this purpose.

Government regulations require that every foreign student attend the institution issuing the I-20 used for entry to the U.S. Transfers are possible but only if the student can show that he has been enrolled at the original institution.

Student Status

Part-Time students—Admission of part-time students into advanced degree programs depends, in addition to applicant's qualification, on the availability of departmental faculty and facilities. In consequence of the uneven growth of graduate programs, some departments are able to accept part-time students; others are not yet in a position to do so. The determination of how many part-time students may be admitted in proportion to full-time students is left to the departments, in consultation with the Dean of the Graduate School, since they are best able to determine how many graduate students they can prepare properly without compromising the standards of graduate education. Part-time students are classified as either 91 code (less than 24 graduate credits) or 92 code (more than 24 graduate credits, regardless of where earned) and may register for no more than 11 credit hours per semester. Students in programs in which the highest degree offered is the masters may not be classified as 92 code.

Full-Time Students—Students regularly admitted to the Graduate School will register for 12 or more credit hours per semester. Responsibility for certifying the full-time status of graduate students rests with the Office of Records and Studies. A graduate traineeship is considered part of the academic program; therefore a graduate student on a regular appointment will be a full-time student and will register for 12 credit hours. Registration for 12 or more credit hours includes credit for supervised teaching and research. Full-time graduate students are classified as either 91 code (less than 24 graduate credits) or 92 code (more than 24 graduate credits, regardless of where earned). Students in programs in which the highest degree offered is the masters may not be classified as 92 code.

International Students—International students may not be part-time if they are here on a student visa. The Immigration and Naturalization Service prohibits any student on a student visa from another country from taking less than a full-time load.

Graduate Record Examination

The result of the Aptitude Test of the Graduate Record Examination is a criterion of admission to the Graduate School. Several departments also require the Advanced Area Tests. Students who have taken the GRE should request the Educational Testing Service to forward their scores directly to the departments or schools to which they are applying.

Admission of Undergraduates to Graduate Courses

Undergraduates of exceptional ability, upon the request of the graduate program director of a department and of the instructor to the Dean of the Graduate School, may be admitted to graduate courses and be permitted to earn graduate credit. The acceptance of such credit by graduate schools other than Stony Brook is the responsibility of the student.

Financial And Residential Information

Registration is not complete until a student has paid all fees and charges which are due and payable by the first day of classes unless properly deferred. All fees and charges are subject to change without further notice.

Charge or Fee	First Semester	Second Semester	Year
Tuition			
Full-time graduate student			
(N.Y. State Resident)	$600.00	$600.00	$1,200.00
(Out-of-State Resident)	$750.00	$750.00	$1,500.00
Special graduate student			
(Part-time, 11 credits or less)			
(N.Y. State Resident per semester credit hour)	$ 40.00	$ 40.00	
(Out-of-State Resident per semester credit hour)	$ 50.00	$ 50.00	
Professional Schools (Medicine, Dental Medicine)			
(N.Y. State Resident)			$1,600.00
(Out-of-State Resident)			$2,000.00
College Fee			
Full-time graduate student	$ 12.50	$ 12.50	$ 25.00
Special graduate student part-time per credit	$ .85 cr.	$ .85 per cr.	
Student Health Insurance Fee			
Individual	$ 65.00		$ 65.00
Student and Spouse	$118.00		$ 118.00
Family Plan	$175.00		$ 175.00

Charge or Fee	First Semester	Second Semester	Year
Housing			
Advance Room Deposit **			$ 75.00
Double Occupancy, per person	$325.00	$325.00	$ 650.00
Board	Fee to be Announced		
Cooking Fee (Residents not on Board Plan)	$ 25.00	$ 25.00	$ 50.00
General University Deposit			
Resident Student	$ 35.00		$ 35.00
Commuting Student	$ 20.00		$ 20.00
Student Activity Fee *	$ 70.00		$ 70.00
Identification Card	$ 2.00		
Lost Identification Card	$ 3.00		
Graduation Fee [a]	$ 15.00		
Late Registration Fee [b]	$ 15.00		
Transcript Fee [c]	$ 1.00 each		
Returned Check Charge	$ 5.00		

The above fees are subject to change without notice.

Payment

Students are responsible for payment of all fees for each semester and Summer Session prior to the first day of classes unless such fees are properly deferred.

Deferments

Deferments are available provided a power-of-attorney card and proof of award is submitted to the Bursar's Office at registration. The following are the only acceptable awards for deferment purposes:

1. Regents Scholarship
2. Scholar Incentive
3. State University Scholarship
4. Any scholarship paid directly to the University
5. National Direct Student Loans

No deferment will be made for New York State Higher Education Loans.

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[a] Payable at the beginning of the semester in which the degree requirements will be fulfilled.

[b] Paid by students registering after the close of the official registration.

[c] A student who obtains a degree may receive two transcripts without charge only if his or her account with the University is clear.

* This fee is optional for graduate students.

** Applied to first semester housing charges.

Housing

A limited number of both single and double occupancy rooms are available for unmarried graduate students in University residence halls. One of the six residential quadrangles is designed to house graduate students in addition to the International College which integrates graduate, undergraduate, foreign, and American students. Admission does not imply nor guarantee housing.

All rooms contain a bed, mattress, bureau, study desk and chair, and closet for each occupant. Board arrangements are available to both resident and nonresident students.

Presently there are limited housing facilities on campus which may be rented on a yearly basis by married graduate students without children.

Houses, apartments, and rooms are available within driving distance of the Stony Brook campus. However, since there is very limited public transportation, students who live off-campus must have access to private transportation and be prepared to commute up to 20 miles each way. Off-campus housing is generally expensive and beyond walking distance.

The University Housing Service, located in the Administration Building, aids students who are interested in renting off-campus facilities in the Suffolk County area.

Housing Charges

The rent for one person sharing a double occupancy room is $650 per academic year, payable on a semester basis. A $75.00 advance room deposit is required, this amount being applied to the first semester payment. The advance room deposit is refundable if application is made in writing before July 1.

Refund Schedule

Request for refund of tuition or room must be made in writing to the Office of Student Accounts, Room 254, Administration Building.

Information regarding Board refunds are to be announced at a later date.

Request for refund of the student activity fee must be made in writing to Polity, Stony Brook Union.

Request for refund of the university deposit, lost I.D. card, or graduation fee must be made in writing to the Faculty Student Association, Room 269, Stony Brook Union.

The college fee is non-refundable.

A student who is given permission to cancel registration shall be liable for payment of tuition in accordance with the following schedule. A withdrawal card, available at the Registrar's Office, must be completed

and returned to that office on the date the student withdraws. The official Registrar's date of withdrawal determines the liability as follows:

Schedule of Tuition Liability

Liability During	*Semester*	*Six-Week Term (Summer Session)*
First week	0	0
Second week	30%	70%
Third week	50%	100%
Fourth week	70%	
Fifth week	100%	

Approval of the cancellation with the date it becomes effective must be certified by the chief administrative officer of the college or his duly designated representative. No money shall be refunded unless application for refund is made.

Financial Assistance

Financial assistance is available to graduate students at the State University of New York at Stony Brook through a program of assistantships, fellowships, scholarships, and traineeships. *The awards described below are available only to full-time matriculated students* through the Graduate School, Office of Financial Aid, or from the appropriate government or state agency. An applicant seeking financial assistance is strongly advised to make sure that all application material, including letters of recommendation and transcripts, has been received by the University no later than February 1. If a student receives a stipend from the University and also from an outside source, the University contribution will be adjusted so that the total of these stipends will not exceed a set limit ($4800–5000) for the academic year.

Graduate School Traineeships

Graduate traineeships are awarded on a competitive basis by the Graduate School on recommendation of the department for one year, but may be renewed up to but not more than four years. Traineeships carry stipends of $2800 in tuition exemption for the first academic year. For advanced students the stipend is $2900 for the second, and $3000 for subsequent years.

Graduate Council Fellowships

A limited number of Graduate Council Fellowships is available to incoming students. These fellowships carry a stipend of $3000 per academic year and do not require any services. They are awarded as a result of Graduate School-wide competition and funds permitting may be renewed for one additional academic year by those students who maintain superior academic standing.

National Science Foundation Graduate Fellowships

Fellowships are available in various fields and offer the same stipends and dependency allowances as graduate traineeships, but are awarded directly by the National Science Foundation. Recipients of this award are exempt from payment of tuition. Candidates must be citizens or nationals of the United States. Closing date for applications is established by NSF, usually late November or early December. For further information, write: the Fellowship Office, National Academy of Sciences, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C., 20418.

Scholar Incentive Awards

Full-time graduate students who are legal residents of the state of New York and are accepted for admission to the Graduate School are required to apply for Scholar Incentive Awards whether or not they receive tuition waivers. The award carries stipends of $100 to $600 per year depending upon financial need. Applications may be obtained from each departmental office.

Loans and Scholarships

Both the state of New York and the federal government offer low cost loan programs to help graduate students finance their education. In order to apply for the federal loan (National Direct Student Loan), a continuing student should submit his *Student's Financial Statement* to Berkeley, Calif., for processing by no later than February 28 of each year. A "new" student should make sure that his *Student's Financial Statement* is submitted at the time of his application to graduate school. Inquiries concerning either financial aid or loan programs should be directed to the Financial Aid Office.

Academic Regulations And Procedures

Registration

All candidates for a graduate degree, whether in residence or *in absentia,* must complete registration each semester. This ruling includes those who are using the library, laboratories, or computer facilities; who are consulting with the faculty while working on their dissertations; and who are preparing for or taking qualifying or oral examinations at the masters or doctoral level. Students who hold graduate traineeships, research assistantships, or predoctoral fellowships must be registered as full-time students. Departments or individual faculty members do not have the authority to waive these rules.

Registration after the close of the announced final registration period in the academic calendar requires the payment of a service charge of $15. Registration is not permitted after the end of the second week of classes. A student is not considered registered until the appropriate forms have been filed with the Registrar and arrangements regarding tuition and fees have been made with the Bursar's Office.

Changes in Registration

During the first four weeks of classes (as noted in the Academic Calendar) graduate students may add or drop courses by completing the request form available from the Registrar and obtaining the approval of the Dean of the Graduate School provided the proposed change does not alter the student's status as defined in "Student Status" (p. 17). Courses dropped during the first two weeks are deleted from the student's semester registration record. Courses dropped during the third and fourth weeks remain on the student's record and withdrawal grades (WP or WF) are recorded. After the fourth week of classes no course may be added or dropped. Should it become impossible for a student to complete a course for a reason such as illness or accident, he or she may petition the Dean of the Graduate School for a waiver of the drop deadline. Such petitions must be approved by both the chairman and the graduate program director of the department.

Registration for Maintaining Matriculation

Students must register for at least a one-credit course in thesis or dissertation research *each semester or session* for which they are maintaining matriculation and must do so at the regular times designated for graduate registration by the Registrar. Students failing to do so either at advance or final registration may register during the first two weeks at the beginning of the current semester and will be subject to payment of the $15 late registration fee. After the first two-week period, no student will be permitted to register. Students do not maintain matriculation during the Summer Sessions unless they plan to graduate in August.

To be eligible to receive a degree, a student must maintain matriculation for *each* semester prior to and including the semester in which the degree is awarded. Students on approved leaves of absences do not register for those semesters for which a leave has been granted; however they must register for the semester in which the degree is awarded.

Students who complete all degree requirements *after* the deadline for any degree date but *before* the first day of classes of the next term or session are eligible for graduation without additional registration. Students who complete all degree requirements during the Summer Session may graduate in December provided they were registered in the preceding spring semester and *all* requirements were completed before classes began in the fall semester. Students who wish an August degree and do not complete all requirements before Summer Session begins must register for one of the two Summer Sessions to be eligible for the August degree.

Graduate Study Away from Campus

Normally, it is expected that a graduate student's course of study and dissertation research will be conducted at Stony Brook under the direct guidance of the faculty of the department or program in which the degree is sought and with the facilities available here or close by, as for example, at Brookhaven, Cold Spring Harbor, the hospitals and institutions on the Island, or the libraries of New York City. However, there may be circumstances in which the student's work would be facilitated by being done away from campus at another institution or research facility. In such cases, the department may petition the Dean of the Graduate School for permission for the student to carry on work away from campus. The petition must contain the following information:

1. The reasons for the request.
2. The conditions under which the student's work away from campus is to be performed, supervised, and evaluated.
3. The student must be registered as a graduate student at Stony Brook and must pay the necessary fees. If the student is supported by a stipend or grant from state funds or from University-monitored federal and private sources, he or she must be regis-

tered as a full-time student. If the student is employed elsewhere, in a position not under the University's jurisdiction, matriculation may be maintained by registering for at least one credit of research each semester providing all degree requirements have been fulfilled except for the writing of the thesis or dissertation.

4. A statement by the chairman of the department attesting that permission for the student to do work away from campus will not diminish the department's capability to fulfill its commitments.
5. A statement from the institution where the student's work is to be performed in which acceptance of responsibility for its supervision is made. In the case of archival research or field work, a statement of authorization for the student to use such resources must be submitted.
6. The petition must have the approval of the graduate program committee and the chairman of the department concerned.

Exchange Credits

When the special educational needs of a doctoral student at one SUNY institution can be served best by taking a course for credit at another unit of the SUNY system, he or she should obtain a statement from the department chairman recommending admission of the student to take the desired course at the visited institution. The recommendation should state that the student has the prerequisites for the course and that, if the course is successfully completed, credit for it will be accepted toward the degree. The statement from the department chairman should be approved by the Dean of the Graduate School of the student's institution. It should then be sent to the Dean of the Graduate School of the visited institution who will clear it with the instructor of the course and the chairman of the department concerned. When approval is obtained, the student will be admitted as a special student for purposes of taking the course requested. The student will pay appropriate tuition and fees at the visited institution. If the student has a waiver of tuition at his or her home institution, that waiver will be recognized by the visited institution. At the completion of the course the visited institution will, on request, send a transcript to the student's home institution. This exchange is restricted to courses not available at the home institution.

Transferred Graduate Credits From Other Universities

A candidate for the masters degree may petition to have transferred a maximum of six graduate credits from another institution toward his or her degree. The student should petition in writing to the appropriate departmental committee. The petition must include a copy of the official transcript. The departmental committee has the responsibility of deciding on the applicability of those credits to their specific program. Approved petitions must be forwarded to the Office of Records for inclusion

on the student's permanent record. A candidate for the doctoral degree may transfer those graduate credits which are allowed by the appropriate departmental committee.

Grading System

The following grading system will be used for graduate students in both graduate and undergraduate courses: A (4.00) Superior, B (3.00) Good, C (2.00) Minimum Passing, F (0.00) Failing. Pass/no credit is not an approved grading system for graduate students.

In addition, the following marks may be awarded at the end of the semester: I (Incomplete). This is an interim grade. It may be given at the discretion of the instructor but only upon evidence that good cause, such as serious, protracted illness, prevented the student's completion of course requirements. The grade of "I" must be resolved by the following dates: March 14 for courses of the preceding fall semester; November 1 for courses of the preceding spring semester. In granting a grade of "I" the instructor signifies a willingness to receive student work and prepare grades in accordance with these deadlines. If final grades are not reported to the Registrar by the specified dates, the grade of "I" will automatically be changed to "F."

Each student's permanent academic record must reflect a final grade or a withdrawal grade for each course in which he or she was enrolled. If a final grade has not been reported by the scheduled deadlines or appropriately extended, the grade of F will be recorded.

S (Satisfactory). Indicates passing work in those courses, so designated by the department and approved by the Graduate Council, where the normal mode of evaluation is impracticable.

U (Unsatisfactory). Indicates unsatifactory work in those courses, so designated by the department and approved by the Graduate Council, where the normal mode of evaluation is impracticable.

R (Registered). Indicates attendance during the first semester in a year-long course, the final grade for which will be assigned only after the completion of two semesters.

NR (No Record). An instructor may assign a temporary grade of NR only for students who have never, to the instructor's knowledge, participated in the course in any way. An NR report is not to be interpreted as a grade but only as a temporary indication of a state of affairs which requires prompt resolution, leading either to removal of the course from a student's program (whenever it turns out to have appeared as a result of an error in recording the registration information submitted by the student), or to the assignment of a grade. If a final grade is not reported by the deadline date appearing in the Academic Calendar, the grade of F will be recorded.

Auditing

Auditing is permitted by special arrangement between student and instructor. No record is kept of courses audited.

Academic Standing

A student may be dismissed if his or her overall average falls below B (3.0) at any time after the completion of the first two semesters of graduate work. Additional minimum grade requirements may be imposed by individual departments. Graduate students may be dismissed upon proof of violation of professional standards and academic honesty.

Withdrawal from the University

Official Voluntary Withdrawal. A student finding it necessary to withdraw from the University must request permission to withdraw from the department chairman. If the department chairman favors such withdrawal, the student must obtain a withdrawal card from the Registrar. This card has to be approved by the offices indicated on the card and by the Dean of the Graduate School. The effective date of withdrawal is the date upon which the completed withdrawal card is returned to the Registrar. The process of withdrawing from the University is a formal procedure and the student has the responsibility for initiating it if, of necessity, he or she must leave graduate study. Students may withdraw from the University up to the last day of classes.

Unauthorized Withdrawal. A student who leaves the University without obtaining an official withdrawal may forfeit the privilege of honorable dismissal and his or her prospect of readmission to the Graduate School. He or she will be reported as having failed all courses.

Involuntary Withdrawal. A student who is called into the Armed Forces during the term should present his orders for induction at the Graduate School along with a formal withdrawal card for appropriate action.

Leave of Absence. Leave of absence may be obtained for a specified time not to exceed two years. Military leave of absence will be granted for the duration of obligated service to students in good standing. Students should request a leave of absence in writing and submit the request to the graduate program director of their individual department. If the graduate program director and the chairman of the department approve the request for leave, they recommend approval to the Dean of the Graduate School. If Graduate School approval is granted, the student should then follow the procedure for filing a withdrawal card outlined in the "Official Voluntary Withdrawal" section above.

Degree Requirements

Admission to the Graduate School does not automatically qualify a student as a candidate for the Ph.D. degree. Formal recommendation of advancement to candidacy for the Ph.D. degree must be made to the Graduate School by the department after a review of the student's performance in courses, independent study, and departmental examinations. A candidate for the Ph.D. degree engages in research leading to a dissertation. For the masters degree a less formal procedure is followed, and a department may substitute a comprehensive examination for the research and thesis.

The granting of the masters degree is based upon the completion of 30 graduate credits, residence, examination, supervised teaching, thesis, special departmental requirements, and the recommendation of the student's department. The granting of the doctoral degree is based upon residence, examination, supervised teaching, dissertation, special departmental requirements, and the recommendation of the student's department. Ordinarily, however, certain courses should be taken in preparation for comprehensive examinations and research. The student will follow an approved program of courses, seminars, and individual study, determined so as to meet his or her needs and to satisfy departmental requirements.

The minimum degree requirements listed below are those of the Graduate School; a department may have additional requirements.

The Master of Arts and Master of Science Degrees

1. Minimum residence: Two consecutive semesters of full-time graduate study. The purpose of the residence requirement is to insure that the graduate student participates in the professional life of the department beyond class attendance. Owing to the difference in the means by which this requirement can be satisfactorily met, departmental residence requirements may vary from the Graduate School norm and are described in the individual department requirements for the degree; the Graduate School regulation pertains unless otherwise specified.
2. Language proficiency: Though the Graduate School itself does not require proficiency in a foreign language for the masters degree, departments have the responsibility for their foreign language requirement and the evaluation of any stated proficiency. Students must comply with their departmental requirements.
3. Practicum in teaching under supervision is required.
4. A minimum of 30 graduate credit hours.
5. Research and thesis, or the passing of a comprehensive examination or both. The thesis must be prepared in accordance with the guidelines presented in the booklet entitled "Instructions for the Preparation of Masters Theses and Doctoral Dissertations" available from the Graduate School. The State University of New York at Stony Brook does not allow multiple authorship for a thesis.
6. The submission of a signed degree card to the Graduate School in accordance with published deadlines.
7. Departmental recommendation: When all departmental requirements are completed, the chairman may recommend to the Dean of the Graduate School that the masters degree be granted.
8. Time limit: All requirements for the masters degree must be completed within three years of the student's first registration as a graduate student. In rare instances, or for part-time students, the Dean of the Graduate School will entertain a petition for extension of time bearing the endorsement of the chairman of the department. In such instances the student may be required to repeat certain examinations or present evidence that he or she is still prepared for the thesis or the final examination.

The Ph.D. Degree

1. Minimum residence: Four semesters of full-time graduate study beyond the baccalaureate including at least two consecutive semesters. The purpose of the residence requirement is to insure that the graduate student participates in the professional life of the department beyond class attendance. Owing to the difference in the means by which this requirement can be satisfactorily met, departmental residence requirements may vary from the

Graduate School norm and are described in the individual department requirements for the degree; the Graduate School regulation pertains unless otherwise specified.

2. Language proficiency. Though the Graduate School itself does not require proficiency in a foreign language for the Ph.D. degree, departments have the responsibility for their foreign language requirement and the evaluation of any stated proficiency. Students must comply with their departmental requirements. The proficiency examination must normally be passed before permission is given to take the Preliminary Examination.
3. Preliminary Examination: The purpose of the Preliminary Examination is to ascertain the breadth and depth of the student's preparation and to appraise readiness to undertake a significant original investigation. At the discretion of the department the Preliminary Examination may be oral or written or both and may consist of a series of examinations. The examining committee is appointed by the Dean of the Graduate School on recommendation of the department chairman and may include one or more members from outside the department. Results of the Preliminary Examination will be communicated to the student as soon as possible and to the Graduate School within one week of the completion of the exam. A repetition of the Preliminary Examination, upon failure, may be scheduled at the discretion of the department. A second repeat must be approved by the Dean of the Graduate School.
4. Advancement to candidacy: The student may be advanced to candidacy when he has completed all Graduate School and departmental requirements for the degree other than the dissertation. Advancement to candidacy is granted by the Dean of the Graduate School upon recommendation of the department.
5. Practicum in teaching under supervision is required.
6. Research and dissertation: A dissertation is required for the Ph.D. degree. It must convey in a clear and convincing manner the results of an original and significant scholarly investigation. Depending upon the character of the student's research, the department chairman will appoint an appropriate supervisor or supervisory committee, in consultation with whom the student will conduct an investigation and write a dissertation. The dissertation must be prepared in accordance with the guidelines presented in the booklet entitled "Instructions for the Preparation of Masters Theses and Doctoral Dissertations" available from the Graduate School. The State University of New York at Stony Brook does not allow multiple authorship for a dissertation.

   The dissertation must be approved by a Dissertation Examining Committee of at least four members of the faculty, appointed by the Dean of the Graduate School. This committee may include

the dissertation supervisor (s) and must include at least one person from outside the department. At the discretion of the department, approval of the dissertation may or may not involve a formal oral defense. If a formal defense is required, it will be conducted by the Dissertation Committee and will not be chaired by the supervisor of the dissertation. The formal defense is open to all faculty members.

In the absence of a formal defense, the student will present the results of dissertation research at an informal dissertation colloquium convened for that purpose by the department and open to interested faculty and graduate students.

Evaluation (approval or disapproval) of the dissertation will be indicated by the Dissertation Examining Committee on a form to be submitted to the Graduate School.

7. The submission of a signed degree card to the Graduate School in accordance with published deadlines.
8. Time limit: All requirements for the Ph.D. degree must be completed within four years after advancement to candidacy. In rare instances, the Dean of the Graduate School will entertain a petition to extend this time limit, provided it bears the endorsement of the chairmen of the department. The Dean or the department may require evidence that the student is still properly prepared for the completion of work. In particular, the student may be required to pass the Preliminary Examination again in order to be permitted to continue work.

The Master of Arts (Liberal Studies) Degree

This is a terminal, non-research degree offered by the Center for Continuing Education primarily for persons interested in studying on a part-time basis. Details of the program and degree requirements may be found on page 105. Additional information is available from the Center located in the Humanities Building.

Award of Degree

When all requirements have been completed, the department chairman will so certify to the Dean of the Graduate School and recommend that the degree be awarded. Degrees are awarded three times a year: May, August, and December. Formal investiture, however, will only be at the spring commencement. To be eligible for a degree a student must have completed all University requirements, submitted the appropriate manuscripts, obtained all University clearances, and have maintained matriculation according to the regulations outlined under "Registration for Maintaining Matriculation" on page 25.

Waiver of Regulations

Specified requirements may be waived by the Dean of the Graduate School in individual instances. A petition for such a waiver must be endorsed by the chairman of the department and the graduate program director who shall append their reasons for believing that the requested waiver would not result in a breach of the spirit of the regulations.

The University reserves the right to alter these regulations without notice.

English
French
Germanic Languages and Literatures
Hispanic Languages and Literature (Spanish)
Music
Philosophy

The Arts And Humanities

Department of English

Professors:

T. J. J. Altizer, Erdman, Fry, [a]Goldberg, Kazin, Kranidas, Levin, R. A. Levine, Ludwig, R. Miller, L. Simpson, Stampfer, Stevens (*Chairman*), Thompson, Weisinger

Associate Professors:

J. T. Bennett, Dolan, Fiess, Huffman, [a]T. E. Maresca, Nelson, Neumeyer, Pequigney, Rogers, Sears, Shaw, Wilson, Zimbardo

Assistant Professors:

A. Altizer, Awoonor, Baker, Bashford, Dibble, [a]Fortuna, Hall, Harvey, Marcus, Newlin, Schreiber

The Department of English offers programs leading to the degrees of Master of Arts and Doctor of Philosophy.

There are two programs leading to the degree of M.A. in English. Program I is a traditional program in preparation for advanced study for the Ph.D. Program II is designed for those candidates who feel the need for an advanced professional degree as part of their commitment to teaching and who do not intend to go on to the Ph.D.

[a] On leave, academic year 1974–75

The program leading to the degree of Ph.D. in English combines a flexible pattern of advanced study with carefully guided training in college teaching and makes it possible for the student to complete the doctorate within four years after taking the B.A. or three years after the M.A. During the first two years of doctoral study the student is expected (1) to take four 600-level seminars, (2) to prepare for the Doctoral Examination by reading independently and by taking 500-level courses where necessary, and (3) to teach for at least two semesters. After taking the Doctoral Examination, the student will complete the dissertation.

The Department invites interested applicants to visit the campus to discuss their qualifications and plans for graduate study with the director of graduate studies, the director of M.A. programs, and with other members of the Department.

Applicants who will have either earned the degree of Master of Arts or completed equivalent work at other graduate schools prior to admission to Stony Brook will be eligible for graduate traineeships with a stipend of $2900 for the academic year. Tuition is waived for holders of full graduate traineeships.

Admission to the M.A. Programs

For admission to graduate study in English the following are required:

A. A bachelors degree from a recognized institution.
B. An average of at least B in undergraduate literature courses.
C. An official transcript of undergraduate record.
D. Letters of recommendation from three previous instructors.
E. The Graduate School requires all applicants to take the GRE Aptitude Test.
F. Proficiency in a foreign language equivalent to two years of college work.

Any deficiencies in these requirements shall not automatically bar admission, but it is understood that inadequacies in undergraduate preparation will normally require the student to take additional work, the amount to be determined by the Graduate Program Committee, and not to be used to fulfill any specific M.A. degree requirements.

Requirements for the M.A. Degree

A. Formal course requirements: A student preparing for the degree of Master of Arts is required to take at least 30 graduate credit hours of courses. For a candidate in Program I, these courses will include one graduate course in the literature of a *period,* one graduate course devoted to one or two authors, and at least five additional graduate courses in the English Department.

   A candiate in Program II must complete one graduate course in the literature of a *period,* one graduate course in one or two au-

thors, three graduate courses, EGL 592 Problems in Teaching Writing or Composition, EGL 593 Problems in Teaching Literature, and EGL 594 Contexts of Literary Study, and additional graduate courses in the English Department. EGL 594 should be taken after EGL 592 and 593; EGL 596 may be substituted for either 592 or 593.

Before a masters degree is granted, candiates in both programs will be required to have taken one course in Shakespeare and one course in Chaucer or Milton. A course entirely devoted to the writer taken while the student was an undergraduate will be accepted as fulfilling this requirement. Such a course on the graduate level will also fulfill the requirement of one graduate English course devoted to one or two authors as stated above.

For candidates in Program I only one course numbered EGL 599 Independent Studies will be permitted to count toward the total courses required for the degree of Master of Arts in English. EGL 599 cannot be elected during the student's first semester of work toward the masters degree. EGL 599 may be elected during the second semester only if the student has a B+ average the first semester and only if he or she has no Incompletes at the time of registering for EGL 599. A proposal for a 599 course should be submitted in writing before the end of the first semester to that member of the faculty under whose direction the student plans to study. The proposal must be approved in writing by both the director and the Graduate Program Committee of the department before the student registers for EGL 599.

Candidates for the M.A. in Program I must cover seven major areas of British and American literature before the degree is awarded. These areas may be covered either by courses completed while the student was an undergraduate or by courses taken as an M.A. candidate. The areas are:

Medieval Literature
Renaissance Literature
Restoration or 18th Century Literature
19th Century British Literature
20th Century British Literature
American Literature: Beginnings to 1870
American Literature: 1870 to Present

A period course, a major authors course, or a genre course will satisfy the requirement for that area.

NOTE: EGL 597 may not be counted toward the course requirement in either program.

B. Performance: An average grade of B in all course work is the minimum required, but no more than two C's will be permitted.

C. Departmental Examination: A student in Program I must pass the written Departmental Examination which is designed to test mastery of analytical and scholarly techniques.

D. Foreign language proficiency: In Program I, candidates must demonstrate as early as possible ability to read texts of moderate difficulty in one approved foreign language.

E. Credit for work done elsewhere: A maximum of six hours of credit for graduate work done at another institution may be allowed toward the degree of Master of Arts in English at State University of New York at Stony Brook. Such work must have been done when the student was registered at the other institution as a graduate student in English and American literature and language, and must have been at the graduate level, that is, the courses must be comparable to Stony Brook's 500-level courses. Stony Brook does not grant transfer credit automatically. It considers granting such credit only upon written application to the director of graduate studies in English after the student has been admitted to the program.

Satisfying these minimum requirements will not guarantee a degree. The final departmental decision as to the awarding of the degree will be made by the Graduate Program Committee.

Admission to the Ph.D. Program

Applicants who have either earned the degree of Master of Arts or completed equivalent work at other graduate schools prior to admission to Stony Brook must submit the following:

A. Official transcripts of both undergraduate and graduate work.

B. Letters of recommendation from three previous instructors, two of whom must have instructed the applicant during graduate study.

C. The Graduate School requires all applicants to take the GRE Aptitude Test.

D. A sample of recent critical or scholarly writing may be required.

Applicants who have earned the M.A. at Stony Brook in Program I will be admitted to the Ph.D. program only upon recommendation of the Graduate Admissions Committee of the English Department.

Requirements for the Ph.D. Degree

A. Course requirements and program: In order to keep requirements at a minimum and make it possible to design programs to fit particular needs, the student is normally required to take four 600-level seminars covering at least two areas of English and American literature and language. (No transfer credit is ac-

cepted at the seminar level.) *The student's doctoral advisor may recommend and the Graduate Committee may require that the student take courses in addition to the required seminars.* It is recommended that in any single semester a student who is teaching take no more than two courses in any combination of 600-level seminars and 500-level courses, and that when not teaching the student take no more than four courses in any combination of 600-level seminars and 500-level courses. Whenever there is a prerequisite to a 600-level seminar, the course which has been designated as the prerequisite may, with the permission of the instructor of the seminar, be taken concurrently with the seminar. The average of the grades in the required 600-level seminars must be B or higher.

Every student must have passed (1) one course in Shakespeare, (2) one course in either Chaucer or Milton, and (3) one course in linguistics or the history and structure of the English language. These requirements can be met by courses taken while the student was an undergraduate. If they have not had a similar course when M.A. students, doctoral students are urged to take EGL 500 Introduction to Graduate Studies during their first semester at Stony Brook.

B. Residence requirements: Every full-time student is normally expected to make a three-year commitment to study toward the doctorate. Every student will be considered in full-time residence during any semester in which he/she: (1) is taking at least one 500-level course or 600-level seminar or is, in the opinion of the Graduate Program Committee, properly preparing for the Doctoral Examination; (2) is holding no position other than that required under the teaching program below; (3) is registered for EGL 690 Thesis Research, or 699 Directed Reading for Doctoral Candidates for 3, 6, 9, or 12 credit hours, depending on the number of other courses the student is taking and the teaching assignment, the total of all these credits and teaching hours to be no more than 12.

C. Teaching program: Every student is required to teach responsibly one course for at least two semesters. The English Department regards training in teaching as a necessary and valuable part of work toward the Ph.D. degree. Such training may take the form of apprenticeship to a senior professor during the first and, possibly, second semester of preparation for the doctoral degree. During the second or later semesters, in some special cases possibly even during the first semester, the student may be asked to instruct in sections of large lecture courses or even to conduct a section of the composition course or a section of one of the University Lecture courses. During apprenticeship and teaching, the student will receive guidance in discussions with the director

of teaching interns and the professor he/she assists, advice from senior members of the department who visit classes, participation in staff meetings of large courses, and seminars in which he/she and fellow students are joined by senior members of the staff. During those semesters in which he/she is teaching, the student is required to be enrolled in EGL 697 or EGL 698 Practica in Teaching.

The director of teaching interns for the English Department will, upon application by the student, decide to what extent a student's teaching experience elsewhere will satisfy the requirements at Stony Brook.

D. Foreign language requirements: the student must complete one of two options before taking the Doctoral Examination.

Option I. The student must, on examination, demonstrate ability to translate and/or comprehend writings of moderate difficulty in two foreign languages appropriate to the area of study and hence ability to make use of relevant literary and scholarly writings in those languages. The choice of foreign languages will be decided by the student and his/her advisor.

Option II. The student must, on examination, demonstrate (1) ability to read, understand and speak well one living foreign language, or ability to read and understand well one classical language appropriate to the area of study, and (2) knowledge of the major literature of that language in the original language, and hence ability to make full use of the literature of another language. This option can be satisfied by passing a half-hour oral examination conducted in the language over the major literary figures or works of the language. The student's advisor should consult the Director of Graduate Studies about setting up such examinations. The passing of the reading and/or comprehension examination at the M.A. level shall *not* be sufficient evidence that the student has met Option II.

E. Doctoral Examination: Following the completion of the course work, there will be a single oral examination (from two to three hours in length), normally taken at the end of the second year of full-time study, which will cover a substantial portion of English literature, including the field of the proposed dissertation. Normally the oral examination will cover three related historical periods or an equivalent combination of genre, topic, and periods. The student will be responsible for primary as well as major secondary works. Materials outside English and American literature will be included where relevant.

Each candidate will submit a description and, if necessary, a justification of the areas to be covered, which must be approved by his/her advisor and then by the Graduate Program Committee.

Historical Periods: Medieval
Renaissance
Neo-Classical
Nineteenth Century
Modern British (from 1890) and American (from 1870)
American to 1870
Other formulations by petition to Graduate Program Committee

Genre and Topics: Comedy
Tragedy
Lyric
Epic
Novel
Prose
The English Language
Literary Criticism
Others by petition to Graduate Program Committee

The examining board is appointed by the Dean of the Graduate School on recommendation of the department chairman and will be selected by the candidate's advisor and the Graduate Program Committee, and will be composed of five members: the advisor, one specialist representing each area, and a fifth member recommended by the director of graduate studies.

The student who fails an area or areas of the Doctoral Examination may be granted a re-examination at the discretion of the Graduate Program Committee of the department upon the recommendation of the student's examining committee which will recommend the nature of the repeat. If the Doctoral Examination or an area of it is failed twice, the student will be dropped from the doctoral program with reinstatement possible only through a successful appeal to the campus-wide Graduate Council.

F. Dissertation: The dissertation may take the form of either a single long study or a series of related papers of the length of articles in learned journals. This study (or these studies) may be critical in nature as well as scholarly.

As soon as possible after the student has passed the Doctoral Examination, he/she must prepare a statement setting out the scope and method of the dissertation and submit it to his/her advisor who will then forward the statement to the Graduate Program Committee of the department for its approval. After the statement has been approved, the dissertation director will meet with the Graduate Program Committee to discuss the selection of the other three readers of the dissertation. The Graduate School re-

quires that one of the readers be from outside the department. The four readers of the dissertation must recommend acceptance of the dissertation before it can be approved by the Graduate Program Committee of the department.

G. Thesis colloquium: The student will present the results of dissertation research at an informal colloquium convened for that purpose by the Department of English and open to interested faculty and graduate students.

Matters Pertaining to Both Degrees

A. Advisory program: Every graduate student will at the beginning of graduate studies at Stony Brook be assigned an advisor. The advisor will help the student plan his/her program on the basis of the individual's wishes and needs and in the light of total preparation, both undergraduate and graduate.

   During the first semester of Ph.D. study, the student will be asked to recommend to the director of graduate studies the names of one or two professors he/she would like to have serve as doctoral advisor. As soon as possible after the advisor has been selected, the student and the advisor will discuss the student's academic background in order to reach a decision about the necessity of course work beyond the four seminar minimum requirement.

B. Extensions of time limits: Extensions of time limits are granted at the discretion of the Graduate Program Committee of the department and the Dean of the Graduate School and normally for one year at a time.

C. Incompletes: The Graduate Program Committee has established as sufficient grounds for the granting of Incompletes either medical reasons on the part of the student himself/herself or emergencies arising within the student's family.

D. English graduate colloquium: The colloquium is designed to foster a scholarly community by bringing the faculty and graduate students together informally to discuss literature and related matters. All graduate students are members of the colloquium. Students will elect the officers from among themselves to plan and direct the meetings of the colloquium. Students and members of the faculty will be invited to present papers, or lectures, or to participate in panel discussions.

Courses

Graduate courses in the 500 series are open to all graduate students. Courses in the 600 series are normally open only to students admitted to study for the Ph.D. degree although M.A. students with adequate prepa-

ration and background can sometimes be admitted with the permission of the instructor. All graduate courses normally carry three credits.

Each course in the 500 or 600 series to be offered in a given semester will be described by the instructor in some detail in a special departmental announcement prepared and distributed toward the end of the semester prior to that in which it is to be offered.

None of the courses numbered 690–699 can be taken to satisfy the requirement of four seminars as stated in "Requirements for the Ph.D. Degree" above.

Courses Open to All Graduate Students

EGL 500 Introduction to Graduate Study

Introduction to the major resources, techniques and approaches involved in literary scholarship and criticism, with illustrative practical applications.

EGL 501 Studies in Chaucer

Variable and repetitive credit

EGL 502 Studies in Shakespeare

Variable and repetitive credit

EGL 503 Studies in Milton

Variable and repetitive credit

EGL 505 Studies in Genres

Variable and repetitive credit

EGL 506 Studies in Literary Theory

Variable and repetitive credit

EGL 509 Studies in Language and Linguistics

Variable and repetitive credit

EGL 510 Studies in Old English Language and Literature

Variable and repetitive credit

EGL 515 Studies in Middle English Language and Literature

Variable and repetitive credit

EGL 520 Studies in the Renaissance

Variable and repetitive credit

EGL 525 Studies in 17th Century Literature

Variable and repetitive credit

EGL 530 Studies in the Age of Dryden

Variable and repetitive credit

EGL 535 Studies in Neoclassicism

Variable and repetitive credit

EGL 540 Studies in Romanticism

Variable and repetitive credit

EGL 545 Studies in Victorian Literature

Variable and repetitive credit

EGL 547 Studies in Late 19th Century British Literature

Variable and repetitive credit

EGL 550 Studies in 20th Century British Literature

Variable and repetitive credit

EGL 560 Studies in Early American Literature

Variable and repetitive credit

EGL 565 Studies in 19th Century American Literature

Variable and repetitive credit

EGL 570 Studies in 20th Century American Literature

Variable and repetitive credit

EGL 580 Studies in British and American Literature

Variable and repetitive credit

EGL 590 Masters Paper Direction

3 credits

EGL 592 Problems in Teaching Writing or Composition

Variable and repetitive credit

EGL 593 Problems in Teaching Literature

Variable and repetitive credit

EGL 594 Contexts of Literary Study

Variable and repetitive credit

EGL 595 Independent Studies in Linguistics

Variable and repetitive credit

EGL 596 Problems in Teaching Language and Literature to the Open Admissions Students

3 credits

EGL 597 Practicum in Methods of Research

Variable and repetitive credit

EGL 599 Independent Studies

3 credits

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Advanced Seminars

EGL 601 Problems in the History and Structure of the English Language

Investigations, employing the techniques of modern linguistics, in the synchronics and diachronics of the English language.

Variable and repetitive credit

EGL 602 Problems in Bibliography, Editing, and Textual Criticism

Analysis of particular problems in establishment of texts, attribution, and analytic and descriptive bibliography, with attention to methods and principles.

Variable and repetitive credit

EGL 603 Problems in Literary Theory and Criticism

Topics in the theory and history of literary criticism, considering major critical documents and the theoretical problems that arise in the formal discussion of literature.

Variable and repetitive credit

EGL 604 Problems in Literary Analysis

Discussion of various modes and techniques of practical criticism, ranging from mythic and archetypal criticism to problems in versification and prosody.

Variable and repetitive credit

EGL 605 Problems in Convention and Genre

Examination of selected topics in comedy, tragedy, epic, pastoral, and satire, as well as conventions of subject matter and technique.

Variable and repetitive credit

EGL 606 Problems in Period and Tradition

Study of the relation of individual works of writers to broader historical developments.

Variable and repetitive credit

EGL 607 Problems in Individual Authors

An investigation of various modes of dealing with a body of work by a single writer.

Variable and repetitive credit

EGL 608 Problems in the Relation of Literature to Other Disciplines

Selective investigation of the relevance of such disciplines as anthropology, communication theory, cultural history, history of ideas, linguistics, philosophy, psychology, and sociology to the study of literature.

Variable and repetitive credit

EGL 609 Problems in Comparative Literature

Study of English works or writers in their relation to other literatures.

Variable and repetitive credit

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Special Advanced Courses

EGL 690 Thesis Research

Variable and repetitive credit

EGL 697 Practicum in the Teaching of English Composition

The methods and techniques of teaching English composition; supervised instruction, conferences, and group discussions.

Variable and repetitive credit

EGL 698 Practicum in the Teaching of Literature

The methods and techniques of teaching literature; supervised instruction, conferences, and group discussions.

Variable and repetitive credit

EGL 699 Directed Reading for Doctoral Candidates

Variable and repetitive credit

Department of French

Professors:

BIEBER, F. BROWN, BRUGMANS, HAAC, LAIDLAW, WHITNEY, ZIMMERMANN (*Chairman*)

Associate Professors:

ALLENTUCH, BLUM, MILLS, RIZZUTO, TURSI

Assistant Professors:

PETREY, RIGGS

Instructor:

BECKER

Subject Specialist Librarian:

VASCO

Admission to Graduate Study

For admission to graduate study in French, the following are required:

A. A baccalaureate degree with preparation substantially equivalent to that of a French major of this institution.

B. Letters of recommendation from three previous instructors.

C. Oral proficiency in French.

D. The results of the Graduate Record Examination.

A student whose background in French is inadequate will be accepted as a candidate on a provisional basis during which time he or she will be able to complete undergraduate requirements in French before starting on the masters program.

Requirements for the M.A. Degree

The Master of Arts degree in French requires a minimum of 30 hours of graduate course work. The selection of courses is to be made in consultation with an Advisory Committee and will normally include six graduate offerings in French investigating those authors, literary movements, and genres which are especially germane to the student's preparation, aims, and program of study. With the permission of the Advisory Committee, six hours may be taken in approved graduate courses in related fields.

Candidates interested primarily in teaching may follow a program of studies ordinarily incorporating work in applied linguistics for teachers and prospective teachers of French, a methods and materials course in language teaching, and a course in contemporary French culture and institutions. Also, in the place of two graduate courses, in order to allow for greater flexibility, candidates may elect, with the permission of the Advisory Committee, to write a Masters Essay. The study of another foreign language is strongly recommended.

After the completion of required courses, the candidate must pass an examination for which his or her course work will serve as the basis. The

examination will be organized around a basic reading list and the choice of a topic to be determined by the student together with his or her advisors.

The following graduate courses will normally be offered at least once within a period of two years. Not all of them will be given in each academic year. A special departmental brochure identifying courses to be offered and clearly setting out their perspectives and content will be prepared for distribution toward the end of each semester preceding the one in which it will be offered.

Courses

FRN 501 Contemporary French Culture and Institutions

Analysis of contemporary French civilization through the study of the development of its historical, cultural, political, and social characteristics. Designed for potential teachers of French at the college level as well as in secondary schools, this course will emphasize and trace the evolution of the character and institutions of contemporary France. Open to qualified CED students.

Spring, 3 credits

FRN 503 Seminar in Applied Linguistics for Teachers and Prospective Teachers of French

A study of the disciplines upon which applied linguistics is based with special emphasis on their contributions to the teaching of French. Practice in the preparation and use of teaching materials in accordance with current principles of phonology, morphology, and syntax. Assessment of the teaching process and study of applied linguistics (linguistics, psycholinguistics, sociolinguistics, etc.) in order to analyze language teaching objectively and from a variety of perspectives. Open to qualified CED students.

Fall, 3 credits

FRN 505 Methods and Materials in Language Teaching and Learning

A review and evaluation of the latest methods and materials introduced into the field of language instruction and learning, this advanced course will stress the practical rather than the theoretical aspects of language teaching. Conducted as a practical workshop, the course emphasizes such matters as individualized instruction (the open classroom), differentiated staffing, modular scheduling, contact teaching and learning, humanities courses of secondary schools, VTR, CIA. Open to qualified CED students.

Spring, 3 credits

FRN 507-508 Advanced Stylistics and *Explication de Texte*

Designed to deepen the advanced student's knowledge of the finer points of the syntax, structure, and stylistic versatility of the French language, this course, during the first semester, will emphasize three principal exercises: translations from English into French stressing idiomatic turns of phrase and correct structuring, compositions in the French language, and advanced work in major discrepancies between French and English syntax. In the second semester greater emphasis will be placed upon weekly *explication de texte,* beginning with Renaissance literature, and proceeding to the modern period, in which analysis will be made of those effects that, taken together, constitute a given author's stylistic pattern.

Fall and spring, 6 credits

FRN 509 Introduction to Research and Literary Criticism

This course is designed to familiarize the student with the tools of literary research, with the various approaches to the interpretation of literature (formalistic, ideological, sociological, archetypal, psychological, comparative) and with the techniques of scholarly writing, including the preparation of bibliographies. Particular emphasis will be given to the study of general and specialized bibliographies,

periodical literature, and the historical development of French literary criticism.

Spring, 3 credits

FRN 511 History of the French Language

A study of the historical development of the French language from its origin.

Fall, 3 credits

FRN 514 Seminar in Medieval Literature

Topic for the 1975 spring semester: *The Cult of Woman in Medieval French Literature.* This course may be repeated for credit when topic changes.

Spring, 3 credits

FRN 521, 522 Seminar in French Renaissance Literature

Analysis of the works of such writers as Rabelais, Du Bellay, Ronsard, and Montaigne. Investigation of their relationship to the principal historical, cultural, and intellectual movements which helped to shape the unique 16th century mentality: humanism, evangelism, reform, Italianism. Emphasis will be placed on the study of the viability of 16th century aesthetics as well as of the relevance of its characteristic notions of man, of his situation, and of his capabilities. Topic for the 1974 fall semester: *Rabelais.*

Fall and spring, 3 credits each semester

FRN 531 Studies in the Classical Theater

Analysis of the aesthetics of the classical theater through the interpretation of works by Racine, Corneille, and Molière.

Fall, 3 credits

FRN 532 Studies in Classical Prose

Analysis of the works of the *écrivains mondains* and *moralistes* such as La Bruyère, La Rochefoucauld, Pascal, Mme de Lafayette, and Mme de Sévigné.

Spring, 3 credits

FRN 541, 542 Studies in 18th Century French Literature

Study of the background of the Enlightenment in France and of its development throughout the 18th century. Extensive reading of such authors as Rousseau, Diderot, Voltaire, Laclos stressing literary technique, themes, and major trends in prose, poetry, and the theater. Topic for thee 1974 fall semester: *The influence of Montesquieu.*

Fall and spring, 3 credits each semester

FRN 551 Studies in Romanticism

Reading and research in the background and manifestation of Romanticism in French literature.

Fall, 3 credits

FRN 552 Studies in 19th Century French Literature

Investigation of special topics and movements in 19th century French prose and poetry based on the study of the works of such authors as Chateaubriand, Benjamin Constant, Balzac, Baudelaire, Flaubert, Zola, and stressing the evolution of genres in the context of such phenomena as realism, symbolism, naturalism.

Spring, 3 credits

FRN 561 Studies in the Modern Novel

A study of the development of the French novel from Flaubert to the *nouveau roman.* Discussion of the historical trends in the novel itself and various critical attitudes toward the novel.

Fall, 3 credits

FRN 562 Studies in Contemporary Literature

The active pursuit of humanist ideas from Anatole France to Louis Guilloux, from Romain Rolland to Camus, with emphasis on the works of Valery Larbaud, Roger Martin du Gard, André Gide, and André Malraux.

Spring, 3 credits

FRN 571, 572 Free Seminars

Fall and spring, 3 credits each semester

FRN 581 Independent Individual Studies

Variable and repetitive credit

FRN 590 Masters Essay Research

Variable and repetitive credit

FRN 599 Practicum in Teaching

Variable and repetitive credit

Department of Germanic Languages and Literatures

Professors:	*Associate Professors:*	*Assistant Professors:*
[b]GREEN, KARST, SCHRÖTER, [a]SJÖBERG	BERR, R. BROWN, COCRON, RUPLIN (*Chairman*), RUSSELL	ELLING, O'NEIL

Admission to the M.A. Program

For admission to graduate study in Germanic languages and literatures the following are required:

A. A bachelors degree from a recognized institution.

B. An average of at least a B in undergraduate German literature courses.

C. An official transcript of undergraduate record.

D. Letters of recommendation from three previous instructors.

E. Proficiency in a second foreign language equivalent to two years of college work. Preference will be given to French, Spanish, Italian, or Russian but each case will be treated on its individual merits.

Any deficiencies in these requirements will not automatically bar admission but will normally mean that the student after being admitted may have to do additional work to bring his or her level of preparation up to the required standard.

If the applicant's credentials and background seem to indicate deficiencies in the German language, he or she may be required at the outset of the first semester of study to take a written and oral examination testing command of the language. If judged insufficiently prepared, the student may be required to enroll in GER 321 and perhaps GER 322 in addition to the other course requirements listed below.

Other relevant graduate courses taken at Stony Brook may be used to substitute for certain courses of the minimum requirements listed below if they are approved in advance by the department.

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[a] On leave academic year 1974–75

[b] On leave fall semester

Requirements for the M.A. Degree

A. Formal course requirements:

	Credit Hours
1. GER 501 Practicum in Teaching	3
GER 539 Contrastive Structures	3
2. Two proseminars chosen from the 546 series, or, for students wishing to specialize in Germanic philology and linguistics, GER 570, and one such seminar	6
3. GER 547 Special Author Studies	3
GER 548 Special Period Studies	3
4. One seminar from the 549-555 series	3
5. GER 556 Bibliography and Methodology	3
GER 557 History of the German Language	3
GER 558 Middle High German	3
	30

B. Performance: Average of B or better for all courses listed under A.

C. Language examination: Passing an examination testing the candidate's knowledge of at least one other language, ancient or modern, approved by the department.

D. M.A. paper: Submission of a scholarly essay on a topic and of a standard acceptable to the department.

Admission to the Ph.D. Program

Applicants who have either earned the Master of Arts degree or completed equivalent work at other graduate schools prior to admission to Stony Brook must submit the following:

A. Official transcripts of undergraduate and graduate work.

B. Letters of recommendation from at least two instructors familiar with the applicant's graduate work.

C. A sample of recent critical or scholarly writing; for example, the candidate's masters thesis or a seminar paper.

Applicants who have earned the M.A. degree at Stony Brook will be admitted to the Ph.D. program only upon recommendation of the department.

Advancement to Candidacy for the Ph.D. Degree in Germanic Languages and Literatures

A. Residence requirements: Minimum of six consecutive semesters beyond the bachelors or four consecutive semesters beyond the masters degree.

B. Foreign language requirements: A student who has not fulfilled the language requirement during the masters program must pass an examination in at least one other ancient or modern language approved by the department.

C. Comprehensive Examination: Before the end of the fourth semester of full-time residence after receiving the M.A., a student will be required to take and pass the departmental Comprehensive Examination testing knowledge and critical understanding of German literature and the history of the German language.

D. Dissertation subject: Presentation of a proposal for a doctoral dissertation which is supported by that member of the department who has agreed to sponsor the dissertation.

E. Course requirements: In addition to those listed under the masters degree, students must take the following courses:

	Credit Hours
1. One seminar from the 549-555 series not previously taken	3
2. GER 561 Goethe	3
GER 563 Old High German	3
3. GER 601 Special Author Tutorials	6
GER 602 Special Period Tutorials	6
GER 601 and 602 must be taken twice. Each course is 3 credits each semester.	
4. One seminar chosen from the 603-609 series	3
	24

Persons wishing to stress Germanic philology will be encouraged to do so by substituting appropriate courses from within the department's offerings as well as those from other departments, such as FRN 511, EGL 509, EGL 510, EGL 515, or EGL 601.

Granting of the Ph.D. Degree

After the student's dissertation has been accepted, it must be successfully defended in an oral examination.

Matters Pertaining to Both M.A. and Ph.D. Degrees

A. Graduate instruction in the Department of Germanic Languages will be given as far as possible by tutorial and seminars. At the beginning of their graduate studies at Stony Brook, students will be assigned tutors. Tutors will be members of the department of professorial rank who will advise students in the planning of

their programs according to their special interests and needs against the background of their undergraduate and graduate preparation before entering the Stony Brook program. In both the M.A. and Ph.D. degree programs, normal course work has been reduced to a minimum so that the maximum amount of time may be released for independent study under the tutorial and seminar program for research seminars.

B. Extensions of time limitations: Extension of time (beyond three years for the M.A. degree and four years for the Ph.D. degree) are granted at the discretion of the department and the Dean of the Graduate School and normally for one year at a time.

C. Incompletes: If a student wishes to request an Incomplete, he or she must get the course instructor's approval, as well as that of the director of graduate studies.

D. Part-time study for either degree may be permitted at the discretion of the department.

Courses

Graduate Seminar and Tutorial Offerings

Candidates should understand that these seminars are given general titles. The specific topics to be offered in proseminars and seminars of the 500- and 600-series in a given semester will be described in announcements prepared and distributed before preregistration for the semester in which they are to be offered. A candidate may take, so far as the requirements allow, the same seminar more than once if the alteration of subjects within that seminar benefits the individual's graduate program. Candidates for graduate degrees are urged to consult with the professors to whom they are assigned in order to work out the most favorable sequence of seminars.

GER 501 Practicum in Teaching

The methods and techniques of teaching a foreign language, supervised instruction conference, and group discussions; students will participate in current research projects in foreign language methodology. Exercises in methodology of literary scholarship; opportunity for practical training in teaching literature.

3 credits

A. Proseminars: M.A. candidates choose three.

GER 539 Contrastive Structures: German-English

GER 540 Proseminar I: The Middle Ages

3 credits

GER 541 Proseminar II: Literature of the Goethe Period

3 credits

GER 542 Proseminar III: Literature of the Romantic Period

3 credits

GER 543 Proseminar IV: The Age of Realism: Prose and Poetry

3 credits

GER 544 Proseminar V: 19th Century Drama

3 credits

GER 545 Proseminar VI: 20th Century Prose and Poetry

3 credits

GER 546 Proseminar VII: 20th Century Drama

3 credits

B. Tutorial offerings for M.A. candidates.

GER 547 Special Author Studies

3 credits

GER 548 Special Period Studies

3 credits

C. Seminars: M.A. candidates choose two.

GER 549 Seminar I: Theory and Criticism

3 credits

GER 550 Seminar II: The Middle Ages

3 credits

GER 551 Seminar III: Reformation, Baroque, Enlightenment

3 credits

GER 552 Seminar IV: The Classical Period

3 credits

GER 553 Seminar V: Romanticism and Realism

3 credits

GER 554 Seminar VI: 20th Century Literature

3 credits

GER 555 Seminar VII: Scandinavian Literature

3 credits

D. Courses required for M.A.

GER 556 Bibliography and Methodology

3 credits

GER 557 History of the German Language

3 credits

GER 558 Middle High German

3 credits

E. Courses required for advancement to Ph.D. candidacy.

GER 561 Goethe

3 credits

GER 562 Gothic and Indo-European

Required for philologists only.

3 credits

GER 563 Old High German

3 credits

GER 564 Old Saxon or Old Norse

May be taken outside the department. Required for philologists only.

3 credits

GER 565 Middle High German Literature

3 credits

GER 570 Historical Linguistics

3 credits

GER 571 Comparative Germanic Linguistics

3 credits

GER 572 German Syntax
3 credits

GER 599 Masters Thesis
Variable and repetitive credit

F. Tutorial offerings for advancement to Ph.D. candidacy.

GER 601 Special Author
3 credits each semester. Must be repeated.

GER 602 Special Period
3 credits each semester. Must be repeated.

G. Advanced seminars for Ph.D. candidates only. Candidates choose two. Topics to be selected by instructor.

GER 603 Seminar VIII: The Middle Ages
Repetitive, 3 credits each semester

GER 604 Seminar IX: Humanism, Baroque, Enlightenment
Repetitive, 3 credits each semester

GER 605 Seminar X: German Literature: 1749-1832
Repetitive, 3 credits each semester

GER 606 Seminar XI: 19th Century German Literature
Repetitive, 3 credits each semester

GER 607 Seminar XII: 20th Century German Literature
Repetitive, 3 credits each semester

GER 608 Seminar XIII: Problems in Comparative Literature
Repetitive, 3 credits each semester

GER 609 Seminar XIV: Scandinavian Literature
Repetitive, 3 credits each semester

GER 699 Doctoral Dissertation
Taken after advancement to candidacy.
Variable and repetitive credit

Department of Hispanic Languages and Literature

Professors:	*Associate Professors:*	*Assistant Professors:*
LASTRA, LLORENS, SCHULMAN *(Chairman)*, ZAVALA	GIORDANO, LIDA	FAINBERG, LITTLE, PERISSINOTTO

The M.A. and Ph.D. programs described below have no prescribed or required courses in order to permit the individual student maximal flexibility *vis a vis* his or her major interests. Broad subject coverage as well as departmental and interdepartmental disciplinary specialization are recommended. Interdisciplinary Ph.D. minors are encouraged, particularly after the first year of course work, in such areas as studies in the Renaissance, studies in the Baroque, etc. Programs of study for both M.A. and Ph.D. candidates are planned in consultation with the student and approved by a committee of advisors under the supervision of the director of graduate studies.

Degree Requirements for the M.A. Programs

Program A: For secondary and junior college teachers who do not intend to do post M.A. studies, thirty units of graduate course work of which six seminar units may deal with problems of the teaching of language and literature at secondary and junior college levels, plus examination.

Program B: For students who wish an intermediate degree but intend to do post M.A. studies, a minimum of two semesters of full-time residence or the equivalent plus examinations and fulfillment of the 30 graduate credit requirement.

Degree Requirements for the Ph.D. Program

There are no unit requirements for the degree. A minimum of four semesters of course work or the equivalent beyond the B.A., two with full-time residence. Although research and its relationship to teaching are stressed, provision is made for creative, non-research, oriented students. The student's individual academic needs will have priority over any specifically prescribed program. Each candidate's program will be planned during his or her first semester on campus by a faculty committee. Programs will reflect previous experience, maturity, and the candidate's proposed area of specialization. All Ph.D. candidates will be involved in two levels of teaching experience: one at the lower division level (SPN 691, 692 Practicum in Lower Division Teaching) as teaching assistants, and one at the intermediate level (SPN 693, 694 Practicum in the Teaching of Literature). The second practicum should be taken in the last year of course work. It is intended to combine theoretical studies with practical applications of literary analysis to classroom situations.

Examinations

M.A. Program

PROGRAM A: An oral comprehensive of two hours based on a reading list.

PROGRAM B: A six hour written examination consisting of three hours of questions on Spanish literature and three on Spanish-American literature, based on a reading list.

Ph.D. Program

Upon completing 12 units of course work a brief qualifying examination based on a selection from six works of literature and criticism will be administered to gauge the candidate's potential and determine the nature of his or her further studies.

The final comprehensive examination will consist of 12 hours of written questions and two of oral. These 12 hours will be distributed according to the following sequence: 1) Three hours of questions directly related to the subject of the dissertation (which consequently should be decided upon sufficiently in advance) ; 2) five hours of questions on Spanish or Spanish-American literature, whichever is the field of the dissertation (the department does not yet offer the Ph.D. with a major in linguistics) ; 3) four hours of questions on the other fields, including basic notions of Spanish linguistics. This examination will be held twice a year: the first week of September and the first week of March. The oral section will be scheduled on an individual basis within a two month period following the last written examination. Failure in one of the sections does not mean failure in the whole series of examinations; the student will repeat only the section he or she has failed.

Foreign Language Requirement

In order to provide Ph.D. candidates with the tools to read competently from a wide variety of sources, they will be required to read French plus one other language relevant to their research interests. Students may satisfy the language requirement by one of the following means:

1. The satisfactory completion of one graduate course in the foreign literature.

2. The passing of an ETS Graduate Reading Examination.

3. The preparation of at least one research paper drawing upon sources in the foreign language. Such a paper may concern itself with a problem in comparative literature or with an exclusively Hispanic topic utilizing criticism in the foreign language. The student opting this approach will consult with the director of

graduate studies regarding an acceptable subject and *modus operandi.*

The student is encouraged to complete his language requirement as early as possible.

Dissertation

The dissertation will consist of the written results of extended independent study under the supervision of a member of the staff. The result may take the form of a critical or scholarly study. It is required for the Ph.D. degree *only.*

Early in his or her studies the Ph.D. candidate should begin to think in terms of a dissertation topic, choose an advisor, and write up a brief prospectus to be submitted to the director of graduate studies. The prospectus will be studied by a committee appointed by the director, and, if approved, the student may begin preliminary bibliographical work.

Requirements for Admission

M.A. Students

1. A B.A. degree with preparation equivalent to that of a standard undergraduate Spanish major. Students with a major in other disciplines will be admitted subject to their fulfilling deficiencies.
2. Three letters of recommendation.
3. G.R.E. scores in Spanish.

Ph.D. Students

1. A B.A. or M.A. degree.
2. Superior preparation in Spanish language and literature.
3. Letters of recommendation from three Spanish professors.
4. A senior thesis paper, an M.A. thesis, or two or three research papers written at another institution.
5. G.R.E. scores in Spanish literature.

Note: Students who are admitted to the Ph.D. program are considered provisional, until they are admitted formally to the doctoral program upon passing the comprehensive examination.

Courses

M.A. and Ph.D. Courses

SPN 501, 502 Seminar in Linguistics
3 credits each semester, repetitive

SPN 511, 512 Seminar in Medieval Literature
3 credits each semester, repetitive

SPN 521, 522 Seminar in Renaissance Literature

3 credits each semester, repetitive

SPN 523, 524 Seminar in Golden Age Literature

3 credits each semester, repetitive

SPN 531, 532 Seminar in Spanish Literature of the 18th Century

3 credits each semester, repetitive

SPN 541, 542 Seminar in Modern Spanish Literature

3 credits each semester, repetitive

SPN 543, 544 Seminar in Contemporary Spanish Literature

3 credits each semester, repetitive

SPN 551, 552 Seminar in Spanish-American Literature (Colonial Period)

3 credits each semester, repetitive

SPN 561, 562 Seminar in Spanish-American Literature (Independence to 1914)

3 credits each semester, repetitive

SPN 571, 572 Seminar in Modern and Contemporary Spanish-American Literature

3 credits each semester, repetitive

SPN 591, 592 Free Seminars

3 credits each semester, repetitive

SPN 595, 596 Independent Individual Studies

Variable and repetitive credit

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Courses for Ph.D. Candidates

SPN 601, 602 Problems in Linguistics

3 credits each semester, repetitive

SPN 611, 612 Problems in Genres

3 credits each semester, repetitive

SPN 621, 622 Problems in Comparative Hispanic Literature

3 credits each semester, repetitive

SPN 641, 642 Problems in Textual Criticism

3 credits each semester, repetitive

SPN 691, 692 Practicum in Lower Division Teaching (Level I)

3 credits each semester

SPN 693, 694 Practicum in the Teaching of Literature (Level II)

3 credits each semester

SPN 695, 696 Directed Doctoral Research

Variable and repetitive credit

Department of Music

Professors:

AREL, LAYTON, LESSARD [a]LEWIN, NEMIROFF, [a]ROSEN, TREITLER,

Associate Professors:

BARON, BONVALOT, FULLER (*Chairman*), LAWTON, ZUKOFSKY

Assistant Professors:

JEFFERS, R. KRAMER, STARR, WINKLER

Instructors:

SEMEGEN, WOLF

Director of the University Band:

KARASICK

Performing Artists in Residence:

ADDISON, ANDERSON, BREHM, CANIN, DES ROCHES, EDDY, FROELICH, GLAZER, GRAHAM, GREENHOUSE, G. KALISH, KREISELMAN, ROSEMAN, WEISBERG

The Department of Music offers graduate programs leading to the Master of Arts degree in musicology and in composition, and the Master of Music degree in performance. All important areas of study are represented, but special emphasis is placed upon the music of the 20th century.

Admission to the M.A. Program

The following are required for admission to the M.A. program in musicology and in composition:

A. A baccalaureate degree from a recognized institution.

B. An official transcript of undergraduate record.

C. A minimum grade average of B in undergraduate music courses.

D. Submission of examples of undergraduate research papers (for musicology students) or musical compositions (for composition students).

E. Scores of the Graduate Record Examination Aptitude Test (GRE).

Applicants are invited to submit any other evidence of their abilities in support of the applications for admission, such as recordings of musical performances or the score on the Graduate Record Examination Area Test in music.

All students entering the M.A. program will be examined in the following areas during the week before the beginning of classes:

1. Ear training.
2. Basic keyboard skills.

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[a] On leave academic year 1974–75

3. The harmonization of a chorale in four voices.

4. The setting of one voice in counterpoint to a cantus firmus in 16th century style (fifth species); *or* the composition of a passage in two-part counterpoint in the style of Bach.

5. The analysis of representative examples of 18th and 19th century music.

6. The history of music (*musicology students only*).

7. The composition of one of the following (*composition students only*):

   a. A motet in four or more voices in 16th century style.

   b. A fugue in four voices in 18th century style.

   c. A sonata or chamber work movement in the homophonic style of the 18th century.

A student who is found deficient in any of the areas of harmony, counterpoint, ear training, or keyboard must continue to retake pertinent examinations as they are given, until the deficiency is removed. A student may not take the comprehensive examinations for the degree until he or she has passed examinations in these four areas. A student who is found deficient in analysis will be required to take pertinent courses immediately.

Requirements for the M.A. Degree in Musicology

A. *Courses:* Thirty graduate credit hours, chosen in consultation with the student's advisor. The program must include MUS 501, 503, 505, and two courses from those numbered 543–555. At least two semester courses, or one year course, outside the area of musicology are also required. If a course in a department other than music is taken toward the degree, approval by the Graduate Studies Committee must be obtained.

B. *Foreign languages:* A reading knowledge of French and German. Examinations must be taken by the end of the second semester of study.

C. *Comprehensive examinations:* Written and oral examinations in the history of music and in the analysis of preassigned compositions.

D. *Research paper:* A substantial essay, normally one which the student has written as part of the course work. The paper should be submitted no later than the first week of the semester in which the student expects to receive the degree.

Requirements for the M.A. Degree in Composition

A. *Courses:* Thirty graduate credit hours chosen in consultation with the student's advisor. The program must include MUS 523 during each semester of residence, and MUS 515, 516. At least two semester courses, or one year course, outside the area of composition and theory are also required. If a course in a department other than music is taken toward the degree, approval by the Graduate Studies Committee must be obtained.

B. *Foreign language:* A reading knowledge of French, German, or Italian. The examination must be taken by the end of the second semester of study.

C. *Comprehensive examinations:* Written and oral examinations on important musical works of all periods and in the analysis of preassigned compositions.

D. *Compositions:* Students must satisfy the department that they have written compositions of sufficient quality and variety during the period of study after admission to the Graduate School. Fair copies of all such works must be submitted to the Graduate Studies Committee as they are completed. The LAST DAY FOR GRADUATE STUDENTS TO SUBMIT THESES AND DISSERTATIONS, as specified in the Academic Calendar, will be the final deadline for all works to be submitted.

Admission to the M.Mus. Program

The following are required for admission to the M.Mus. program in performance:

A. A baccalaureate degree from a recognized institution.

B. An official transcript of undergraduate record.

C. An audition in the major field of performance. Students residing at a distance may gain provisional acceptance by means of recordings of their work. Applicants should contact their prospective major teachers regarding suitable repertory for auditions.

D. Letters of recommendation from the principal teacher and at least one other person familiar with the student's work.

E. Scores of the Graduate Record Examination Aptitude Test (GRE).

Requirements for the M.Mus. Degree

A. *Courses:* Thirty graduate credits, chosen in consultation with the student's advisor, of which up to fifteen may be in individual study of the major instrument or voice. None of the remaining fifteen degree credits may be in individual study of another in-

strument or voice. The program must include at least two semester courses, or one year course, outside the following group of studio courses: MUS 561, 563, 565, 570, 571, 573, 575, 583. MUS 565 is required of all students who play orchestral instruments during each semester of residence. If a course in a department other than music is taken toward the degree, approval by the Graduate Studies Committee must be obtained.

B. *Jury examinations:* These will be offered each semester.

1. The student must take one jury examination during each academic year.
2. The student must take and pass the jury examination offered in the penultimate semester of his or her program.

C. *A public recital.*

Courses

Any student wishing to take a graduate course outside the major area (composition, musicology, performance) must take the qualifying examination or audition for that course.

The department is prepared to offer the following graduate courses, although not all of them are given in each academic year:

MUS 501 Introduction to Musical Research

An introduction to the major bibliographic aids and research techniques in the field of music, with illustrative practical applications.

3 credits

MUS 503 Music in the 20th Century

An intensive course in 20th century musical styles, focusing on historical problems of influence, development, and change. Seminar reports and research papers on works of major significance.

3 credits

MUS 505 Introduction to Early Notation

Selected problems in musical paleography, using exercises in transcription and editorial method.

3 credits

MUS 506 20th Century Notation

Study of various contemporary notational systems with emphasis on problems in standardization and common usage.

3 credits

MUS 507 Proseminar in Music History

Concentrated study of the works of a single composer, or of repertories that comprehend single compositional tendencies in Western music. Various topics are offered each semester.

Variable credit

MUS 508 Proseminar in Composition

Concentrated study of skills and techniques ancillary to musical composition.

Variable credit

MUS 509 Performance Studies for Composers and Musicologists

This course provides opportunity for a student who is not in the M.Mus. program, but who can demonstrate graduate-level performance ability, to pursue performance studies without investing the time and credit required for M.Mus. stu-

dents. The course is not open to students in the M.Mus. program, except for conducting students who can demonstrate graduate-level ability in an instrument or voice, to study without investing the time and credit required of instrumental or vocal degree students.

Variable up to 4 credits

Not more than 8 credits of MUS 507, 508, and 509 combined may be counted toward any degree.

MUS 511, 512 Compositional Techniques of the 20th Century I, II

A study, by means of practical exercises in writing, of some of the important techniques of the present century in the organization or non-organization of pitch, rhythm, line, motive, and form.

3 credits each semester

MUS 513 Musical Applications of Modern Mathematics

For musicians wishing to acquire mathematical concepts and techniques pertinent to the theory and composition of music in certain important contemporary styles. Mathematical introductions to group theory, lattice theory, probability, and information theory; the pertinence of these subjects to serial, aleatoric, and stochastic music. The course will not touch on calculus or computer programming; music students interested in these topics are directed toward the appropriate courses in other departments. No mathematical prerequisites beyond the high school level are required, but students should have a more than perfunctory acquaintance with and professional interest in at least one of the musical styles cited above.

3 credits

MUS 515 The Fundamentals of Electronic Music

A short survey of the history and literature of the medium will be followed by study of the pertinent background in theoretical acoustics and practical engineering. Students will then be instructed in the basic techniques of electronic sound production and modification.

3 credits

MUS 516 Electronic Music Workshop

Individual short experimental works on specific assignments. Uses of electronic music equipment.
Prerequisite: MUS 515 or the equivalent.

3 credits

MUS 517 The Literature of Electronic Music

A survey of the history and literature of the medium, including various technological approaches.

3 credits

MUS 523 Advanced Composition

Individual projects for graduate students in composition.

3 credits

MUS 531 Seminar in Music Theory: Tonality

Works of important theorists in the field, from Rameau and his precursors to Schenker, will be studied. The course, though, will not be oriented primarily toward historical survey of this literature; rather, it will be directed toward critical examination of the theoretical bases of tonality, and toward examination of the nature, meaning, value, and limitations of "theory" in the study of music.

3 credits

MUS 535 Lecture-Workshop in the Performance of Baroque Music

An examination of problems confronting the performer of music from the period ca. 1600–1750, from both musicological and practical points of view. The *basso continuo,* its function and realization; phrasing and articulation; ornaments, notated and improvised; period instruments; aspects of notation; bibliography. The course will meet in lecture for two hours each week with a third hour devoted to the coaching of a rehearsal or performance of music prepared by members of the class.

3 credits

MUS 539 Contemporary Criticism and Analysis in Music, Literature, and Art

The methodology of contemporary criticism. A discussion of theories of form

and style, and the relations and cross-currents among contemporary criticisms in different media. Formalist theories (Schenker in music, Riegl and Woelfflin in art), statistical analysis, sociological criticism and Marxism (Adorno), structuralism, psychological theory, and traditional philology. This course is equivalent to EGL 506.

3 credits

Special Topics Courses

Topics to be chosen each time a course is offered will depend upon the needs of the students and the interests of the instructor.

3 credits

MUS 543 Topics in Medieval Music

MUS 545 Topics in Renaissance Music

MUS 547 Topics in Baroque Music

MUS 549 Topics in 18th Century Music

MUS 553 Topics in 19th Century Music

MUS 555 Topics in 20th Century Music

MUS 559 Topics in Analysis

MUS 561 Orchestral Conducting

Guidance in the preparation and practice of conducting instrumental groups. Open only to adequately prepared students with a professional commitment to conducting.

3 credits

MUS 563 Choral Conducting

Guidance in the preparation and practice of conducting choral groups. Open only to adequately prepared students with a professional commitment to conducting.

3 credits

MUS 565 University Orchestra (Advanced)

Study and performance of works from the repertory of the concert orchestra. Includes opportunities for chamber and solo work within the organization.

1 credit

MUS 569 Performance Problems in 20th Century Music

A study of performance skills required in new music, with emphasis on polyrhythms, composite rhythms, control of tone color and dynamics, and on the understanding of new methods of notation. Exercises, and the study of selected 20th century works.

2 credits

MUS 570 20th Century Conducted Ensemble

Works to be studied will range from five to 15 players. Representative composers would be: Boulez, Carter, Stockhausen, Stravinsky, Varèse, Webern. Performance of the works will be a normal part of the course. The course is available to student instrumentalists for two credits, and to student conductors for three credits. Instrumental students will be conducted by the instructor for one and one-half hours per week, and by the student conductors for one hour per week. Conducting students will meet with the instructor alone for one and one-half hours per week; besides working with the instrumentalists, they will also observe the sessions conducted by the instructor. Enrollment of conducting students will be limited to three.

Prerequisite: MUS 569 or the equivalent.

Variable credit

MUS 571 Advanced Instruction in Instrument or Voice

Individual guidance in technique and repertory, with 30 practice hours required each week. Each student is required to perform at least one solo piece per semester, unless excused by the instructor in a written note to the department's Graduate Studies Committee.

6 credits

MUS 573 Chamber Music

Chamber ensembles such as the string quartet, wind quintet, solo vocal ensemble, two-piano team and other special groups meet, each under the direction of a member of the performance faculty, for the study of works from the repertories of the respective groups, with particular

attention given to the music of the 20th century. Required: presence at a weekly coaching session, at least three hours per week of uncoached rehearsal, and at least one performance per semester.

2 credits

MUS 575 Master Class in Solo Repertory for Instrument or Voice

Performance techniques and problems in works for instrument or voice, drawn from all historical periods. The instructor will be a teacher of the specific instrument in each case, except that his section may be open to students of certain other instruments with his permission. Not offered each semester in every instrument.

2 credits

MUS 577 Master Class in Performance Pedagogy

Guidance and supervision in the teaching of an instrument or voice.

2 credits

MUS 581 20th Century Repertory for Instrument or Voice

A study of the solo works of the 20th century, with emphasis on performance techniques and problems. The instructor will be a teacher of the specific instrument in each case, except that his section may be open to students of certain other instruments with his permission. Not offered each semester in every instrument.

2 credits

MUS 583 Works for Piano and One Other Instrument or Voice

Credit for piano students only. An intensive performance workshop for pianists in the repertory.

2 credits

MUS 585 Renaissance and Baroque Brass Performance Practice

Study and survey of original and transcribed Renaissance works, and of various Baroque works, for brasses. Investigation of styles and techniques of Renaissance ornamentation using mainly Ganassi's *Fontegara* (1535) as text. Investigation of Baroque ornamentation styles and symbols.

2 credits

MUS 591 Practicum in Teaching

Instruction in the department under the supervision of the faculty. (MUS 591 may not be included in the courses taken in fulfillment of degree requirements.)

Variable credit

MUS 599 Independent Studies

Individual study under the guidance of a faculty member. Each student must submit to the Graduate Studies Committee of the department a written prospectus of the work he intends to pursue, with the amount of credit proposed, together with the written endorsement of the prospective instructor. Approval of the Graduate Studies Committee is required; hence this material should be submitted as soon as possible, and in any case within the first two weeks of the semester (or the first week of a summer session).

Variable credit

MUS 611 Workshop in Composition and Performance

Student composers will write pieces to be played by the student performers in the class. Discussion of compositional and performance problems. Emphasis upon present day performance techniques. The course will be under the joint supervision of a member of the composition faculty and a member of the performance faculty. The course can be repeated once for credit toward the degree.

2 credits

MUS 615 Electronic Music Composition

Individual compositions, of substantial proportions, in electronic or concrete music media. The course may be repeated. Open only to qualified students in a music degree program.

Prerequisite: MUS 516 or the equivalent

3 credits

Department of Philosophy

Professors:

BUCHLER, GELBER, HEELAN *(Chairman)*, IHDE, STERNFELD, TEJERA, ZYSKIND

Associate Professors:

DE NICOLAS, DILWORTH, HILL, SLOTE, SPECTOR, WATSON, ZEMACH

Assistant Professors:

A. DALLERY, C. DALLERY, HOWARD, WELTON

Instructor:

ALLISON

Lecturers:

ACKLEY, C. L. MILLER

The Department of Philosophy offers programs leading to the Master of Arts in Philosophical Perspectives, and to the Doctor of Philosophy. The two programs, extremely different in content and purpose, are described below.

The Masters Program

The Master of Arts in Philosophical Perspectives (MA/PP) concentrates on the development of an *appreciation* of the contribution of philosophical perspective to the self-understanding of men and women in a changing world. The principal focus of the program is on contemporary problems.

The program is designed with principally two kinds of students in mind: (a) those currently enrolled in Stony Brook's MA/LS program (i.e., CED); and (b) those who received their baccalaureate degree some years ago, and who are desirous of returning to school to broaden or continue their education in this area.

Admission to the M.A. Program

For admission to the M.A. program in philosophical perspectives, the following are required:

A. A bachelors degree from a recognized institution.
B. An average of at least B in the last two years of undergraduate work or six credits of graduate work with a B average in the MA/LS program or another recognized graduate program.
C. An official transcript of undergraduate record and of any work completed in the MA/LS program or other graduate programs.
D. Letters of recommendation from two previous or current instructors.
E. An admissions essay of roughly 500 words expressing your interests and expectations of the program as it relates to your current state of life.

Deficiencies in these requirements shall not automatically bar admission to the program, although a candidate may be required in such cases to enroll in philosophy courses in the MA/LS program prior to consideration of his/her application.

Requirements for the M.A. Degree

A. Formal course requirements: A student preparing for the degree of Master of Arts in Philosophical Perspectives is required to take a total of ten courses amounting to 30 graduate credit hours. These courses will include seven courses on contemporary problems, two courses (PHI 524–5) in the history of philosophical perspectives and one course (PHI 527 or 528, or 586 or 587) in the detailed analysis of a philosophical text.

Additionally, the student is required to take two courses (PHI 588 and 589) in directed research leading to the M.A. paper or the M.A. practicum. (See below.)

B. 1. *The M.A. Paper.* The paper is a research paper in which the student exhibits his/her ability to locate, comprehend and present in a communicately sensitive form the fruits of mature philosophical research as that bears upon one or another contemporary problem. The paper will usually be written under the direction of the instructor in one of the seven perspective courses and will eventually be presented to that instructor and one other faculty member upon completion. Students who have not completed the paper by the end of the third semester must enroll for at least one credit of work during the semester in which they intend to complete the paper.

2. *The M.A. Practicum.* For those students who are teaching in high school and who can obtain permission to introduce a philosophy course into the curriculum, the supervised preparation and teaching of this course will substitute for the M.A. paper. The student will be required to present course plans, bibliographies and other evidence of his/her academic readiness prior to the teaching of the course. During the course, the construction and grading of exams and papers will be supervised and several classes will be visited. Overall evaluation will take place at the conclusion of the course. The Philosophy Department has some resources to locate programs or schools where the student might teach such a course.

C. *Performance.* An average grade of B is the minimum, but no more than six credits of C's will be permitted to count for credit toward the degree. Any student who accumulates 12 credits of C grades will be dropped from the program.

D. *Credit for work done elsewhere.* A maximum of six hours of post-baccalaureate credit in philosophy from other institutions *may* be transferred towards the M.A. in Philosophical Perspectives. The transference

of credit will not be automatic, but will depend upon the suitability of the courses to the goals of the program and upon the grades received in the courses. All credits in philosophy earned in Stony Brook's MA/LS program are transferable, subject only to the performance and distribution regulations mentioned above. Credits transferred from other institutions will not be accepted toward the PHI 524, 525 courses.

Courses Open to Masters Students

PHI 524, 525	History of Philosophical Perspectives
PHI 527, 528	Individual Thinkers in the History of Philosophy
PHI 530	Anglo-American Philosophy in the Twentieth Century
PHI 531	Existentialism and Phenomenology
PHI 532	Marxism and Communism
PHI 533	Oriental Views of Man and Nature
PHI 543	Logic
PHI 544	Perspectives on Communication
PHI 545, 546, 547	Perspectives on Social and Political Issues (Variable topics, including equality, genetics, the cities, technology, etc.).
PHI 549	Perspectives on Law
PHI 550, 551	Perspectives on Contemporary Moral Problems
PHI 552	Perspectives on Feminism
PHI 553	Perspectives on the Environment
PHI 554	Perspectives on Death
PHI 555, 556	Perspectives on Education
PHI 582, 583	Colloquium: Contemporary Problems
PHI 584, 585	Teaching Practicum
PHI 586, 587	Directed Readings
PHI 588, 589	Directed Research

Additional Information

In view of the intended audience for the MA/PP program, nearly all courses will be scheduled after 5 p.m. or on Saturdays.

N.Y. State Permanent Certification can be gained by the successful completion of this program, if the student already has Temporary Certification. The program *cannot* confer Temporary Certification.

The M.A. in Philosophical Perspectives is considered to be a terminal degree. There is no doctoral program in this University for which it is prerequisite or to which it guarantees admission.

General Aims of the Doctoral Program

1. To cultivate the principal contemporary styles of philosophical reasoning;
2. To engage in philosophical discourse about aspects of contemporary human experience that involve communication with other disciplines especially the natural sciences;
3. To bring philosophers using different styles into ongoing dialogue on such contemporary interface issues;
4. To make explicit the methodology and rational values involved in the different contemporary styles of philosophical reasoning.

Requirements for Admission into the Doctoral Program

Students will be admitted to the doctoral program who have a bachelors degree with a major in philosophy, provided their undergraduate work has introduced the student to the history of philosophy and given some acquaintance with a variety of contemporary philosophical styles. In the case that these requirements are not fulfilled, the department may require that some specific remedial work be done. In applying for admission, a student must also submit a philosophical essay he/she has written.

Requirements of the Doctoral Program

The doctoral program is designed so that a doctoral student will ordinarily be able to complete the Ph.D. in four years of full-time work after admission to the doctoral program. No minimum length of time, however, is prescribed. Requirements are as follows:

A. Four doctoral courses or seminars in the history and the traditional core areas of philosophy. Doctoral students must take PHI 500 History of Philosophy and Philosophical Texts which will be offered every year. In addition, they will take their choice of three out of six graduate courses or seminars offered in a two-year cycle, where at least one course will have to be taken from each of the following groups:

Group A: PHI 501 Philosophy of Science and Logic
PHI 502 Metaphysics and Systematic Philosophy
PHI 503 Epistemology, Philosophy of Mind, Perception and Experience

Group B: PHI 504 Philosophy of Value, Culture and Society
PHI 505 Aesthetics and Rhetoric
PHI 506 Oriental Philosophy

B. Participation in two Ongoing Style Seminars, one in the style the student prefers for his or her own philosophical activity, and one in some other style.

C. Participation in two Ongoing Interface Seminars where communication is established between philosophy and some other discipline.

Over and above these requirements, the student will be guided by the director of graduate studies in planning and executing an appropriate program of philosophical studies.

Combined Ph.D. in Philosophy and M.A. or M.S. in Some Other Discipline

Courses in departments other than philosophy may be accepted as part of a doctoral program in philosophy or even required by such if the director of graduate studies so decides in a particular case. A doctoral student in philosophy may earn an M.A. or M.S. in some other discipline while doing a Ph.D. in philosophy. If, in addition, the student can show that he or she has made a special study of the philosophy of that discipline in which the M.A. or M.S. was received, the student will graduate with a special recommendation indicating proficiency in the philosophy of that discipline.

Ph.D. Candidacy

To be promoted to Ph.D. candidacy, a student must, in addition to the above requirements, fulfill the following conditions:

A. Pass an exam in the main figures, areas, or developments in history of philosophy;

B. Submit a philosophical essay in a major philosophical style;

C. Submit a philosophical essay in an interface area;

D. To have fulfilled the symbolic logic requirement, which is to have reached a degree of proficiency equivalent to having taken one semester of symbolic logic;

E. To have fulfilled the foreign language requirement, which is to have passed the appropriate ETS language exam before the end of the student's first year and to have used that language for a piece of philosophical research in the succeeding year;

F. To have passed the candidacy Preliminary Exam (see below) ;

G. To have been recommended by the graduate faculty to begin work on a dissertation.

The Preliminary Exam will ordinarily be oral. The material for the exam will be drawn up by the student with the help of the faculty advisor, and is subject to the approval of the director of graduate studies

and the Graduate Committee of the department. This will be contained in an extended outline of about 4000 words of the area of the student's special competency (usually, the domain in which he or she intends to write the dissertation) and an attached bibliography.

Principal Structures on the Doctoral Level

There will be Ongoing Style Seminars, each exploiting a major contemporary method of philosophical reasoning. These styles comprise principally semiotic (or analytic) philosophy, phenomenology or existentialism, and systematic philosophy. These seminars will meet once every four semesters or more often. Participants will be both members of the faculty and students.

The Ongoing Style Seminars will discuss (1) contemporary philosophical problems, both narrowly professional and those involving interdisciplinary issues, the topics to be determined by the chairman of the seminar together with the members of the seminar; (2) the methodology, style, and rational values of their own way of philosophical reasoning. The faculty will participate either by engaging in philosophical discourse according to the style appropriate to the seminar, or by raising critical metaphilosophical questions. The aim of the Ongoing Style Seminars is to display the way a philosophical style or sensibility works.

There will also be an unspecified number of Ongoing Interface (Interdisciplinary) Seminars where other disciplines are brought into communication with philosophy. These seminars will be chaired by cross-disciplinary appointments or visiting professors or members of the department versed in some discipline other than philosophy. Participants will be both members of the faculty and of the student body.

The Ongoing Seminars will aid in the continuing education of the junior faculty. They will, moreover, be resource seminars for undergraduate teachers who more and more are being asked to say what philosophy is today and to express critical views on current problems often involving an interdisciplinary interface.

Courses and Seminars (Open to Doctoral Students)

I. Area Courses: The following courses are designed to provide advanced work in the traditional areas of philosophical concern. These courses are deliberately broad in coverage and emphasize the development of research tools and resources in each area covered.

PHI 500 History of Philosophy and Philosophical Texts
Study of a major pre-contemporary figure or period including detailed studies of primary texts and the history of interpretation involved.
3 credits

PHI 501 Philosophy of Science and Logic
Advanced study of some major area in the philosophy of the natural or social science or in logic or the philosophy of logic; e.g., space, time, causality, explanation, deduction, induction, probability,

models, modal logic, intuitionism, logicism, etc.

3 credits

PHI 502 Metaphysics and Systematic Philosophy

The examination of a major metaphysical thinker or school with emphasis upon the development, coherence, and speculative extension of philosophical systems.

3 credits

PHI 503 Epistemology, Philosophy of Mind, Perception and Experience

The study of problems of knowledge and experience, including truth, certainty, subjectivity and objectivity, givenness, and the justification of epistemic claims.

3 credits

PHI 504 Philosophy of Value, Culture, and Society

The study of ethical and social philosophy including political philosophy. Problems of ethical theory, the social structures of thought, political and legal systems.

3 credits

PHI 505 Aesthetics and Rhetoric

Examination of theories of art and the beautiful, including theories of literature and rhetorical discourse. Questions of form, aesthetic experience, style, and reason are discussed.

3 credits

PHI 506 Oriental Philosophy

An examination of the major types of Oriental philosophy including Hindu, Buddhist, Taoist forms of thought. The emphasis is upon the interpretations of experience and their philosophical implications.

3 credits

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II. Proseminars: Advanced introductions to contemporary philosophical styles. Proseminars assume a general background in philosophy and serve to acquaint the beginning graduate student with the methods, presuppositions, and operational style of the philosophies involved. Proseminars balance readings of important texts with projects, papers, and discussions designed to prepare the student for the advanced Ongoing Style Seminars.

PHI 590 Analytic Philosophies

3 credits

PHI 591 Phenomenological-Existential Philosophies

3 credits

PHI 592 Contemporary Systematic Philosophies

3 credits

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III. Ongoing Style Seminars: Ongoing Style Seminars are highly advanced courses in one or another of the main contemporary philosophical styles. These seminars have as prerequisites some advance preparation on the part of the students involved. The seminar, chaired by an accomplished philosopher of the style involved, is to be an ongoing display of the philosophical method in question through the discussion of a problem of the seminar's choice.

PHI 600 Ongoing Style Seminar: Analysis

A leading problem will be discussed and argued by the seminar participants in accordance with methods appropriate to one or another of the semiotic (analytic) styles of philosophical reasoning.
Prerequisite: PHI 590 or permission of seminar chairman.

3 credits

PHI 601 Ongoing Style Seminar: Phenomenology and Existentialism

Same as above according to methods appropriate to phenomenological or existential philosophies.
Prerequisite: PHI 591 or permission of seminar chairman.

3 credits

PHI 602 Ongoing Style Seminar: Systematic Philosophies

Same as above with emphasis upon systematic philosophy.
Prerequisite: PHI 592 or permission of seminar chairman.

3 credits

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IV. Ongoing Interdisciplinary Seminars: Although only two interface listings are noted below, the content of interdisciplinary seminars will vary from term to term. Interface seminars are to be chaired by staff members acquainted with fields of study, particularly the sciences, outside philosophy. Interface Seminars will draw upon visiting and interdepartmental participants as well.

PHI 610 Ongoing Interface Seminar

3 credits, repetitive

PHI 611 Ongoing Interface Seminar

3 credits, repetitive

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V. Independent and Directed Studies: The following listings include a variety of independent study routes, all of which must be submitted and passed by the Graduate Committee and the professor (s) involved. The flexibility and variety of choices open to the special interests of students and staff are to be matched through a program of advisement. Staff vitae with appended summaries of current interests will be available for graduate students and, in counter fashion, the graduate student may present proposals to the committee for projects he or she may wish to develop in conjunction with staff supervision.

PHI 620 Advanced Problems in Philosophy

Investigations into specialty areas led and directed by accomplished philosophers in the discipline involved.

Variable and repetitive credit

PHI 621 Independent Study

Projects proposed by students in the areas of their interest. Must be accepted by professor in the area of interest for supervision and approved by the director of graduate studies, and the departmental committee on graduate studies.

Variable and repetitive credit

PHI 622 Supervised Teaching

Advanced graduate students who have already completed at least one term of

lower level participation in course work may elect to participate in a supervised term of instruction under a staff member's supervision. Observation, advice, criticism, and discussion of teaching problems would be required for completion of the project.

3 credits, repetitive

PHI 690 Dissertation

Directed studies in the area of approved dissertation research. Requires approval of dissertation advisor, director of graduate studies, and completion of preliminary requirements.

Variable and repetitive credit, maximum six hours

Psychology
Sociology

The Behavioral Sciences

Department of Psychology

Professors:

BRAMEL, DAVISON, GAZZANIGA, [a]GEER *(Chairman)*, GOLDFRIED, H. KALISH, KRASNER, M. LEVINE, LIEBERT, MENZEL, MERLIS *(Visiting Clinical)*, D. O'LEARY, F. PALMER, RACHLIN, ROSS, [d]RUBINSTEIN, J. SINGER, STAMM, [d]TURSKY, WYERS

Associate Professors:

CROSS, D'ZURILLA, D. EMMERICH, JOHNSON, KAYE, F. LEVINE, MORRISON, NEALE, POMERANZ, SCHVANEVELDT, [a]VALINS

Assistant Professors:

CALHOUN, CATULLO, DOLL, FRIEND, H. JONES-EMMERICH, KENT *(Visiting)*, MACDONALD, S. O'LEARY, POLITE, S. ROSEN, S. SPRINGER, S. STERNGLANZ, TWEEDY, WEINTRAUB, WHITEHURST

Clinical Associate:

MCCONNELL

[a] On leave academic year 1974–75
[d] Joint appointment

Admission to Graduate Study

A. A baccalaureate degree in psychology.

B. An average of 3.0 in all undergraduate course work.

C. Letters of recommendation from three instructors or academic advisers.

D. Results from the Graduate Record Examination.

E. Acceptance by the Department of Psychology and the Graduate School.

Students who do not meet these requirements may also apply if they feel that special circumstances should be considered.

Requirements for the Ph.D. Degree

The award of the Ph.D. degree in psychology is intended to signify both a scholarly mastery of the field of psychology and the ability to conduct independent research.

A. Residence: Minimum residence required is two years, including at least two consecutive semesters of full-time study. Full-time study is defined as 12 graduate credits per semester, which may include credits for supervised teaching and research.

B. Preliminary Examination: The Preliminary Examination ordinarily must be completed by the end of the fourth semester of graduate study and consists of two parts: (1) the General and (2) the Specialty Examination. The General Examination is a combination of written examinations and a review paper. The Specialty Examination is constructed individually for each student depending upon the area of specialization.

C. First year evaluation: The progress of each first year graduate student is reviewed at the end of the academic year by the entire faculty. The purpose of this review is to allow the student to withdraw without an unusually heavy investment of time when, in the opinion of the department, the student would not pass the Preliminary Examination at the Ph.D. level or produce a suitable dissertation. Any student whose performance is below the standard of the Ph.D. established by the Department of Psychology may be asked to withdraw. Under certain circumstances a student may be permitted to obtain a terminal Master of Arts degree after passing the Preliminary Examination at the M.A. level, satisfactorily completing the quantitative methods course

and the learning course, and completing 30 graduate semester hours of study culminating in an M.A. thesis.

D. Advancement to candidacy: Upon successful completion of the Preliminary Examination and the review paper the student is recommended for advancement to candidacy for the Ph.D.

Graduate Programs in Psychology

The graduate programs in psychology attempt to provide the student with training in general psychology and in the areas of specialization by emphasizing the laboratory apprenticeship and the seminar-tutorial method. Students are encouraged to become involved in ongoing research immediately upon entering graduate school and to engage in independent research when sufficient skills and knowledge are acquired. The department limits the general requirement in course work to two basic areas, quantitative methods and learning, and provides seminars and laboratory experience in the student's area of specialization as soon as possible. The areas of study are described below:

Clinical Psychology

The clinical training program is organized to prepare the student to function both as a behavioral scientist and as a practicing professional psychologist by providing the necessary theoretical background and specific techniques. The program stresses the application of learning, cognitive and social processes to deviant behavior, and emphasizes the utilization of behavior modification in therapy and practicum.

Psychobiology (Comparative-Physiological Psychology)

The program is oriented towards research in areas of comparative animal behavior and the anatomical, physiological, and chemical basis of human and animal behavior. An interdisciplinary program in psychobiology is offered jointly with the Biological Sciences Department and focuses on behavioral psychology, ethology, and animal social behavior, with emphasis on both field and laboratory methods.

Developmental Psychology

The program in developmental psychology will provide students with research training in cognitive development, personality formation, behavioral analysis, infant growth, and maturation and comparative development. The role of clinical, experimental, and social psychological theories and factors in human development will provide the major focus of the area.

Experimental Psychology

The experimental psychology program trains students in a broad range of experimental areas from operant techniques and classical conditioning to psychophysics and measurement theory. The program emphasizes human learning with specific research training in such topics as mathematical models of learning, information processing, discrimination and concept learning, and memory.

Social Psychology

The social psychology program is centered about training, both in laboratory studies in complex human function and in survey research and field studies. Topics covered in the program include social conflict, aggression and catharsis, attitude formation and change, attribution theory, emotion, and stress.

Courses

PSY 501 Quantitative Methods I

Inferential statistics and advanced statistical techniques which have special usefulness in psychological research, including complex analysis of variance, trend analysis, and analysis by orthogonal polynomials.

Fall or spring, 3 credits

PSY 502 Quantitative Methods II

This course presumes a knowledge of basic statistical methods. Emphasis will be on scaling, measurement, psychophysics, correlation, and curve fitting.

Fall or spring, 3 credits

PSY 507 Distribution-Free Statistics

Statistical inference when the exact form of population distributions is not specified, or when interval scale measures are not available. These techniques will be compared with "classical" methods.

Spring, 3 credits

PSY 510 History of Psychology

Intensive reading in the history of psychology from original sources. Emphasis will be on class discussion and relation to modern problems.

Spring, 3 credits

PSY 511 Learning

A consideration of the basic principles of learning. Analysis of the leading theories of learning as well as areas of controversy and dispute.

Fall, 3 credits

PSY 512 Learning

An introduction to research and theory related to human learning and information processing. A review of major historical contributions as well as a critical review of contemporary developments.

Spring, 3 credits

PSY 514 Sensation and Perception

An introduction to the phenomena of sensation and perception and the methods by which they may be studied. Different theoretical frameworks will also be considered.

Fall, 3 credits

PSY 515, 516 Research Practicum in Experimental Phychology

A review of the basic literature of experimental psychology. Emphasis will be placed on a research project which each student will formulate and complete within the year.

Fall and spring, 3 credits each semester

PSY 518 Clinical Research

Application of scientific methodology to special problems in clinical research (e.g., quasi-experimental design).

3 credits

PSY 520 Proseminar in Developmental Psychology I

A review of the literature in early sensory, conditioning, and perceptual attributes; children's learning; complex attentional and learning development including research and theories on mediation.

Fall, 3 credits

PSY 521 Proseminar in Developmental Psychology II

An examination of the basic literature in children's cognition; socialization; abnormal and retarded development.
Prerequisite: PSY 520

Spring, 3 credits

PSY 522 Children's Learning

The literature relating to learning processes in children will be covered. Respondent, operant, and observation learning will be major topics. The experimental analysis of behavior will be stressed.
Prerequisite: Permission of instructor.

Fall, 3 credits

PSY 523 Complex Learning Processes

Examples of the research in S-R and approaches to complex human behavior. The materials cover several concepts of mediation transfer of training, and the S-R structure of memory.
Prerequisites: PSY 522 and permission of instructor.

Spring, 3 credits

PSY 524 Cognitive Development

The information in this course will integrate and expand some of the research and new methods available in the study of complex human processes; such as, language, memory, and growth of logical thinking.
Prerequisites: PSY 521 and two other developmental courses.

Fall, 3 credits

PSY 533 Behavior Modification: Theory, Research, and Practicum

A critical overview of theory and research in behavior modification, with associated practicum. Special attention given to problems in translating general principles of behavior change into viable clinical procedures.

Fall, 4 credits

PSY 534 Behavior Assessment: Theory, Research, and Practicum

Techniques of psychological measurement and assessment as they relate both to theoretical formulations and to specific clinical problems; supervised experience in the use of various assessment procedures.

Spring, 4 credits

PSY 537 Behavior Problems in Children

Intensive study of the nature, development, assessment, and treatment of behavior problems found in children. Coordinated with PSY 601 Clinical Practicum.

Fall, 3 credits

PSY 538 Behavior Problems of Adolescents and Adults I

Intensive study of behavior disorders typically encountered with non-institutionalized clients, covering description, theory, research, assessment, and treatment. Coordinated with PSY 601 Clinical Practicum.

Spring, 3 credits

PSY 539 Behavior Problems of Adolescents and Adults II

Intensive study of behavior disorders typically encountered with institutionalized populations with coverage similar to that of PSY 538/601. Coordinated with PSY 603 Internship: Adult.

Fall, 3 credits

PSY 550, 551 Topics in Social Psychology

Content varies from year to year as function of staff and student interests. Recent topics include environmental psychology, group dynamics, history of social psychology, society and health, aggression, politics of social psychology, research methods, attitude change, and social inequality.

Fall and spring, variable and repetitive credit each semester

PSY 560 Neuropsychology

The functions of the normal and pathological primate brain in behavior. Consideration of anatomical, electrophysiological (EEG), and pharmacological correlates of behavioral functions such as: perception, attention, motivation, learning, memory, cognition, and language. The behavioral consequences of various forms of brain pathology will be discussed.

Spring, 3 credits

PSY 561, 562 Physiological Methods

Basic bioelectric principles and techniques, stereotaxic techniques, lesioning methods, pharmacological methods, and histological techniques will be presented and practiced. Basic methods for bioelectric stimulation and recording will be emphasized. This course will be taught in conjunction with PSY 563, 564.

Fall and spring, 3 credits each semester

PSY 563, 564 Physiological Methods Lab

Experience in practical application of techniques for manipulating the physiological substrate in relation to behavior in an experimental setting. Emphasis will be placed on individual projects, library research, and seminar reports.

Fall and spring, 3 credits each semester

PSY 571, 572 Comparative Behavior

Comparative methods for the observation and measurement of animal behavior. Both naturalistic and laboratory methods will be discussed. This course will be taught in conjunction with PSY 573, 574.

Fall and spring, 3 credits each semester

PSY 573, 574 Comparative Behavior Lab

The use of detection response techniques, conditioning techniques, and habituation methods in the study of adaptive behavior will be practiced using a wide variety of vertebrate and invertebrate species.

Fall and spring, 3 credits each semester

PSY 575 Psychobiology of Primates

An advanced general course in the behavior of Old World monkeys and apes. Emphasis will be placed on social organization, communication, development, and learning, especially under naturalistic conditions; but beyond this, topics are selected to reflect the most important current advances in the area. Prerequisite: Permission of instructor.

Fall or spring, 3 credits

PSY 581, 582 Comparative Physiological Colloquium

Colloquium presentations on current research problems by advanced students, staff, and visiting scientists. Lecture and seminar each week.

Fall and spring, 3 credits each semester

PSY 583, 584 Experimental Psychology Colloquium

Seminars on current research problems directed by students, staff, and invited scientists.

Fall and spring, 3 credits each semester

PSY 590 Theories of Child Development

This course is oriented toward analyzing three classes of developmental theory (analytic, cognitive, and behavioral approaches), and relating the basic structure of each class of theory to current notions of philosophy and science.

Spring, 3 credits

PSY 599 Instructional Methods for Child Development

The purposes of this course are (1) to introduce the student to literature on college teaching, (2) to aid the student in formulating instructional objectives, (3) to consider instructional methodolo-

gies, and (4) to provide the student with systematic feedback on his teaching performance.

Fall and spring, 3 credits

PSY 600 Teaching Methods and Practicum

Variable and repetitive credit

PSY 601 Clinical Practicum

This practicum provides supervised experience in the use of appropriate techniques for dealing with the disorders examined in the corequisite courses PSY 537 and PSY 538. Clinical students only.

Fall and spring, 1 credit

PSY 602 Internship: Child

Advanced students in the clinical program carry supervised responsibility for child and adolescent cases in the Child Unit of the Psychological Center.

Variable and repetitive credit

PSY 603 Internship: Adult

Advanced students in the clinical program carry supervised responsibility for adult cases in the Student and Adult Units of the Psychological Center.

Variable and repetitive credit

PSY 604 Internship: Community and Institutions

Advanced students in the clinical program carry supervised clinical responsibilities in off-campus community agencies and institutions.

Variable and repetitive credit

PSY 605 Orientation to Clinical Psychology

Ethics, professional issues, and ongoing faculty research. Required of all first-year clinical students.

Fall and spring, 1 credit

PSY 606 Clinical Case Conference and Colloquium

Regularly scheduled conferences and colloquia to discuss ongoing work with Psychological Center cases. Required of clinical students.

Fall and spring, 1 credit

PSY 610, 620 Seminars in Selected Topics

Topics will be selected on the basis of the needs of the graduate program and the research interests of the staff. The seminars will consider such topics as: the physiological bases of higher mental processes, sensory processes, animal behavior, psychopharmacology, theories and problems of learning, and social psychology, and computer applications in psychology.

Variable and repetitive credit each semester

PSY 696 Readings

Variable and repetitive credit

PSY 697 Experiments in Psychology

Variable and repetitive credit

PSY 698 Research

Variable and repetitive credit

PSY 699 Doctoral Research

Variable and repetitive credit

Department of Sociology

Professors:

COLE, L. COSER, R. COSER *(Joint)*, DOGAN *(Adjunct)*, GAGNON, GOODMAN *(Chairman)*, KELMAN *(Adjunct)*, G. LANG *(Joint)*, K. LANG, PERROW, SCHILD *(Adjunct)*, SELVIN, SINGER *(Joint)*, SUTTLES, [a]E. WEINSTEIN

Associate Professors:

COLLVER, [a]FELDMAN, E. GOODE, POLSKY, RULE, WEITMAN

Assistant Professors:

DILL, HARRISON, ROSENBERG, M. SCHWARTZ, TANUR

Instructors:

GRØNBJERG, LOGAN, WEDOW

M.A. Degree Program for Social Studies Teachers

This program is designed to provide a graduate-level introduction to sociological analysis for a select group of 20 to 25 teachers of social studies in secondary schools and community colleges. The program is meant to help teachers develop the analytical perspectives of academic sociology and its methodological approaches in order to enrich their teaching in all social sciences as well as to prepare them to teach sociology in high school. The curriculum is related to the ongoing experiences of the students and consideration is given to the problems of teaching high school sociology and of incorporating sociological perspectives into other courses. The program is thus a logical extension of the department's current offerings in the Continuing Education Department and draws in part on those courses.

Requirements for admission to this program will normally include:

A. A baccalaureate degree or its equivalent.

B. Six hours of undergraduate sociology.

C. A B (3.0) average or above is *desirable*.

D. One year of teaching experience at the juninor high school level or above.

E. Students must be planning to teach (at least partly in social studies) while enrolled in the first two semesters of the program or be willing to be placed (without remuneration) for a few hours a week in a secondary school. This requirement is de-

[a] On leave academic year 1974–75

signed to make it possible for students to explore ideas and methods in a regular teaching situation.

F. Graduate Record Examinations are strongly recommended.

G. Personal interview.

Minimum residence is two semesters of full-time study. The degree will be awarded upon successful completion of 30 graduate credits in sociology, approved by the director of the masters program for teachers. The courses would normally include the following:

Fall Semester: SOC 514, SOC 546, and SOC 694.

Spring Semester: SOC 523, SOC 695, and a graduate course in sociology selected by the student in consultation with the director of the program.

Summer Session: SOC 598 (a six credit seminar on sociological analysis involving participation in a collective research project on a topic chosen during the spring and an individual research paper as part of this project).

Variations in the program may be arranged with the permission of the director.

Admission to the Doctoral Program in Sociology

Requirements for admission will normally include:

A. An average of 3.0 in undergraduate course work.

B. Five courses in sociology.

C. A one-semester course in statistics.

D. Proficiency in a foreign language (preferably French or German) equivalent to two years of college work.

E. Results from the Graduate Record Examination.

F. Acceptance by the Department of Sociology and by the Graduate School.

In special cases, some of the above requirements may be waived, to be made up as soon as possible.

Applicants with a masters degree from an accredited university seeking admission to the Ph.D. program at Stony Brook must submit evidence (including GRE scores and a masters thesis or its equivalent) that their preparation is similar to the work described under requirement E below. Deficiencies must be made up before students receive permission to take the Preliminary Examination for the Ph.D. degree.

Requirements for the Ph.D. Degree

A. *Residence:* Minimum residence is generally two years of full-time study including at least two consecutive semesters. In certain cases, however, one year of full-time study is sufficient. Full-time study entails 12 or more graduate credit hours per semester. Since a graduate traineeship is considered part of the academic program, credit hours will be given for supervised teaching. Credit hours may also be given for individual research work outside formal courses but under the supervision of a faculty member.

B. *Courses:* Students must successfully complete an approved program of study including two courses in sociological theory (SOC 505 and 506) and three courses in methods of research (SOC 501, 502, and a third course of the student's choice in either quantitative or qualitative methods).

C. *Track I:* Students may choose either "Track I" or "Track II," but most are advised, and most do, choose the former. This consists of a written Comprehensive Examination to evaluate the student's general preparation. This examination, to be taken between the beginning of the fifth and the beginning of the sixth semester of graduate study, must be passed at the standard set by the department for Ph.D. level work. Only under special circumstances will a student who fails to pass this examination at the required level but whose performance is satisfactory in all other respects be permitted to take a *terminal* M.A. by completing 30 credits of graduate course work and submitting an acceptable research report.

D. *Track II:* Instead of taking the comprehensive examination, the student may choose Track II, which involves completing a paper judged to be of publishable quality. The paper may be either empirical or theoretical. Students opting for this track must submit a memorandum to this effect, together with a favorable statement from a faculty sponsor, by the end of the third semester in residence. The paper is normally to be presented during the fourth semester in residence. It will be judged by a three-person evaluation committee, consisting of two members of the department and an off-campus expert. If judged publishable it will substitute for the research report, providing either it or the student's dissertation is empirical; if the paper is not judged publishable, it still may be evaluated as satisfying the requirement for a research report.

E. *Research report:* Every student must submit a research report that demonstrates ability to analyze empirical data and to present findings clearly and systematically. Upon successful completion of all the above requirements along with completion of a

minimum of 30 hours of graduate credit, the department will recommend to the Dean of the Graduate School that the student be awarded the M.A. degree as a sign of progress toward the Ph.D. Recipients of the terminal M.A. will not be granted permission to continue.

F. *Teaching requirement:* Graduate training includes supervised teaching experience. After completing either C or D above, students are required to teach one undergraduate course in their specialty area (those in Track II are strongly advised to teach a section of the introductory course), and to repeat that course if their teaching is satisfactory.

G. *Requirements outside of the department:* The student must choose *one* of three possible options: (1) to demonstrate proficiency in a modern foreign language by passing a suitable examination, or (2) to demonstrate proficiency in mathematics by passing a suitable examination, or (3) to pass with at least a "B" average a program of three graduate courses in other departments determined in consultation with the student's advisor and approved by the Graduate Committee.

H. *Preliminary examination:* This takes the form of an oral examination in the student's specialty to be given only after all the above requirements have been met. It is designed to appraise the student's depth of knowledge in the broad area from within which he or she has selected a dissertation topic and will include a consideration of the dissertation proposal. The content of this area is to be defined individually for each student. It consists of a generally recognized, broad subfield and must deal with related materials from other subfields.

I. *Advancement to candidacy:* The department's recommendation that a student be advanced to candidacy for the Ph.D. is based on passing the Preliminary Examination.

J. *Doctoral dissertation:* It must be an independent piece of research and scholarship representing an original contribution, the results of which are worthy of publication. Upon oral defense and acceptance of the dissertation, the department will recommend to the Dean of the Graduate School that the student be awarded the Ph.D. degree.

The progress of every student will be evaluated by the department at the end of the first full year of graduate study. Those whose performance and ability are clearly below the standard for Ph.D. established by the department will be asked to withdraw before they have made a costly investment of time. If more than four years should elapse between a student's *advancement to candidacy* and the submission of the finished dissertation, the student's Ph.D. candidacy may lapse and he or she can be required to take a second set of examinations.

After the first year, a progressively larger proportion of a student's time will be spent as a participant in research activities, under the supervision of faculty members. Ordinarily, a student with adequate preparation and involved in full-time study should be able to earn a Ph.D. within four years from the time he or she begins graduate work.

Students who arrived with an M.A. degree in sociology or with three semesters of work in the discipline will be expected to complete some of the requirements above more quickly than indicated.

Courses

During the spring of 1974 the following information will be made available about each course for the academic year 1974–75: (a) the semester in which the course is to be given; and (b) the professor who will teach it.

SOC 501 Research Design

Decisions in the design of research, including choice of population, techniques of sampling, and methods of gathering and processing data.

3 credits

SOC 502 Quantitative Analysis of Social Data

Statistical methods most frequently used by sociologists. Rationale and analytic usage of statistical tools from simple descriptive statistics and inference to introductory multivariate techniques.
Prerequisite: One course in undergraduate statistics or permission of instructor.

3 credits

SOC 503 Multivariate Analysis of Social Data

The general linear model and multivariate analysis, including dummy variable analysis, multiple covariance, multivariate analysis of variance, and factor analysis.
Prerequiste: SOC 502 or permission of instructor.

3 credits

SOC 505 Foundations of Sociological Theory

In-depth analysis and discussion of the key works of classical sociological theorists. Burkheim, Marx, Weber, Simmel, Mannheim and Parsons are the central figures to be examined, although there will be reference to other representatives of the classical tradition.

3 credits

SOC 506 Contemporary Issues in Sociological Theory

Analysis of contemporary theories and the issues surrounding them. Includes discussion of such areas as structural-functional analysis, "general systems" theory, conflict theories, exchange theories, and ethnomethodology.
Prerequisite: SOC 505 or permission of instructor.

3 credits

SOC 508 Experimental Methods

The design, conduct, analysis of laboratory and field experiments.

3 credits

SOC 509 Field Work

Practicum in field interviews and observations; problems of rapport, reliability, and validity.

3 credits

SOC 511 Population Analysis

A survey of demographic theory and research. Determinants and consequences of population size, growth rates, composition and spatial distribution, family formation, fertility, mortality, and migration.
Prerequisite: One course in statistics.

3 credits

SOC 513 The Metropolitan Community

Determinants and consequences of the growth of urban settlements. Their demographic composition and spatial structure. Problems in metropolitan community organization.

3 credits

SOC 514 Sociological Methods

An introduction to the logic of research and data analysis. Emphasis on concepts of association, elementary causal analysis, sampling, and problems of measurement. Applications to the interpretation of data encountered in the school curriculum and the mass media.

4 credits

SOC 521 Social Interaction

The study of interaction in formal and informal settings. The reciprocal influence among group structure, norms, and interactive processes. A prior course in social psychology is assumed.

3 credits

SOC 522 Socialization and the Self

Socialization as a continuous process throughout the life-cycle. Social and cultural sources of identity. Self-other systems as a form of social control. A prior course in social psychology is assumed.

3 credits

SOC 523 Sociology of Education

Relationship between education and other institutions. Internal dynamics of the school and the classroom. Students attend the lectures of CES 585 and a supplementary seminar.

4 credits

SOC 531 Stratification

Causes and consequences of the unequal distribution of wealth, power, prestige, and other social values in different societies. Changes in the stratification system as a result of industrialization and revolution.

3 credits

SOC 532 Complex Organizations

Division of labor, communication, and decision-making in large and formally administered organizations, such as industrial concerns, governmental agencies, political parties, trade unions, schools, hospitals, and prisons.

3 credits

SOC 541 Conflict and Violence

Conflict and violence as related to social change. Examination of community controversies, social movements, uprisings, and war.

3 credits

SOC 542 Deviance

Survey of recent research literature on various kinds of deviance (crime, delinquency, and morally stigmatized behavior). Controversial issues in theory and research methods.

3 credits

SOC 545 Social Movements and Collective Behavior

Unorganized collectivities and their role in change. Studies of specific social movements and other collective behavior episodes.

3 credits

SOC 546 Sociological Perspectives on American Society

Analysis of American social structure. Political and economic institutions and their bearing on social problems. Students attend the lectures of CES 581 and a supplementary seminar.

4 credits

SOC 549 Social Change

The impact of technological, generational, and cultural forces on social organization from a historical and comparative perspective.

3 credits

SOC 556 Political Sociology

The study of political institutions and of the politically relevant actions and attitudes of individuals and groups. Particular stress will be placed on the reciprocal relationships between social movements and political institutions.

3 credits

SOC 561 Sociology of Intellectual Life

A comparative and historical analysis of the social conditions leading to the development of intellectual professionals.

3 credits

SOC 562 Sociology of the Arts

The relations between social structure, social change, and the development of major art forms.

3 credits

SOC 563 Sociology of Science

The relations between science and society; social influences on the choice of problems and methods; the social organization of scientific research.

3 credits

SOC 564 Communications

The social organization of the communications industry; the effects of mass communication.

3 credits

SOC 571 Sociology of Health and Medicine

Social factors in health and illness; the socialization of health practitioners; the social organization of hospitals, clinics, and other facilities.

3 credits

SOC 590 Independent Study

Intensive reading, under supervision of one or more instructors, of material not covered in the formal curriculum.

Credit to be arranged

SOC 591, 595 Special Seminars

Topics to be arranged. The seminar will be built around actual research activities of students and faculty.

3 credits each semester

SOC 598 Research

Execution of a research project under the supervision of one or more faculty members.

Credit to be arranged

SOC 603 Advanced Topics in Quantitative Analysis

Mathematical and statistical methods in the analysis of quantitative data.
Prerequisites: SOC 501 and SOC 502.

3 credits

SOC 604 Advanced Topics in Qualitative Analysis

The use of personal documents, official records, field observations, and interviews.

3 credits

SOC 606 Sociological Theory Construction

Modes of conceptualization and theory construction. Problems in developing a theory.
Prerequisites: SOC 361 and SOC 362 or permission of instructor.

3 credits

SOC 691 Practicum in the Teaching of Sociology

Lectures, discussions, and case studies of effective teaching. Designed especially for graduate teaching assistants.

3 credits

SOC 694, 695 Practicum in the Teaching of Social Studies

The first semester consists of a number of day-long sessions (during weekends or school holidays), each of which introduces a particular teaching technique or new materials for the social studies curriculum. Students are expected to make

use of the ideas and techniques when teaching their regular classes and to write papers describing the development, teaching, and evaluation of such projects. Similar sessions occur during the first half of the second (spring) semester. During the second half of the spring semester, students develop, teach, and evaluate a unit several weeks in length on a topic of their choice.

4 credits each semester

SOC 698 Research for Ph.D.

Credit to be arranged

Biochemistry
Cellular and Comparative Biology
Ecology and Evolution

The Biological Sciences

Division of Biological Sciences

Provost: R. F. Jones

The Division of Biological Sciences consists of three academic departments: Biochemistry, Cellular and Comparative Biology, and Ecology and Evolution. The faculty of these departments, together with those from the Marine Sciences Research Center and the Departments of the School of Basic Health Sciences, interact to offer a wide variety of graduate programs at the masters and the doctoral level. Other participating faculty include representatives from the Departments of Chemistry, Earth and Space Sciences, and Psychology. By this interaction provision is made to meet the needs of students with diverse professional interests in the various fields of the biological sciences.

Graduate studies in the biological sciences are centered around a number of programs, each under the direction of a program chairman and an executive committee. Within the Division of Biological Sciences these programs are in Cellular and Developmental Biology, Ecology and Evolution, Marine Biology, Molecular Biology, and Psychobiology. With the exception of the Molecular Biology program, which accepts only students seeking the Ph.D. degree, the programs accept students for the M.A. and Ph.D. degrees. A special M.A. program in Biology for High School Teachers is also offered.

Several other doctoral training opportunities are offered in cooperation with the School of Basic Health Sciences. These include programs in Anatomical Sciences, Microbiology, Pathology and Physiology and Biophysics. Descriptions of these particular programs, their faculties, and their respective course offerings are presented in the Health Sciences section of this *Bulletin.*

A special masters program—an M.S. program in Marine Environmental Sciences, is offered in association with the Marine Sciences Research Center.

Department of Biochemistry

Professors: CIRILLO, SHAW *(Adjunct),* M. SIMPSON *(Chairman)*

Associate Professors: DUDOCK, FREUNDLICH, GESTELAND *(Adjunct),* INOUYE, MOOS, RILEY, STUDIER *(Adjunct)*

Assistant Professors: ARNHEIM, SARMA, SCHMIDT, S. SIMON, R. STERNGLANZ

Department of Cellular and Comparative Biology

Professors: E. CARLSON, ERK, GLASS *(Distinguished Professor)*

Associate Professors: BATTLEY, A. CARLSON, EDMUNDS, KRIKORIAN, LYMAN, [a]MERRIAM, [a]TUNIK, WALCOTT *(Chairman)*

Assistant Professors: [a]J. FOWLER, E. KATZ, KNOTT, D. SMITH

Department of Ecology and Evolution

Professors: ROHLF, SANDERS *(Adjunct),* [a]SLOBODKIN *(Chairman),* SOKAL

Associate Professors: J. FARRIS, HECHTEL, KOEHN, SMOLKER, TURNER

Assistant Professor: FUTUYMA

Lecturer: B. CARROLL, C. R. CARROLL

Faculty Holding Joint Appointments in Division of Biological Sciences

Professors: E. BAYLOR, E. MENZEL, G. WILLIAMS

Associate Professors: V. FARRIS, WURSTER

General Admission Requirements for Graduate Study in Biological Sciences

A. A baccalaureate degree with the following minimal preparation is required: mathematics through one year of calculus, chemistry including organic chemistry, general physics, and one year of biology including laboratory.

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[a] On leave academic year 1974–75

B. A minimum grade point average of 2.75 (B−) in all undergraduate course work, and 3.00 (B) in science and mathematics courses.

C. Letters from three previous instructors and results of the Graduate Record Examination.

D. Acceptance by the Division of Biological Sciences and Graduate School.

In special cases, students not meeting requirements A through C may be admitted on a provisional basis. These students must act immediately to fulfill deficiencies in basic courses before being enrolled as regular students. Credits earned in these courses do not count toward graduate degree requirements. Detailed information about admission to specific programs and their degree requirements may be obtained from the program chairman.

Brief Description of Graduate Programs

Cellular and Developmental Biology (BCD)

Program Chairman: Dr. H. Lyman

The Cellular and Developmental Biology Program is designed to produce investigators and teachers who can define, experimentally attack, and communicate fundamental problems associated with the development of biological systems. The staff members of the program are drawn from the faculties of the Division of the Biological Sciences and the Departments of Anatomical Sciences and Microbiology of the School of Basic Health Sciences, and are engaged in research upon developmental problems in microorganisms, lower and higher plants, insects, and vertebrates. Their interests cover problems from the molecular to the systemic levels of organization. The viewpoint of most of the staff is experimental and the program emphasizes a high level of competence in the genetic, cellular, biochemical, and molecular analyses of developing systems.

Ecology and Evolution (BEE)

Program Chairman: Dr. L. B. Slobodkin

The Ecology and Evolution Program includes staff members engaged in research in a broad spectrum of theoretical, laboratory, and field problems involving the major groups of organisms and geographical regions ranging from the Red Sea and the Caribbean to the Arctic. Staff interests represent a broad diversity of approaches to ecological and evolutionary problems. The intellectual quality of the staff is considered more important than specific viewpoint. The staff includes persons who are working in population dynamics from a behavioral, mathematical, and experimental approach as well as from the study of field populations. Taxonomic theory and methodology (especially numerical taxonomy) and

certain aspects of physiology, genetics, statistics, and systems analysis are also being studied in their relation to ecological and evolutionary problems. The program also includes staff whose primary activity lies in the area of conservation (both resource management and pollution problems) and who are actively involved in ecologically-based social action in the Long Island area and on a national and international scale.

Marine Biology (BMB)

Program Co-Chairman: J. Levinton (Earth and Space Sciences)

L. Slobodkin (Ecology and Evolution)

Interdisciplinary research including biological oceanography, physiology and behavior of marine organisms, paleoecology of marine communities, the relation between community metabolism and geological processes, e.g., coral reef formation, mariculture and pollution abatement, is conducted by faculty members from the Division of Biological Sciences, Earth and Space Sciences, and the Marine Sciences Research Center. Students interested in this area of research should contact either one of the co-chairmen for further information concerning programs of study.

Molecular Biology (BMO)

Program Chairman: Dr. C. Moos

The Molecular Biology Program is designed to prepare the student to formulate and attack biological problems at the molecular and cellular levels. The program accommodates a broad spectrum of interests, from traditionally biochemical areas such as the chemical basis of enzyme action, the physical biochemistry of macromolecules, the structure and function of proteins, or the biosynthesis of proteins and nucleic acids through the molecular and cellular bases of gene expression, metabolic control mechanisms, contractile systems, and ultrastructure. The faculty of this program comprises all members of the Department of Biochemistry plus faculty drawn from other departments in the Division of Biological Sciences, and from the School of Basic Health Sciences, and the Department of Chemistry.

Psychobiology (BPB)

Program Co-Chairmen: Dr. D. Smith (Division of Biological Sciences)
Dr. E. Menzel (Department of Psychology)

The Psychobiology Program is an interdisciplinary program offered by faculty members of the Division of Biological Sciences, the Department of Psychology, and Departments of the School of Basic Health Sciences. The purpose of the program is to provide a broad and flexible training tailored to the needs and interests of the individual student in the areas of neurobiology, physiological psychology, ethology, behavioral ecology, and animal behavior. This research can include both field and laboratory studies. Nearly 4000 acres of undeveloped land near the campus is available for field research.

In cooperation with the Division of Biological Sciences, newly organized doctoral programs are being offered by the Departments of the School of Basic Health Sciences and are described in detail in the Health Sciences section of this *Bulletin.*

These programs and their respective program chairman are:

Anatomical Sciences

Program Chairman: Dr. M. Fusco

Microbiology

Program Chairman: Dr. W. Bauer

Pathology

Program Chairman: Dr. A. Janoff

Physiology and Biophysics

Program Chairman: Dr. S. McLaughlin

Special Masters Programs

M.A. Program in Biology for High School Teachers (BHT)
Program Chairman: Dr. R. Knott

This program is concerned with the further education of secondary school teachers leading to the development and maintenance of high quality high school biology teaching. Besides studies on the development of curricula in the biological sciences, the emphasis will also be placed on modern developments in the areas of Marine and Environmental biology; Physiological and Biochemical aspects of cell growth and differentiation; the behavior and social patterns of animals; the way in which microorganisms, plants and animals reproduce, develop and function; and the methodology of biological research.

M.S. Program in Marine Environmental Studies (BMS)

Program Chairman: Dr. C. Wurster

The M.S. Program in Marine Environmental Studies seeks to prepare the student for a career in environmental management, where wise utilization of natural resources can contribute to the protection of environmental quality and the enhancement of human values.

Modern environmental management involves the synthesis of many disciplines into an effective multifaceted system. Complex relationships between biological, physical, chemical, geological, oceanographic and meteorological, as well as social, legal, political, and economic factors all must be evaluated before intelligent environmental decisions can be made. This interdisciplinary, problem-oriented curriculum attempts to meet that challenge.

General Requirements for the M.A. Degree

A. Residence: One year.

B. Formal course requirements: Successful completion of an approved course of study of at least 30 graduate semester credits.

C. Thesis: Independent laboratory, field, or theoretical research under the supervision of a staff member.

D. Comprehensive Examination: When the thesis is completed, a Comprehensive Examination will be given no later than two weeks before the end of the semester in which the final work in the masters program is done.

E. Oral defense of thesis: Upon acceptance of the thesis by a reading committee, an oral examination on the thesis will be given.

Requirements for the Ph.D. Degree

In order for a student to continue in a program of study toward the Ph.D. degree, the Executive Committee of each graduate program must have reached consensus that the overall first-year performance of the student has been satisfactory.

A. Formal course requirements: Successful completion of an approved course of study.

B. Language requirement: A reading knowledge of one foreign language chosen in consultation with the chairman of the particular graduate program. A graduate program may also require further linguistics or related training.

C. Preliminary Examination: After completing the major portion of course work, a student may apply for the Preliminary Examination. Normally the examination will be oral and/or written, and may be taken no later than the sixth semester after entrance.

D. Advancement to candidacy: The division's recommendation with respect to candidacy for the Ph.D. degree will be based upon the satisfactory completion of the above requirements.

E. Dissertation Examination: An examining committee will read the dissertation and give the candidate an oral examination on the dissertation research and related areas. The Dissertation Examination Committee will consist of at least four members of the faculty appointed by the Dean of the Graduate School.

F. Residence: Two years of full-time graduate study.

Requirements for Admission to the Program in Marine Environmental Studies

A. A baccalaureate degree (B.S. or B.A.).

B. Course work in at least three of the following four areas: (1) mathematics, including statistics; (2) physical sciences—physics, chemistry or earth sciences; (3) biological sciences; (4) social sciences—political science, sociology, economics or psychology.

C. A minimum grade point average of 2.75 (B−) in all undergraduate work, and 3.00 (B) in courses relevant to the program.

D. Official undergraduate transcripts, letters of reference from three previous instructors and/or employers in relevant professional fields, and the results of the Graduate Record Examination must accompany applications for admission. In special cases students not meeting all requirements may be admitted on a provisional basis. These students must fulfill deficiencies in basic courses before being enrolled as regular students. Credits earned in these courses do not count toward graduate degree requirements.

Requirements for M.S. Degree in Marine Environmental Studies

A. *Residence and language requirements:* None.

B. *Formal course work:* Successful completion with a B average of an approved course of study, totaling 30 graduate credits, of which not more than six credits may be MAR 580 Seminar and/or Mar 590 Research. Students may take the following courses or their equivalents:

1. MAR 501 Physical Aspects of the Marine Environment
2. MAR 502 Biological Aspects of the Marine Environment
3. MAR 503 Chemical Aspects of the Marine Environment
4. MAR 511 Marine Instrumentation
5. MAR 521 General Problems of the Marine Environment
6. MAR 580 Seminar (2 semesters required)
   and two of the following:
   MAR 522 Case Studies in Environmental Problems
   MAR 544 Environmental Law
   MAR 553 Fishery Management

C. *Research:* A scientific research paper on a topic, and of a standard, acceptable to the program Graduate Studies Committee is required.

Requirements for Admission to the M.A. in Biology for High School Teachers

Applicants must meet the general admission requirements for graduate study in the biological sciences, and include a letter of recommendation from their school principal.

Requirements for M.A. in Biology for High School Teachers

A. *Residence:* One year (24 semester credits).

B. *Course Requirements:*

1. Successful completion of an approved course of study of at least 30 graduate credits.

2. All candidates are required to take Research Techniques for High School Teachers. In this one-semester course a candidate, under direction, will experiment with teaching methods which will include demonstrating and analyzing biological processes in a high school laboratory. Emphasis will be placed on simple and innovative techniques for handling plants and animals, methods of quantitative observation and analysis, and procedures for the analysis of quantitative observations.

3. Thesis: A masters thesis must be prepared by the candidate and accepted by a reading committee of at least 2 members of the program staff. The reading committee will be selected by the program chairman after consultation with the candidate and his sponsor.
The thesis will normally be on the results of a laboratory or field project.

4. Comprehensive Examination: When the thesis is completed an examining committee composed of the dissertation reading committee will examine the candidate on the subject matter of the dissertation. This examination will be a comprehensive examination.

5. After satisfactory completion of the above requirements a recommendation will be made to the Dean of Graduate School for the award of the M.A. degree.

Teaching Responsibilities

As part of their graduate training, all students in the division are required to participate in the teaching activities of the division for a minimum of one year. Certain forms of financial support may require that a student teach more than one year. *High School teachers are exempt from this teaching requirement.*

Graduate Courses

Specific courses associated with a particular graduate program are identified by their program code. All graduate students, however, should consult with their program chairman in planning and executing an appropriate program of study.

Students should note that certain advanced undergraduate courses which appear in the *Undergraduate Bulletin* are particularly suitable for additional training in some areas of specialization.

BIO 600 Practicum in Teaching

Practice instruction in the teaching of biology at the undergraduate level, carried out under faculty orientation and supervision. A minimum of two semesters of registration for BIO 600 is required for all candidates for graduate degrees in biological science, unless explicitly waived by the Provost of Biological Sciences.

Fall and spring, 3 credits

Courses in Cellular and Developmental Biology

BCD 523 Topics in Animal Development

This course considers certain morphological, biochemical, and genetic aspects of animal development. Topics will include oogenesis, embryogenesis, and tissue and organ differentiation.

Fall, 3 credits

BCD 524 Cellular Aspects of Development

The process of development at the cellular level is studied as a regulated transcription of a genetic program. Gene modification and gene interaction relevant to differentiation are emphasized. The chromosome as an organelle of transcription, nuclear-cytoplasmic interactions, biogenesis of organelles, oogenesis, and special aspects of cell differentiation are among the topics discussed.

Spring, 4 credits

BCD 526 Principles of Development

The course will deal with developing systems at all levels from the morphological to the molecular. Illustrative material from both animal and plant kingdoms will be used. Emphasis will be placed on cellular aspects of these non-equilibrium systems with special attention to gametogenesis, genetic control of early development, translational control of protein synthesis, the role of cell division and cell movements, and cell-cell interactions in defining developing systems.

Spring, 3 credits

BCD 527 Photoperiodic Control of Plant and Animal Developments

This seminar will examine *seasonally* correlated developmental processes that are modulated and controlled by light, the physiological and biochemical pathways whereby the control is mediated, and the nature of the biological timing mechanisms involved. Topics will include: measurement of daylength and nightlength in photo-periodic responses; the phytochrome system; the Bünning hypothesis; internal and external coincidence models; true circannian rhythms; flowering; insect diapause, ecdysis, and polymorphism; annual reproductive cycles in birds and mammals; and the role of the neuroendocrine system, with the emphasis on the pineal gland and systems level control. Lecture, discussion, and oral and written reports.

Fall, 3 credits

BCD 528 Problems in Cell Differentiation

In this course the characteristics of cell differentiation are examined in considerable detail from the morphological to the molecular level for one cell type. Cellular lineage and interactions; increasing restrictions on potential cellular expression; hormonal influences; cell division and chromosomal duplication; gene transcription and message translation are considered.

Spring, 3 credits

BCD 530 Projects in Developmental Biology

Individual laboratory projects, closely supervised by staff members, to be carried out in staff research laboratories on a rotation basis.

Fall and spring, 2 credits

BCD 531, 532 Graduate Seminar in Developmental Biology

Seminars are given by graduate students on current literature in the field of developmental biology.

1 credit each semester

BCD 535 Physiology and Development of Higher Plants

A survey of selected topics in plant physiology with emphasis on developmental aspects. The areas from which specific problems will be selected include photomorphogenesis, hormonal control of plant growth, and plant tissue culture.

Fall, 2 credits

BCD 537 Physiology and Biochemistry of the Cell Cycle

An integrated view of the cell developmental cycle in prokaryotes and eukaryotes, its dynamics and control, and the events that comprise it. Topics considered will include: cell cycle anatomy; measurements on fixed and living single cells; cell population dynamics; theory and methodology of batch, synchronized, and continuous cultures; general patterns of nucleic acid synthesis; regulation of enzyme activity during the cell cycle; temporal control of gene expression; development and function of cellular organelles during the cell cycle; and the control of cell division. Lecture, discussion, and reports.

Fall, 3 credits

BCD 599 Research

Original investigation undertaken with the supervision of a member of the staff.

Fall and spring, credit to be arranged

BCD 621, 622 Developmental Biology Seminar

A weekly series of seminars by members of the staff, advanced graduate students, and visiting scientists on current research in developmental biology.

Fall and spring, 1 credit each semester

BCD 681-684 Advanced Seminars

Topics to be arranged.

Variable and repetitive credit

BCD 699 Research

Original investigations undertaken as part of Ph.D. program under supervision of research committee.
Prerequisite: Advancement to Candidacy.

Fall and spring, credit to be arranged

Courses in Molecular Biology

BMO 502 Physical Biochemistry

A review of the physical techniques and concepts involved in the study of biological molecules, particular macromolecules. Much of the course will be devoted to the three dimensional structure of proteins and nucleic acids.

Spring, 3 credits

BMO 503 Crystallography of Biological Macromolecules

Lectures and laboratory experience in the principles and techniques of structure determination of single crystals using X-ray diffraction. Particular emphasis will be placed on applications to biological macromolecules. Other topics such as fiber diffraction, small angle X-ray scattering and neutron diffraction will be discussed.
Prerequisite: BMO 502.

Fall, 2 credits

BMO 505 Microbial Regulatory Mechanisms

A series of lectures and discussions devoted to current concepts of microbial regulatory mechanisms. Some of the topics to be discussed are feedback inhibition; allosterism; the operon theory and repression; the role of RNA in repression; control of RNA and DNA synthesis. The genetic and biochemical aspects of these subjects will be stressed.

Fall, 3 credits

BMO 506 Membranes and Transport

Molecular and ion transport mechanisms will be studied in microorganisms, higher cells, and the cellular organelles. Emphasis will be placed on the molecular basis of transport functions, their genetic and physiological control and energy coupling mechanisms in active transport. Membrane structure, chemical composition, and biosynthesis will be considered in terms of their role in membrane transport.

Spring, 2 credits

BMO 508 Immunochemistry

The principles of immunochemistry will be discussed with special emphasis on the structure of antibodies, the measurement of antigen-antibody interactions, the nature of antigenic determinants in proteins, and the origin of antibody diversity.

Spring, 2 credits

BMO 509-510 Experimental Biochemistry

An introduction to modern biochemical research techniques. During the course of the year, the student spends seven-and-one-half weeks in the laboratory of each of four different members of the staff. The choice of staff members is made by the student in consultation with the course director. Rather than performing standardized laboratory exercises the student works on some aspects of an ongoing research project being pursued by the faculty member.

Fall and spring, variable credit, minimum two credits each semester

BMO 513 Enzymology

This course considers the detailed mechanisms of enzyme catalysis with emphasis on the role of the structure of the protein and the structure of the active site.

Fall, 3 credits

BMO 514 Muscle and Contractile Mechanisms

Seminar discussions based primarily on student presentations of published research papers on muscle contraction and other forms of biological motility. Topics will include the physiology and energetics of the contractile processes, the ultrastructure of the contractile machinery, the biochemical and physiochemical properties of the active proteins, and a critical review of current theories.

Spring, 2 credits

BMO 515 Macromolecular Evolution

Information taken from the amino acid sequences of proteins and data on nucleic acid hybridization will be related to the questions of how new genetic material arises during evolution. The elucidation of the degree of genetic relatedness among organisms using protein and nucleic acid data will also be considered.

Fall, 1 credit

BMO 599 Research

Original investigation undertaken with the supervision of a member of the staff.

Fall and spring, credit to be arranged

BMO 601, 602 Colloquium in Molecular Biology

A weekly series of talks and discussions by visiting scientists in which current research and thinking in various aspects of molecular and cellular biology will be presented. This course is required of all students every semester in which they are registered in the Molecular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and spring, no credits

BMO 603, 604 Student Seminar in Molecular Biology

Seminars are given by graduate students on recent work taken from the literature in the area of molecular or cellular biology. This course is required of all students every semester in which they are registered in the Molecular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and spring, no credits

BMO 605, 606 Molecular Biology Workshop

Progress reports are given each week by members of the faculty and advanced graduate students on their recent, but as yet, unpublished research. This course is required of all students every semester in which they are registered in the Molecular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and spring, no credits

BMO 685-688 Advanced Seminars

Topics to be arranged.

Variable and repetitive credit

BMO 699 Research

Original investigations undertaken as part of Ph.D. program under supervision of research committee.
Prerequisite: Advancement to Candidacy.

Fall and spring, credit to be arranged

Courses in Ecology and Evolution

BEE 551 Principles of Ecology

This course examines the interactions of organisms. The development of theoretical concepts of community structure and their biological and evolutionary implications will be emphasized. There will be field and laboratory work. It is expected that all first year students in the Ecology and Evolution Program will take this course.

Spring, 4 credits

BEE 552 Multivariate Analysis in Biology

An introduction to multivariate statistical analysis for biologists with emphasis on the use of computers.
Prerequisite: BEE 553 or equivalent.

Spring of odd numbered years, 3 credits

BEE 553 Biometry

An intensive course in statistical theory and methodology in the design and analysis of biological data. Topics included are parent and derived distributions, probability, confidence intervals, tests of hypotheses, sample size, and the analysis of variance. Use of computer data processing is introduced with some practice in computer work.

Fall, 4 credits

BEE 554 Population Genetics

A general introduction to mathematical population genetics. The effects of mutation, selection, and migration are considered for a variety of models (single and multilocus models, two and multiallelic models, haploid, diploid and polyploid models and a variety of population simulation of genetic systems are also covered).
Prerequisite: BEE 553 (or equivalent)

Spring of even numbered years, 3 credits

BEE 555 Isoenzyme Methods in Ecological Genetics

An introduction to biochemical techniques for investigations in ecology and population genetics with an emphasis on the use of electrophoresis for eco-genetic studies of natural and experimental populations. Topics include an introduction to the properties of proteins, particularly enzymes, genetic variation of populations, molecular basis of genetic and non-genetic variability of isoenzymes.

Spring, alternate years, 4 credits

BEE 556 Research Areas of Ecology and Evolution

A description of the current research areas of ecology and evolution broadly conceived. All first year Ecology and Evolution students are expected to participate.

Fall and spring, 2 credits

BEE 557 Systematics

A study of evolutionary theory and taxonomic methods with emphasis on numerical techniques.

Spring of odd numbered years, 2 credits

BEE 558 Tutorial Readings in Ecology and Evolution

Individual tutorial study between an instructor in the Ecology and Evolution Program and the graduate student for the purpose of background reading in an area of ecology and evolution.

Fall and spring, variable credit.

BEE 559 Individual Studies in Organisms

A detailed study of the biology of a selected systematic group chosen by the graduate students and a faculty member. This is conducted as a tutorial course.

Fall and spring, variable credit

BEE 587-592 Special Seminars

Topics to be arranged.

Variable and repetitive credit

BEE 599 Research

Original investigation undertaken with the supervision of a member of the staff.

Fall and spring, credit to be arranged

BEE 651, 652 Marine Biology Seminar

Seminars by staff members, visiting scientists, and advanced graduate students on aspects of their research.

Fall and spring, no credits

BEE 653, 654 Student Seminar in Marine Biology

Seminars and discussions on major areas and current topics in marine biology.

Fall and spring, 1 credit each semester

BEE 658 Advanced Invertebrate Zoology

Lectures, student seminars, and discussions on selected topics in invertebrate zoology, with emphasis on the local and tropical American faunas.

Spring, 2 credits repetitive

BEE 671, 672 Seminar in Ecology and Evolution

A weekly series of research seminars by visiting scientists and members of the staff.

Fall and spring, 1 credit each semester

BEE 689-692 Advanced Seminars

Topics to be arranged.

Variable and repetitive credit

BEE 699 Research

Original investigations undertaken as part of Ph.D. program under supervision of research committee.
Prerequisite: Advancement to Ph.D. Candidacy.

Fall and spring, credit to be arranged

Courses in Psychobiology

BPB 543 Topics in Animal Behavior and Physiology

A seminar on selected topics from the literature. Subjects covered will vary from year to year and will be determined by the interests of the student.

Fall, 3 credits

BPB 544 Laboratory in Neurophysiology

This course is intended to introduce the student to basic experimental techniques of neurophysiology. It will include techniques for the measurement of ionic potentials, receptor and effector activity, and synaptic properties and both vertebrate and invertebrate preparations. Individual laboratory work will be emphasized.

Fall and spring, 3 credits

BPB 546 The Physiological Basis of Animal Behavior

The analysis of animal behavior, primarily dealing with invertebrates, from an electro-physiological point of view. An examination of the integration of sensory and motor systems that produce behavior.

Spring, 3 credits

BPB 583-586 Special Seminars

Topics to be arranged.

Variable and repetitive credit

BPB 599 Research

Original investigation undertaken with the supervision of a member of the staff.

Fall and spring, credit to be arranged

BPB 693-696 Advanced Seminars

Topics to be arranged.

Variable and repetitive credit

BPB 699 Research

Original investigations undertaken as part of Ph.D. program under supervision of research committee.
Prerequisite: Advancement to Ph.D. Candidacy.

Fall and spring, credit to be arranged

Courses for High School Teachers

BHT 560 Comparative Physiology of Marine Organisms

A comparative examination of the physiology of marine plants and animals. The student will be introduced to the diversity of mechanisms which serve to ensure a unity of life processes in the marine environment. Emphasis will be placed upon physiological problems associated with fresh water estuarine and marine habitats which vary in physical characteristics.

Fall, 3 credits

BHT 561 Human Genetics

This course assumes a knowledge of the fundamentals of general genetics. It focuses upon the study of genes in human kindreds and populations, and gives attention to human cytogenetics and to the importance of genetic factors in human development, disease, society and evolution.

Spring, 3 credits

BHT 562 Cell Biology

A course designed to present current thinking and progress in problems concerning cell structure, function, and the relationship between the two. The approach is basically analytical, striving where possible to explain cellular phenomena in terms of molecular and biochemical organization.

Fall, 3 credits

BHT 563 Research Techniques for High School Teachers

The course involves experimentation with teaching methods which will include demonstrating and analyzing biological processes in a high school laboratory. Emphasis will be placed on simple and innovative techniques for utilizing live organisms, making quantitative observations, and analyzing group data.

Spring, 3 credits

BHT 571 Biology and Ethics

A consideration of ethical problems growing out of recent developments in molecular biology, genetics, reproductive physiology, pharmacology, and psychology as well as other branches of the biological sciences. Topics to be considered will include: the ethical animal: evolutionary basis and the naturalistic fallacy; levels of organization and conflicting values; the ethics of the gene pool; sex, the family, and morality; senescence and the prolongation of life; death-necessity and dignity; reproduction—whose right?; refabrication of the individual; the control of behavior-individual freedom and choice; the goals and guidance of human evolution.

Spring, 3 credits

BHT 580 Special Topics in General Biology for High School Teachers

The subject matter varies, depending upon interests of students and staff, but will cover recent developments in the biological sciences. As part of this course the student will write a short monograph in the area of study.

Fall and spring, 3 credits

BHT 593-598 Special Seminars

Topics to be arranged.

Variable and repetitive credit

BHT 599 Research

Original investigation undertaken with the supervision of a member of the staff.

Fall and spring, credit to be arranged

Courses in Marine Environmental Studies

MAR 501 Physical Aspects of the Marine Environment

Physical oceanography emphasizing processes and man-induced problems in the coastal ocean. Among the topics covered

are heat and water budgets, equation of state, currents, tides and tidal currents, water chemistry, shorelines and shoreline processes, waste disposal, and estuaries. Specific areas will be discussed as examples of the processes and their impact on various problems.

Fall, 3 credits

MAR 502 Biological Aspects of the Marine Environment

Detailed treatment of mutual dependence of the biological communities and physiochemical aspects of the marine environment, with emphasis on coastal and estuarine areas.

Spring, 3 credits

MAR 503 Chemical Aspects of the Marine Environment

Primarily an introduction to chemical oceanography. The course will cover: water structure effects and thermodynamics of electrolyte solutions as they pertain to the marine environment; the chemical history of seawater by examining equilibrium, steady state, and biodynamic models for the control of seawater composition; descriptive chemical oceanography and the distribution of conservative and nonconservative constituents for tracing ocean water masses. The course will also cover a blend of marine environmental chemistry, chemical ecology, and chemical oceanography to assess man's influence on the marine environment.

Fall, 3 credits

MAR 511 Marine Instrumentation

A field and laboratory course covering the practical aspects of physical and chemical marine environmental research. This course is designed to be taken concurrently with MAR 501 and MAR 503. Students will be trained in the use of routine and sophisticated marine instruments.

Fall, 3 credits

MAR 512 Field Studies

Work in the field and laboratory will emphasize quantitative biological sampling from a variety of marine communities and standard techniques in the collection of environmental data. Six hours of field and laboratory work on Saturdays.

Fall, 2 credits

MAR 521 General Problems of the Marine Environment

The course examines the multiple utilization of the marine environment. Ecological and economic problems that result from conflicting uses are investigated and methods for the management of marine resources are discussed.

Fall, 3 credits

MAR 522 Case Studies in Environmental Problems

A variety of current environmental issues will be examined in depth from a multidisciplinary viewpoint. These will include such topics as whale conservation, waste disposal, pesticide contamination, eutrophication, energy utilization, and water resource management.

Spring, 2 credits

MAR 550 Topics in Marine Sciences

Fall or spring, variable and repetitive credit

MAR 544 Environmental Law

The course will consider the various ways, including judicial, legislative and administrative action, through which the law does and can affect use, management and development of regional waters and water related land, such as Long Island ground water, shorefront, wetlands, coastal waters, Long Island Sound and the Outer Continental Shelf. It will analyze some specific legal actions and relevant Federal, State and local legislation.

Spring, 3 credits

MAR 553 Fishery Management

The theory of fishing and fishery management is well developed. The kinds of scientific information needed for management are well understood, and techniques are available for obtaining the necessary data. But marine fishery management,

with a few notable exceptions, has not been outstandingly successful. The problems are social-political rather than scientific, and they are not very easy to solve. The course is presented as a series of case history reviews of some major domestic and international marine fishery research and management programs. Strengths and weaknesses will be discussed, as well as the problems of achieving agreement between conflicting interests.

Fall, 3 credits

MAR 580 Seminar

Fall and spring, 1 credit, repetitive

MAR 590 Research

Fall and spring, variable and repetitive credit

Center For Continuing Education

Center for Continuing Education

Dean of Continuing and Developing Education: M. KREUTER *(Acting)*

Director of MA/LS Programs: D. MARESCA

Director of Administration: D. KEMPNER

Director of Non-Credit Courses and Technical Services: P. LETT

The Center for Continuing Education (CED) provides an educational opportunity to part-time students of post-high school age and extends the university resources for a broad spectrum of public and community services. At present the Center offers a terminal M.A. degree in Liberal Studies. This degree is not a prerequisite for any doctoral program at the University nor will it guarantee admission to any graduate department. Admission to the MA/LS degree program does not guarantee immediate course registration.

Admission to the MA/LS Program

For admission to graduate study in the Center for Continuing Education the following are required:

A. A baccalaureate or an advanced degree (M.A., M.S., Ph.D.) from an accredited institution.

B. A minimum grade point average of 3.0 (B) in the last two years of undergraduate work or an earned graduate degree.

C. Acceptance by the Center for Continuing Education.

Students who do not meet these requirements may be admitted as non-matriculated students.

Requirements for Matriculation

For students admitted on a non-matriculated basis, one of the following is required to attain matriculated status:

A. Completion of six credits with grades of 3.0 (B) or better in any graduate course.

B. A combined score of 1200 on the verbal and math portions of the Graduate Record Examination.

Requirements for the MA/LS Degree

A. Formal course requirements: There are two programs within the MA/LS degree requirements: The Distribution Program (see below) will be required of all students admitted for Fall, 1973 onward. Students in the MA/LS program prior to Fall, 1973 may elect either the Distribution Program or the Liberal Studies Seminar Program.

1. *Liberal Studies Seminar Program*—30 graduate credit hours, of which a minimum of 12 and a maximum of 18 must be taken from the Liberal Studies Seminars; appropriate number of elective credit hours chosen from the courses offered by the Center or from academic departments' offerings. Admission to all courses outside the Center's offerings is by permission of the department concerned, and depends on the satisfactory fulfillment of the department's academic requirements and on the availability of space.

2. *Distribution Program*—Students are required to divide their 30 graduate course credits among three general subject areas: Natural Sciences, Social and Behavioral Sciences, Arts and Humanities, as follows:

   a. a minimum of nine credits from each of two general areas.

   b. a minimum of six credits from the third general area.

   c. six remaining credits chosen from any of the three areas a student desires.

   Natural Sciences—includes all CEB or CEN courses, appropriate CEI courses, and graduate courses from the Departments of Biological Sciences, Chemistry, Earth and Space Sciences, Mathematical Sciences, Physics, College of Engineering.

   Social and Behavioral Sciences—includes all CEE, CEM or CES courses, appropriate CEI courses, and graduate courses from the Departments of Anthropology, Economics, History, Psychology, Sociology.

Humanities and the Arts—includes CEH courses, appropriate CEI courses and graduate courses from the Departments of Art, English, Philosophy, Music, French, Germanic Languages, Hispanic Languages.

Admission to all courses outside the Center's offerings is by permission of the department concerned, and depends on the satisfactory fulfillment of the department's academic requirements and on the availability of space.

B. Time limit: All requirements for the MA/LS degree must be completed within seven years of admission to the program.

C. Work Load: No students may register for more than eight hours or more than two courses per semester except under extraordinary circumstances and with the approval of the CED Academic Standing Committee.

D. Performance: Students in the MA/LS program are required to maintain a B average (3.0). Only one course with a grade of C will be counted for credit toward the degree and must be offset with an A to maintain the B average. Any matriculated student who receives two grades of C or below will be automatically dematriculated. Dematriculated students who subsequently complete six credits of graduate work with grades of B or better may apply for rematriculation. However, a dematriculated student who receives two further grades of C or below—a total of four grades below B during his attendance at Stony Brook—will be ineligible for rematriculation. Such students may continue to take courses on a non-matriculated basis for as long as they like, but they will not be readmitted to candidacy for the MA/LS degree. *NOTE:* Dematriculated students may register for courses only after all matriculated candidates are registered.

Transfer Credits

A maximum of 12 graduate credits taken at accredited institutions may be transferred toward the MA/LS degree. All credit transfers must be approved on a course by course basis by the appropriate academic departments. These credits must be less than ten years old at the time the student is admitted. Courses used to fulfill degree requirements at other institutions may not be transferred.

Special Student Status

Students who do not hold a baccalaureate or advanced degree and who wish to take courses in the Center for Continuing Education may petition the CED Academic Standing Committee for admission as a special student. Individual cases are judged on their merits. All special students are admitted on a non-matriculated basis, pending satisfactory completion of specified requirements.

New York State Teaching Certification

A. Provisional certification: It is not possible to attain a provisional certificate through the Center for Continuing Education. This program requires education courses and fulfillment of a full-time practice teaching requirement which are not available for post-baccalaureate students at SUNY at Stony Brook.

B. Permanent certification: This requirement can be met by fulfilling the requirements for the MA/LS degree based upon an already existing provisional certificate.

Applications

Applications and further information may be obtained by writing or calling:

Center for Continuing Education
Room 198, Humanities Building
State University of New York at Stony Brook
Stony Brook, New York 11790
Telephone: (516) 246-5936

Application deadline for the 1974–75 academic year, including 1975 summer session, is June 30, 1974.

Applied Mathematics and Statistics
Computer Science
Electrical Sciences
Materials Science
Mechanics

The Engineering Sciences

Graduate Programs in Engineering Sciences

The College of Engineering offers graduate study with degree programs leading to the M.S. and Ph.D. The College consists of five academic departments each under the direction of a chairman. Each department reviews student applications and approves the enrollment of the graduate student in the program best suited to his or her background and interests.

Admission to Graduate Study

For admission to graduate study in engineering, the minimum requirements are as follows:

A. A bachelors degree in engineering, mathematics, physics, chemistry, or a closely related area from an accredited college or university.

B. A minimum grade average of at least B in all courses in engineering, mathematics, and science.

C. Acceptance by the College of Engineering and the Graduate School.

Requirements for the M.S. Degree

A. The M.S. degree in the College of Engineering requires the satisfactory completion of a minimum of 30 graduate credits.

B. All credits must be at the graduate level. The faculties of individual graduate programs may impose additional requirements as listed under departmental headings. In addition, the grades in courses totaling at least 15 credits must be B or better and the average for all courses taken must be B or better.

C. Final recommendation: Upon the fulfillment of the above requirements the faculty of the graduate program will recommend to the Dean of the Graduate School through the Dean of Engineering that the Master of Science degree be conferred, or will stipulate further requirements that the student must fulfill.

D. Time limit: All requirements for the Master of Science degree must be completed within three years of the student's first registration as a graduate student.

Requirements for the Ph.D. Degree

A. Qualifying Examination: A student must satisfactorily pass a qualifying examination to ascertain ability for study for the Ph.D. degree.

B. Research advisor: After completion of at least one year of full-time residence and prior to taking the Preliminary Examination, the student must select a research advisor who agrees to serve in that capacity.

C. Preliminary Examination: Upon completion of the course work, a comprehensive oral examination, which may be supplemented by a written examination, will be given to the student.

D. Advancement to candidacy: After successfully completing all requirements for the degree other than the dissertation, the student is eligible to be recommended for advancement to candidacy. This status is conferred by the Dean of the Graduate School upon recommendation from the chairman of the graduate program.

E. Dissertation: The most important requirement of the Ph.D. degree is the completion of a dissertation which must be an original scholarly investigation. The dissertation must represent a significant contribution to the scientific literature and its quality must be compatible with the publication standards of appropriate and reputable scholarly journals.

F. The student must defend the dissertation before an examining committee. On the basis of the recommendation of this committee, the Dean of Engineering will recommend acceptance or rejection of the dissertation to the Dean of the Graduate School. All requirements for the degree will have been satisfied upon the successful defense of the dissertation.

G. Time limit: All requirements for the Ph.D. degree must be completed within four years after advancement to candidacy.

Department of Applied Mathematics and Statistics

For detailed description of admission requirements and degree programs, see page 150.

Department of Computer Science

For detailed description of admission requirements and degree programs, see page 156.

Department of Electrical Sciences

Professors:
BRAUN, CHANG *(Acting Chairman)*, MARSOCCI, PIEL *(Adjunct)*, D. SMITH, STROKE, TRUXAL

Associate Professors:
CARLETON, C. CHEN, DOLLARD, RAPPAPORT, THOMAS, TUAN

Assistant Professors:
BARRY, HARRISON, LIAO *(Adjunct)*, SHORT, WAYNE

M.S. and Ph.D. Degrees

The Department of Electrical Sciences offers graduate programs leading to the M.S. and Ph.D. degrees. Graduate programs are tailored to the needs of each student so as to provide a strong analytical background helpful to the study of advanced engineering problems. Ample opportunities exist for students to initiate independent study and to become involved in active research programs, both experimental and theoretical. In addition to its emphasis on modern electrical engineering, the department participates in interdepartmental graduate programs in computer science and in urban and policy science; these are described in adjoining sections of this *Bulletin*.

Some of the research areas currently under investigation by faculty members and graduate students of the department include: optimal control theory, systems theory, modern energy conversion, digital communications techniques, pattern recognition, synthesis of logic networks, artificial intelligence, systems programming, laser physics, non-linear optics, electromagnetic waves in plasmas, microwave acoustics and integrated optics, coherent optics and holography, solid state electronics, magneto-optics.

Combined BE-MS Degrees

Undergraduate students may enter this special 5 year Master of Science-Bachelor of Engineering program at the end of their junior year. During the next two years a student will complete the requirements for both the B.E. and M.S. degree and for the M.S. Thesis.

M.S. in Applied Science Degree

The department also offers a part-time applied science program which leads to the M.S. in Applied Science degree.

Requirements for Graduate Degrees

The faculty of the Electrical Sciences Department has set the following regulations, which are in addition to the College of Engineering requirements.

Immediately upon arrival, every graduate student entering the department is assigned by the graduate program chairman to a temporary advisor, with whom the student plans the first semester of courses. Before the start of the second semester a student should seek the permission of a faculty member to act as research advisor, and with his approval compose a plan of course work which is then filed with the graduate program chairman. Any subsequent changes of advisor or courses should also be reported to the graduate program chairman. To qualify for the M.S. degree a student must either pass a comprehensive written examination or complete a thesis. There is no residence requirement for the M.S. degree. Passing of the doctoral qualifying examination is one of the requirements for the Ph.D. degree. The residence requirement for the Ph.D. is two consecutive semesters of full-time study. Both the M.S. comprehensive examination and Ph.D. qualifying examination are normally given once each semester.

Financial support in the department is subject to annual review by the faculty based on available funds and satisfactory progress. Such support is not normally renewed for M.S. candidates after the second year.

There can be identified, within the total body of graduate courses offered by the Department of Electrical Sciences, sequences which, together with associated research work, constitute a program in specific subject areas of academic interest. These sequences provide a means for the student to focus his work, in depth, within an area of specialization for the M.S. or the Ph.D. degree. The listings below are given as a guide and are not intended to represent a required sequence of courses. It is to be especially noted that the sequences are of a multidisciplinary nature.

Graduate Program in Systems Science and Engineering

Since the research emphasis and the applications of systems sciences have been broadened to include socio-economic, urban, transportation, pow-

er-distribution and health-services systems, a considerable expansion in faculty-student interests and closer ties with other related departments are necessary to meet this rising challenge. The present academic and research programs in Electrical Sciences form an excellent basis for such activities. The relevant course sequence is: ESE 502, ESE 503, ESE 531–532, ESE 535, ESE 539, ESE 540, ESE 541, ESE 542, ESE 543–544, ESE 545, ESE 551. In addition a number of courses useful to this subject area and offered by other departments are: UPS 513, UPS 531, ECO 510–511, ECO 514, ECO 520–521, ECO 572, SOC 502, SOC 503, SOC 505, SOC 514.

Graduate Program in Solid-State and Quantum Electronics

The program of courses and of research pertinent to solid-state electronics ranges from a study of the fundamental electronic processes in solids and gases through a description of the mechanisms which yield useful devices, to a study of the design of complex integrated-circuit systems. The course offerings which relate to these subject areas are: ESE 510, ESE 511, ESE 512, ESE 514, ESE 515, ESE 516–517, ESE 518, ESE 610. Relevant courses from other departments include: ESM 536, ESM 615, ESM 618, ESM 652–653, PHY 511–512, PHY 540, PHY 555, CHE 521–522.

Graduate Program in Biomedical Systems Engineering

The Department of Electrical Sciences has established graduate-course offerings in the subject areas of biomedical systems engineering and bioelectronics. Research work in these areas is presently underway and is expanding. The course offerings from which the student may make a selection include: ESE 570, ESE 660, ESE 535, ESE 540, ESE 516–517, ESE 542, HBY 532, HBY 551, HAD 510, BIO 544.

Graduate Program in Applied Sciences

This is a 30-credit part-time M.S. program intended for secondary school and community college educators and others who are interested in design, and implementation of inter-disciplinary curricula, and the application of science and technology to education. A bachelors degree in Engineering, natural sciences or social sciences and an average of B in course work is required for admission into the program. The unique feature of the program is its flexibility to meet individual needs and interests. Only five courses, CEN 580, CEN 581, CEN 582, ESE 583, and ESE 584 are required courses. The other 15 credits may be selected from other departments.

Courses

ESE 501 Graduate Laboratory in Electrical Sciences

This course is intended to familiarize the student with the use of research laboratory equipment, the basic techniques of taking measurements, and the integration of these fundamentals into an overall experimental project. Each student will select at least three experimental projects from the following areas: applied optics, microwave electronics, wave propagation, and solid state electronics. The work on each of these topics will be supervised by the faculty members whose own research interests are in these areas. Each topic will require the student to set-up the experimental system, measure the necessary parameters of the system, and perform the required experiments in order to complete the project.

3 credits

ESE 502 Deterministic Systems

Concepts and analysis techniques fundamental for networks and systems both analog and digital. Mathematical descriptions of systems including the input/output and state-variable formulations; solutions and structure properties of dynamical equations in infinite and finite fields. Functional components of digital systems and description by Boolean algebra. System reduction techniques for linear and non-linear cases. The course will be illustrated with applications to common analog and digital systems and an introduction to computer simulation in the laboratory.

3 credits

ESE 503 Stochastic Systems

Basic probability concepts and application. Probabilistic bounds, characteristic functions, and multivariable distributions. Central limit theorem, normal random variables. Stochastic processes in communication, control, and other signal processing systems. Stationarity, ergodicity, correlation functions, spectral densities, and transmission properties. Optimum linear filtering, estimation and prediction. The concept of entropy of physical systems and information transfer. Basic detection theory.

3 credits

ESE 504 Random Processes in Communications

Applications of random process representations to further problems in communications. Traffic congestion in communications systems. Blocking and delay probabilities. Erlang's formulas. The Equivalent Random Method. Analogies to other fields. Important channel models. Synchronization, multiple access, and carrier recovery techniques. Appropriate background for each topic will be developed in the course.
Prerequisite: ESE 503 or permission of the instructor

3 credits

ESE 510 Fundamentals of Physical Electronics

Lagrangian and Hamiltonian formulation of mechanics. Classical and quantum statistics. Schrodinger's and Heisenberg's representation of quantum mechanics; perturbation theory. Solid state theory, crystal structure, simple band structure, effective mass theorem, properties of semiconductors. Transport theory, derivation and application of Boltzman transport theory. Semiconductor devices.

3 credits

ESE 511 Solid State Electronics I

A study of the electron transport processes in solids leading to the analysis and design of solid state devices. Electrical and thermal conductivities; scattering mechanisms; diffusion; galvanomagnetic, thermomagnetic, and thermoelectric effects. Hall effect and magnetoresistive devices. Conductivity in thin films. Ferroelectrics, piezoelectrics, theory of magnetism and of magnetic devices.

3 credits

ESE 512 Solid State Electronics II

Resonance phenomena in solids; para-and ferromagnetic resonance, cyclotron resonance, electron spin resonance; applications to microwave devices and to measurements of electronic parameters, optical properties of solids, direct and indirect transitions, luminescence, photoelectric devices, photomagnetic effects. Elements of superconductivity, the macroscopic and the microscopic theories, tunneling effects, application to the design of superconducting devices.

3 credits

ESE 514 Semiconductor Electronics

The theory of semiconductor electronics and related devices. Conduction mechanisms in semiconductors; trapping centers, recombination centers, surface states. The continuity equation, p-n junction theory of the junction transistor, transistor characterization. Metal to semiconductor contacts, theory of metal-oxide-semiconductor transistors.
Prerequisite: ESE 511.

3 credits

ESE 515 Quantum Electronics I

A detailed treatment of the physics of microwave and optical lasers. Topics include: introduction to laser concepts; review of fundamental concepts of quantum theory, mathematical formulation; classical radiation theory; resonance phenomena in two-level systems, Block equations, Kramers Kronig relations, density matrix; rate equation approach to laser oscillation and amplification; Lamb's semiclassical theory of laser oscillation, hole burning; optical resonators; laser gain and saturation effects; CO_2 lasers; discharge lasers; optically pumped lasers; semiconductor lasers.

3 credits

ESE 516, 517 Integrated Electronic Devices and Circuits I and II

A course in the theory and the applications of integrated electronic devices and circuits. Elements of semiconductor electronics, basis of the methods of fabrication, the physical mechanisms and electrical characterizations of bipolar junction transistors, field effect transistors (FET), metal-oxide-semiconductor transistor (MOS transistors), diodes, capacitors and resistors. Design techniques for linear and digital integral circuitry. Temperature effects and fundamental limitation of integrated electronic components and circuits. Discussion of computer-aided design; active filters, medium-scale integration (MSI) and large-scale integration (LSI).

3 credits each semester

ESE 518 Quantum Electronics II

Interaction of simple quantum systems with complex systems; semiclassical laser oscillation theory, stochastic theory of fluctuations; semiclassical non-linear optics, harmonic generation, parametric amplification. Brillouin scattering, Raman effect; quantum theory of fields, spontaneous emission, interaction theory; quantum theory of laser oscillation, coupled Green's function relations, fluctuation-dissipation, intensity and phase fluctuations; quantized non-linear optics, quantum noise, photon scattering.

3 credits

ESE 520 Electronics II—Fundamentals of Electromagnetics

Electro- and magneto-statics; Maxwell's equations; vector and scalar potentials, gauge transformations, vector and tensor transformation properties, Lorentz transformation; derivation of Maxwell's equations from Coulomb's Law and Lorentz transformation. Boundary value problems; Green's function, guided waves, travelling wave and charged particle interactions. Radiation, multipole expansion-dipole and quadrapole radiation, geometric optics. Electromagnetic waves propagating in solids, dispersion, interaction with quantum systems, propagation in non-linear and anisotrophic media.

3 credits

ESE 521 Applied Electromagnetic Theory

Advanced boundary value problems in electromagnetic and microacoustic wave propagation, guided wave and radiation. Topics include: variation and perturbation methods applied to cavity, wave guide discontinuity and wave guide exci-

tation problems, radiation from wave guide aperture and equivalent source theorem, mode theory of guided wave around the earth, microwave acoustic wave guide and transducers, excitation scattering and diffraction of electromagnetic and microacoustic surface wave topics of current interest in electromagnetic theory.

3 credits

ESE 522 Wave Propagation in Plasma

The course includes the following topics: introduction to the magnetoionic theory and plasma kinetic theory, wave propagation in unbounded plasma, guided waves at a plane plasma interface and its application to terrestrial propagation, radiation from antennas in plasma.

3 credits

ESE 531 Theory of Digital Communications I

This is the first course of a two-course sequence. It begins with a brief review of probability theory leading to derivation of the Chernoff bound and the central limit theorem. There follows a review of random variables, random processes, and vector (multivariate) random variables and processes. The concepts of entropy and the measure of information, and the basic theorem of noiseless coding are introduced to justify the restriction of subsequent development of the theory to the case of independent equiprobable sources. Further topics include the vector model of digital communications systems, waveforms as vectors, time-bandwidth and dimensionability, the correlation receiver, matched filtering, probability of error and bounds thereon, and efficient signalling schemes. A course in basic probability theory or demonstration of familiarity with the basic concepts of probability is required. ESE 503 is desirable but not prerequisite.

3 credits

ESE 532 Theory of Digital Communications II

The course is a direct continuation of Theory of Digital Communications I; it begins with a proof of the theorem of channel capacity. The concept of encoding for error protection is introduced as a special case of vector signals. Further topics include the basic algebraic structure of linear codes, block and sequential codes, random linear codes, cyclic codes and their implementation, the fading channel, unidirectional versus feedback communication, and the tradeoffs of rate of reliability. The course concludes with some further theorems of information theory and a discussion of the information theoretic versus the communication theoretic approach to the general problem of digital communication.
Prerequisite: ESE 531.

3 credits

ESE 539 Communication, Transportation, and Power Nets

A problem-oriented course in systems whose structures resemble (and can usefully be described as resembling) a net. The course will include both lectures and seminars. It will provide an introduction to graph theory, but only to the extent necessary to establish a common terminology for problem formulation and a common basis for insight into problem solutions, plus whatever details may be required for specific problems. Other aspects of operations research (e.g., queuing theory, decision theory, 0–1 integer linear programming) will be introduced on the same basis. Lecture coverage of individual problems will explore direct analogies, or significant similarities and differences among problems which are conceptually related but functionally quite different. For the seminar portion, participants will select problems from current literature and report on the present status of problem solution with an analysis of the relationship with other problems. Examples of problems to be covered include: the trunking problem in the telephone net, the "school bus" problem in transportation, and the "economic dispatch" problem in power nets.

3 credits

ESE 540 Introduction to System Theory

Basic system concepts: linearity, causality, relaxedness, time-invariance, and state; input-output description and state-variable description of systems; controllability and observability; canonical structure of dynamical equation; irreducible realiza-

tion; state feedback and state estimator; design of compensator; bounded-input bounded-output stability, asymptotic stability and total stability; study of linear composite systems.

3 credits

ESE 541 Discrete Time Systems

Analysis and synthesis of discrete time systems and discrete time controlled continuous systems. Topics include: Z-transform and state variable representations of discrete time systems, controllability and observability. Stability criterion. Synthesis methods. Dynamic programming and optimum control. Sampled spectral densities and correlation sequence. Optimum filtering and control of random processes.
Prerequisite: ESE 502.

3 credits

ESE 542 Non-Linear Control Systems

Formulation of mathematics equations for non-linear physical systems. Equalibrium points and various stability concepts. Anlaysis and design techniques covered including graphical method, perturbation method, describing function. Tsypkin locus, Liapunov's second method, Popov's theorem, and functional and analysis technique. Design examples including non-linear control systems, switching voltage regulators.
Prerequisites: ESE 315 or ESE 502.

3 credits

ESE 543, 544 Optimum Design of Feedback Control Systems I and II

System design by minimization of integral square error with constraint. Root square locus method. Analysis of random processes including power spectrum, correlation functions and Weiner's theorem. Statistical design theory of continuous and sample systems. Interpolation, extrapolation, filtering, and prediction of continuous and sample data. Optimum filtering and control of non-stationary systems. Pontryagin's maximum principle and applications. Bang-Bang and Pang-Bang systems. Dynamic programming and generalized maximum principle.

3 credits each semester

ESE 545 Computer Architecture

Same as MSC 502.

3 credits

ESE 546 Analysis and Synthesis of Computer Communication Networks

Mathematical analysis of message queuing and buffering processes for various signal statistics. Analytical and algorithmic methods for network optimization. Topological design for network reliability. Waveform optimization, encoding. Error analysis of coded and feedback systems. Optimum features and software requirements of communication processors.

3 credits

ESE 547 Digital Signal Processing

The course covers three aspects of digital signal processing: digital filter, fast Fourier transform (FFT) and error analysis. Topics include: review of analog filters, and design of infinite pulse response filters, design of finite impulse response filters. Algorithm and implementation of FFT, application of FFT. Effects and analysis of quantization errors.

3 credits

ESE 551 Switching Theory and Sequential Machines

Survey of classical analysis and synthesis of combinational and sequential switching circuits, followed by related topics of current interest such as error diagnosis and fail soft circuits, use of large scale integration, logic arrays, automated logic design.
Prerequisite: ESE 318 or equivalent.

3 credits

ESE 560, 561 Coherent Optics and Holography I and II

A course introducing the field of modern optics and electro-optical science. Particular emphasis is placed on generally applicable fundamentals, as well as on similarities and relations with electrical science and radio-astronomy techniques. The theory is developed and illustrated with examples drawn from the most recent ramifications, including applications of holography, such as optical computing,

character recognition and image restoration, optical correlators, holographic interferometry (vibration and stress analysis), microwave, radar and acoustical imaging and synthesized holograms. A review of the necessary mathematics is introduced at appropriate times in the course.
Prerequisites: A bachelors degree or equivalent in the physical sciences, mathematics or engineering. Mathematics training through calculus and differential equations.

3 credits each semester

ESE 570 Bioelectronics

The basic principles of the origin of bioelectric events; ion transport in cells, membrane potentials; action potentials generated by neural and by muscular activity, cortical potential, cardiac potentials. Techniques for the detection and the measurement of bioelectric signals; impedance measurements used to detect endocrine activity, perspiration and blood flow; impedance cardiography, vector cardiography, impedance plethymography; a description of electrical characteristics of transducers and of the transducer-tissue interface; special requirements for the amplification of transducer signals.

3 credits

ESE 599 Research

Variable and repetitive credit

ESE 610 Seminar in Solid State Electronics

Current research in solid-state devices and circuits and computer-aided network design.

3 credits

ESE 630 Seminar in Communication Theory

3 credits

ESE 640 Seminar on Systems Theory

Recent and current research work in systems theory.

3 credits

ESE 660 Seminar in Biomedical Systems Engineering

This seminar will treat topics of current interest in bioengineering. Modeling and simulations of physiological systems, such as cardiovascular, respiratory, renal, and endocrine systems. Instrumentation systems including automatic chemical assaying, electric probes, ultrasonic tracer methods, and radiation techniques. Application of computers in biomedicine in the subject of diagnosis, emergency services, and hospital management.
Prerequisites: ESI 310, ESE 370 or equivalent.

Spring 3 credit

ESE 670 Topics in Electrical Sciences

Varying topics selected from current research topics. This course is designed to give the necessary flexibility to students and faculty to introduce new material into the curriculum before it has attracted sufficient interest to be made part of regular course material.

Variable, repetitive credit

ESE 698 Practicum in Teaching

Variable, repetitive credits

ESE 699 Research

Variable and repetitive credit

Courses CEN 580, 581, 582, and ESE 583, 584, and 585 are for the M.S. program in Applied Science. Credit will not be given toward other graduate degrees offered in the department.

CEN 580 Socio-Technological Problems

A series of case studies of current socio-technological problems encompassing such areas as health service delivery, emergency medical care, auto safety, and surburban transportation, and the energy crisis. In each case, the problem dictates the quantitative models from which the alternatives are developed with the corresponding technological, economic, and social constraints.

3 credits

CEN 581 Decision-Making in Technology—People—Environment Problems

Application of basic elements of decision-making (criteria, constraints, models, and optimization techniques) to the analysis of potential solutions to problems which involve technology and its impact on people and the environment. Areas of study include; technology forecasting and assessment methods, cost/benefit analysis, resource management, and the matching of technological systems to societal needs.

3 credits

CEN 582 Systems Approach to Technology—People—Environment Problems

Application of system concepts (input-output, feedback, stability, information analysis) to the analysis of dynamic systems involving technology and society. Areas of study include: automatic compensation of systems through use of feedback; stability and instability of urban systems, transportation, epidemics, and economics; machines and systems for men, including communication and prosthetics.

3 credits

ESE 583 Computer Literacy

A course to provide a basic understanding of digital computers, their applications, and the benefits from the threats to society from their use. Emphasis will be placed on applications in education, medicine, and government. Actual experience with the computer will include introduction to programming, algorithmic problem formulation, and running existing programs.

3 credits

ESE 584 Project Seminar in Applied Science

3 credits

ESE 585 Independent Study in Applied Science

3 credits

Department of Materials Science

Professors: HERMAN *(Chairman)*, JONA, S. LEVINE, NATHANS, SEIGLE, F. WANG

Associate Professors: BILELLO, CARLETON, JACH, PREECE, SIEGEL

Assistant Professor: HERLEY

The Department of Materials Science offers graduate work leading to the Master of Science and Doctor of Philosophy degrees. The motivating philosophy of the graduate program is to provide the student with a broad synthesis of the theoretical and experimental techniques required for work with all classes of materials. Emphasis is placed on courses which unify the field in terms of fundamentals treated with sufficient depth to enable the student to contribute in diverse areas of materials science and engineering. Current research interests of the faculty include studies of the structure and properties of metals and ceramics, imperfections in solids, mechanical properties, thermodynamics, diffusion in solids, phase transformations, mechanisms of solid state sintering, surface structure, x-ray and neutron diffraction, radiation effects, polymers, magnetism, optical properties, amorphous materials, biomedical materials, marine materials, composite materials and deterioration of materials. In addition to the College of Engineering requirements, a student shall be admitted to the Ph.D. degree program after satisfactorily passing a graduate program Qualifying Examination. (However, see below for students entering with the M.S. degree.) The Qualifying Examination shall be given at the beginning of each semester, and shall be a comprehensive examination covering undergraduate work in materials science, physics, chemistry, and applied mathematics. The Qualifying Examination shall be taken by every student who plans to study toward the Ph.D. degree, within the first month of the second semester in which he or she is enrolled as a full-time student in the Materials Science Department. However, well prepared students are encouraged to take this examination in their first semester.

Requirements for the M.S. Degree

A. *Residency:* Two consecutive semesters of full-time study are required for full-time students. No residency requirement is necessary for part-time students.

B. *Course requirements:* There are two options for the M.S. degree in the Materials Science Department:

1. Satisfactory completion of a minimum of 18 graduate course credits and a thesis in the student's area of specialization. A

total of 30 graduate credits is required.

or

2. The satisfactory completion of a minimum of 30 graduate credits, 24 of which must be for graduate courses. This option is primarily for part-time students. Full-time students may petition to the Graduate Program Committee of the Materials Science Department to elect this option, but the petition must be made at the time of admission application.

In addition, the average grade for all credits, excluding ESM 599, ESM 698, and ESM 699, must be B or better.

C. *Thesis:* For the student who elects to complete a thesis for the M.S. degree, the thesis must be approved by three faculty members, at least two of whom are members of the Materials Science Department, including the research advisor.

D. *Final recommendation:* Upon the fulfillment of the above requirements the faculty of the graduate program will recommend to the Dean of the Graduate School through the Graduate Program Committee, that the Master of Science degree be conferred or will stipulate further requirements that the student must fulfill.

E. *Time limit:* For full-time students, all requirements for the M.S. degree must be completed within three years of the student's first registration as a full-time graduate student in the Materials Science Department.

Requirements for the Ph.D. Degree

A. *Residency:* Two consecutive semesters of full-time study are required for full-time students. No residency is required for part-time students.

B. *Qualifying Examination:* Students must satisfactorily pass a Qualifying Examination as described above. A student who elects the non-thesis option for the M.S. program will be considered a terminal M.S. student by the department and must formally reapply for admission to the department if he or she wishes to pursue a Ph.D. degree. Students who elect the M.S. thesis program, however, will be considered as continuing students in the department and may proceed to the Ph.D. Qualifying Examination. Students entering with an M.S. degree, and who are considered by virtue of background and experience to be well qualified by the Graduate Program Committee, with the concurrence of the department faculty, shall not be required to take the Qualifying Examination.

C. *Plan of work:* Before completion of one year of full-time resi-

dence, the student must have selected a research advisor who agrees to serve in that capacity. The student will then prepare a plan of further course work. This must receive the approval of the student's advisor and of the Graduate Program Committee.

D. *Preliminary Examination:* A comprehensive oral examination on the subjects covered in graduate materials sciences. The Examination Committee will consist of four faculty members including the research advisor, two members of the Materials Science Department, and one member from outside the department. Students entering the program with a baccalaureate degree must take the Preliminary Examination before the end of the 5th semester. If a second examination is required, this must be completed by the 10th week of the 6th semester. Students entering the program with a masters degree must complete the examination by the 10th week of the second semester.

E. *Advancement to candidacy:* After the student has successfully completed all requirements for the degree, other than the dissertation, he or she is eligible to be recommended for advancement to candidacy. This status is conferred by the Dean of the Graduate School upon recommendation of the chairman of the graduate program.

F. *Dissertation:* The most important requirement of the Ph.D. degree is the completion of a dissertation which must be an original scholarly investigation. The dissertation shall represent a significant contribution to the scientific literature and its quality shall be compatible with the publication standards of appropriate and reputable scholarly journals.

G. *Defense:* The candidate shall defend the dissertation before an examining committee consisting of four faculty members including the research advisor, two members of the Materials Science Department, and one member from outside the department.

H. *Time limit:* All requirements for the Ph.D. degree must be completed within four years after advancement to candidacy.

Courses

ESM 502 Techniques of Materials Science

A survey of the important experimental methods employed in studies of materials. This is essentially a laboratory course where the student carries out refined measurements using research grade equipment. The areas covered include electrical and magnetic measurements, thermal properties and calorimetry, X-ray diffraction studies of crystalline and amorphous materials, optical and electron microscopic examination of materials, and the mechanical properties of materials.

4 credits

ESM 504 Materials Design by Structure and Purity Control

The aim of this course is to combine theory and practice to show how control of the structure and purity of materials can be utilized to produce metals, semi-

conductors, glasses, ceramics, and polymers which fulfill predetermined design goals. Lectures and demonstrations are integrated so that it is possible to obtain practical experience in applying theory to the actual control of physical properties of materials. Topics covered include: crystal growth, doping and diffusion in metals and semiconductors, texture and recrystallization, magnetic domain structures, age-hardening systems, solid state phase transformations, composites and structure, and purity control in polymers and glasses.

3 credits

ESM 506 Mechanical Properties of Engineering Materials

A unified approach for all solid materials will be made with regard to the correlation between microstructure and their macroscopic mechanical properties. The course deals with various testing techniques for delineating mechanical properties of materials, considering elasticity, anelasticity, plasticity, dislocation theory, cohesive strength, fracture and surface wear. Attention is given to strengthening mechanisms for solids, metals, ceramics and polymers, with a view towards learning how manipulation of microstructure can be used to design materials of specified properties. Discussion of the various engineering applications of materials and of materials selection for a number of specified tasks is pursued.

3 credits

ESM 509 Thermodynamics of Solids

The basic laws and thermodynamic relationships are briefly reviewed, with emphasis on the computation of standard free energy changes of reactions, and application to equilibrium calculations. Current knowledge regarding the thermodynamic properties of condensed phases is discussed, including the thermodynamics of first and higher order phase transitions in solids. The thermodynamic treatment of ideal, regular, and real solutions is reviewed. Use of the foregoing in the estimation of reaction free energies and equilibria in condensed phase reactions such as diffusion, oxidation, and phase transformations is emphasized. Finally the thermodynamic analysis of phase equilibrium diagrams is considered.

3 credits

ESM 510 Kinetic Processes in Solids

Atomistic rate processes in solids will be studied, with emphasis on diffusion in crystals. Theory of diffusion and experimental techniques will be developed, and the role played by a broad class of crystalline imperfections will be examined. Topics will include annealing of deformed materials, kinetics of defect interactions, thermally controlled deformation, kinetics of nucleation and growth, solidification and precipitation.

3 credits

ESM 511 Imperfections in Crystals

The course provides an introduction to point and extended imperfections in crystalline solids. The characteristics of point defects in metals, semiconductors, and ionic solids are described, and the thermodynamics of point defects is developed in detail. Elementary dislocation theory is introduced. The energetics of dislocations are treated using elasticity theory, and important dislocation reactions are described. In addition, the structures of internal boundaries are presented. Finally, interactions between lattice imperfections are discussed, with emphasis on the generation and annihilation of imperfections, dislocation climb, clustering, and segregation.

3 credits

ESM 520 Structure of Solids

This course offers a broad treatment of the structure of solids, beginning with the principles of geometrical and mathematical crystallography, symmetry and groups, the reciprocal lattice, and Brillouin zone construction. The structures of real crystals are discussed and rationalized in terms of atom and molecular geometry and bonding. Next the structure of non-crystalline solids is considered. The atom distribution function is introduced and applied to liquids and glasses. Structural factors influencing the formation of amorphous phases are discussed. Finally the structure of heterogeneous solids is considered, including the

topology of crystallite assemblies and domains in polycrystalline and multiphase systems.

3 credits

ESM 525 Diffraction Techniques and the Structure of Solids

The structure of solids can be studied using X-ray, neutron, and electron diffraction techniques. X-ray diffraction techniques are emphasized in this introductory course. Topics covered are: coherent and incoherent scattering of radiation, structure of crystalline and amorphous solids, stereographic projection and crystal orientation determination. The concept of reciprocal vector space is introduced early in the course and is used as a means of interpreting diffraction patterns. Laboratory work in X-ray diffraction is also included to illustrate the methods.

4 credits

ESM 526 Materials and Environment

Interactions between materials and their environments including corrosion, oxidation, absorption and adsorption reactions. The influence of these reactions on the properties of materials, the design of materials resistant to these phenomena, alternative methods of protection and the utilization of these reactions in promoting breakdown and deterioration of materials.

3 credits

ESM 530 Physical Properties of Polymers I

This course provides an advanced study of the physical and physical-chemical principles underlying the behavior of polymers. Topics include an introduction to the statistical thermodynamics of polymers, X-ray and spectroscopic techniques and their use in structural studies, thermodynamics of polymer solutions, light scattering techniques, theory of viscosimetry and osmometry. Practical applications are emphasized.

3 credits

ESM 531 Physical Properties of Polymers II

Continuation of ESM 530 to such topics as viscoelasticity, flow, and diffusion of polymers; sedimentation theory and ultraconfiguration, electrostatic free energy and the statistical mechanics of poly-electrolytes, electrophoresis theory and techniques, configuration of polymers in solution, catalysis by macromolecules.
Prerequisite: ESM 530.

3 credits

ESM 533 Radioisotopes in Materials Studies

This course is primarily a laboratory one which stresses the utilization of radioactive isotopes in the study of a variety of materials problems such as wear testing, thickness gauging, electrodeposition, chemical reactivity of solids, etc.

3 credits

ESM 536 Electronic Properties of Solids

A development of the modern theory of solids from the quantum nature of matter. After a review of basic concepts the band structure of solids is derived as a consequence of the Bloch theorem. The band theory is then applied to the interpretation of the properties of metals and alloys, semiconductors, and ionic crystals. Topics include dielectric and magnetic properties, electrical and thermal conductivity, and the interpretation of resonance techniques.

3 credits

ESM 540 Advanced Techniques of Materials Research I

Theory and laboratory demonstrations of modern techniques for the preparation and characterization of engineering materials such as high vacuum and high temperature techniques, cryogenic procedures, crystal growth, and zone melting techniques.

4 credits

ESM 541 Advanced Techniques of Materials Research II

Continuation of ESM 540 to the theory and demonstration of spectroscopic methods, diffraction techniques, electron microscopy, and other methods for the examination of materials.
Prerequisite: ESM 540.

3 credits

ESM 550 Statistical Theory of Matter

The principles of classical and quantum statistical mechanics are introduced and the relationships between statistical mechanics and classical thermodynamics developed. Detailed applications are made to electronic and lattice specific heats, order-disorder transformations, paramagnetism, and other phenomena in solids. An introduction to the thermodynamics of irreversible processes is given, and the methods of irreversible thermodynamics applied to thermoelectric and thermomechanical effects in solids.
Prerequisite: ESM 509.

3 credits

ESM 570 Chemical Foundations of Biomedical Engineering

This course surveys those aspects of organic, biochemistry and physical chemistry which arise most often in biomedical engineering. Among the topics covered are review of classes of organic compounds, discussion of amino acids and proteins, carbohydrates, lipids, nucleic acids, enzyme mechanisms, membrane phenomena, and bioelectrodes.

3 credits

ESM 599 Research

Variable and repetitive credit

ESM 603 Surfaces and Interfaces I

A large part of technology depends on the properties of surfaces and interfaces. This course explores the application of physical and chemical principles to the study of surface behavior. The following topics are included: thermodynamics of surfaces, surface bonds, interfacial tension, properties of monolayers, surface potentials, surface conductance, electrokinetic phenomena, adsorption at liquid interfaces and solids, reactivity at interfaces, theory of corrosion and oxidation, structural defects and interfacial behavior.

3 credits

ESM 604 Surfaces and Interfaces II

This course is the second half of ESM 603 and includes the physics of semiconductor surfaces and thin films with applications, chemadsorption and catalysis, membrane phenomena, mass transport through surfaces, applications to adhesion, friction, lubrication, wear, wetting and detergency; stability of colloids, emulsions, foams, smog and pollution, ion exchange, chromatography.
Prerequisite: ESM 603.

3 credits

ESM 606 Strength and Plasticity of Solids

An advanced treatment of the strength and plasticity of solids from both the macroscopic and microscopic viewpoints. Subjects included are analysis of stresses and strains in solids, mechanical tests and properties, macroscopic criteria for yielding and fracture in homogeneous solids, modes of fracture, ductile and brittle behavior; disclocation theory and the strength of materials, generation and multiplication of dislocations, dislocation interactions and theories of yielding and fracture, influence of impurities, solutes, and dispersed phases upon dislocation movement, theories of fatigue, creep, and rupture at elevated temperatures.

3 credits

ESM 609 Diffusion in Solids

Diffusion in solids is considered in detail, including solution of the transport equations for volume, grain boundary, and surface diffusion, Kirkendall effect and other diffusion phenomena, atomic mechanisms of diffusion, correlation effects, etc. Next, the theory of processes in which diffusion plays an important role is considered, such as ionic conduction, oxidation of metals, and the sintering of solids.

3 credits

ESM 610 Phase Transformations

The theory of phase transformations in solids is considered. Kinetics and mechanisms of nucleation and growth and martensitic transformations. Melting and solidification, precipitation from solid solution, polymorphic transformations, eutectic and eutectoid reactions, second order transitions, recrystallization and other transformations in solids.
Prerequisite: ESM 515.

3 credits

ESM 615 Electron Theory of Solids

Ban theory of solids, Brillouin zones, Fermi surface in metals, alloys, and semi-conductors, galvanomagnetic effects, optical properties, magnetism, lattice vibrations, and thermal properties of solids. Applications to magneto-resistance, Hall effect, and thermoelectric devices, photoconductors and luminescent materials, metal-semiconductor contacts and the photovoltaic effect.

3 credits

ESM 616 Advanced Topics in Solids

Selection is made from topics such as: shape of the Fermi surface in metals, theory of de Haas van Alphen effect, cyclotron resonance, anomalous skin effect, magnetoplasma wave propagation, acoustic attenuation. Energy bands in semiconductors and spin resonance; impurity states, optical absorption, and excitons. Theory of alloys, neutron diffraction by crystals, Mossbauer effect.

3 credits

ESM 618 Electric and Magnetic Polarization of Materials Science I

This course is designed to teach the student the origins of magnetic and dielectric properties of materials, the relationship between properties and structure, and impart an understanding of the physical principles involved in the device applications of magnetic and dielectric materials. The course covers a review of atomic structure; electric and magnetic susceptibilities; piezoelectricity, ferroelectrics and antiferroelectrics; thermodynamical theory of ferroelectricity; ferroelectricity and lattice dynamics; ferro- and ferrimagnetics and anti-ferromagnetics; theories of ferromagnetic anisotropy; magnetic metals and alloys; garnets and ferrites; domain theories and micromagnetics.

3 credits

ESM 619 Electric and Magnetic Polarization of Materials II

This course is a continuation of ESM 618 concentrating on the physical principles of dielectric and magnetic materials in technical applications. The course covers the semiclassical spin wave theory; para-, ferro- and anti-ferromagnetic resonances; mechanisms of magnetic relaxation; dielectric loss and relaxation; magnetoacoustic effects; magnetic piezoelectric materials; flux reversal mechanisms; switching mechanisms in ferromagnets and ferroelectrics; magnetic thin film; coupled films and other forms of computer materials; materials for microwave applications.

Prerequisite: ESM 618.

3 credits

ESM 620 Theory of Diffraction

A development of the basic theory of diffraction of X-rays, electrons, and neutrons by crystalline and non-crystalline matter is presented. Both the kinematical and dynamical theory are treated. Topics covered include scattering by atoms; diffraction from a small crystal and powders; effect of thermal vibration; effects of aperiodicities such as order-disorder, particle size, strains, twin faulting; scattering by non-crystalline matter, and diffraction from an extended perfect crystal.

Prerequisite: ESM 520 or permission of instructor.

3 credits

ESM 650 Advanced Topics in Mechanical Properties of Solids

This course is intended for advanced students especially those doing research in the area. The specific topics covered will vary from semester to semester depending upon the interest of the instructor and the students and the recent developments in the field. Generally, topics to be covered would include the facts of detailed description of defects and their relation to mechanical structure, especially the dislocation theory; plasticity and yield criteria, creep, fatigue; microscopic theory of fracture including ductile and brittle behavior and the relationship of plastic flow to cleavage.

3 credits

ESM 651 Materials in Medical and Dental Sciences

The purpose of this course is to provide a thorough survey of the uses of mate-

rials in the medical and dental sciences. Current research and the problems encountered in each area will be reviewed. Topics include general considerations of materials requirements, corrosion and wear under physiological conditions, mechanical stress, interaction of materials with blood and the problems of clotting, transport of biological substances through membranes, application to the development of artificial arteries, hearts, heart valves, oxygenators, artificial kidneys and other organs, bone and dental implants.

3 credits

ESM 652, 653 Optical Properties of Matter I and II

After a brief review of basic concepts of physical optics, a survey of modern optical materials and their characterizations is undertaken. The optical properties of both glasses and crystalline materials are developed and related to their physical origin. Specific attention is given to interaction mechanisms including electrooptic and elasto-optic behavior and to the principles of coherent diffraction. Applications of these materials into optical systems such as lasers, coherent processors, Q-switches, displays, and instruments will be developed within the context of the course.

3 credits each semester

ESM 654 Lattice Defects in Metals

An advanced seminar course primarily concerned with point defects in metals and their interactions with themselves, dislocations, and other extended crystal defects. Topics covered may include equilibrium defects, non-equilibrium defect populations introduced by quenching, radiation damage and deformation, primary and secondary properties of defects, and defect interactions. The specific course content will, however, be planned with the students.
Prerequisites: ESM 511 and ESM 515 and/or permission of the instructor.

3 credits

ESM 655 Processing of Materials

An advanced topics seminar on the mechanical and thermal processing of a wide range of metallic and non-metallic materials. Both traditional and more modern forming operations will be examined. Recently developed schemes of thermomechanical treatment and thermal processing for the control of microstructure and properties will be explored.
Prerequisite: Permission of the instructor.

3 credits

ESM 656 Advanced Thermodynamics of Solids

This course is concerned with the analysis of diffusion, oxidation, phase transformation, and other rate processes in complex materials from the point of view of the thermodynamics of irreversible processes. After presenting the basic concepts of entropy production, coupled processes, and the Onsager relationships, application of the theory is made to thermoelectric and thermomechanical effects in solids, as well as diffusion in multicomponent and multiphase systems, and theory of sintering, and the oxidation of metals and alloys.
Prerequisite: ESM 509.

3 credits

ESM 696 Special Problems in Materials Science

Supervised reading and discussion of selected publications in particular fields of materials science. This course is designed primarily for advanced graduate students who are, or expect to be, involved in research in these areas, although other students may enroll with permission of the instructor.

3 credits, repetitive

ESM 697 Materials Science Colloquium

A weekly series of lectures and discussions by visitors, local faculty and students presenting current research results.

1 credit, repetitive

ESM 698 Practicum in Teaching

3 credits, repetitive

ESM 699 Research

Variable and repetitive credit

Department of Mechanics

Professors:
BERLAD, BRADFIELD, CESS, IRVINE, R. S. L. LEE *(Chairman)*, O'BRIEN, STELL, TASI, C. H. YANG

Associate Professors:
CHEVRAY, CHIANG, S. HARRIS, VARANASI, L. WANG

The Department of Mechanics offers graduate work leading to the Master of Science and Doctor of Philosophy degrees. The department offers a broad program emphasizing fundamental knowledge in the basic academic areas of energy transfer and thermokinetics, thermodynamics, solid mechanics, and fluid mechanics. Faculty research interests include convective and radiative heat transfer, magnetohydrodynamics, statistical mechanics, gas dynamics, turbulence, combustion, thermokinetics, photoelasticity, theory of structure, anelasticity, fluid mechanics, solid mechanics, biomechanics, experimental methods, atmospheric study, fire research, and suspension flows. In each area students are encouraged to participate in research. Only two areas are required for Ph.D. Preliminary Examinations.

Requirements for the M.S. and Ph.D. degrees are listed on pages 109–110. In addition, for admission to the doctoral program in the Department of Mechanics, a defense of a Ph.D. thesis proposal is required as part of the preliminary examination, unless the student has earned his masters degree, with thesis.

The residence requirement for the Ph.D. degree is two consecutive semesters of full-time study; there is no residence requirement for the M.S. degree.

Courses

ESC 501 Convective Energy Transfer

Discussion of the laws of conservation of mass, momentum, and energy, with particular emphasis on the proper formulation of the energy equation and its subsequent reduction to physically useful limits such as that of incompressible flow. Introduction of the method of singular perturbations and the application of this method to develop the velocity and thermal boundary layer equations. Similarity solutions of the boundary layer equations, asymptotic formulations of the energy equation for large and small Prandtl number and methods of treating boundary layer problems which do not reduce to a similarity transformation.

3 credits

ESC 502 Radiative Energy Transfer

Discussion of the basic physics of black body radiation with emphasis upon the respective roles of electromagnetic theory and quantum statistics. Radiative absorption and emission processes for both opaque surfaces and absorbing-emitting gases. Radiative properties of surfaces, and formulation of the radiative exchange equations for systems of surfaces

separated by a non-participating medium. Derivation of the equation of transfer for absorbing, emitting, and scattering media, subsequent formulation of the radiative flux vector within such media, and application of this formulation to conservation of energy within systems involving absorbing, emitting, and scattering media.

3 credits

ESC 503 Heat Conduction and Heat Exchangers

Analysis in one, two and three dimensions of steady state and transient heat conduction problems including the use of analogue and approximate analytical techniques. Study of the basic operation and design of a variety of Heat Exchangers.

3 credits

ESC 505 Topics in Power Generation and Energy Resources

This course provides a study of the physical principles of energy technologies. Topics include heat transfer, thermodynamics, energy conversion, electrochemistry, hydrogen fuel, solar power, and fusion power.
Prerequisite: ESC 398 or its equivalent.

3 credits

ESC 511, 512 Advanced Fluid Mechanics I and II

Lagrangian and Eulerian frames. Dynamical equations of momentum and energy transfer. Fluid statics, including self gravitation, stability of floating bodies, surface tension effects, and statics of planetary atmospheres. Two dimensional dynamics of incompressible and barotropic perfect fluids and of the compressible perfect gas. Conformal mapping applied to two dimensional fluid dynamics. Jets and cavities. Surface waves, internal waves, and shock waves. Perfect shear flows and shear flow turbulence.

3 credits each semester

ESC 513 Transport Phenomena

An introduction to the transport of momentum, energy, and mass in fluid media. The equations of change for isothermal systems. Interphase transport in isothermal systems. Macroscopic balances for isothermal systems. Mechanism of energy transport. The equations of change for nonisothermal systems. Interphase transport in nonisothermal systems. Mechanism for mass transport. Concentration distributions in solids and in laminar flow. Concentration distributions in turbulent flow. Interphase transport in multicomponent systems.

3 credits

ESC 514 Introduction to Turbulence

Introductory concepts and statistical description. Kinematics of random velocity fields. Equations of motion and their interpretation. Experimental techniques: isotropic turbulence and the closure problem. Transport processes in a turbulent medium. Turbulent jets, wakes, and boundary layers.

3 credits

ESC 515 Dynamical Meteorology

Introduction to the study of weather. Differential solar heating. Hydrostatic equilibrium. Coriolis effect, geostropic wind, and thermal wind. Baroclinic instability and barotropic instability. Interaction of the small scale turbulent eddies and the large scale two-dimensional flows. Jet stream, long waves and cyclone waves. Synoptic meteorology and weather predictions.

3 credits

ESC 516 Physical Climatology

Introduction to the study of climate—statistical aspect of weather (temperature, pressure, humidity, precipitation, and wind). Solar physics and solar constant. Theory of radiative transfer, global albedo. Orbital parameters of a planet. Transport of angular momentum and heat, hydrological processes. Stability of polar caps. Paleoclimatology and climatic changes.

3 credits

ESC 521, 522 Energy Transfer in Gases I and II

Review of fundamental concepts in quantum mechanics, statistical thermodynamics, and electromagnetic theory from an

engineer's point of view. Thermodynamic properties of gases at high temperatures. Absorption and emission of radiation in high temperature gaseous environments. Rates of relaxation processes in gases and plasmas. Shock wave structure and radiating shock layers. Discussion of current experimental techniques for measuring temperature, rate constants, and other properties in equilibrium and non-equilibrium processes.

3 credits each semester

ESC 524 Statistical Mechanics

The course begins with the theory of the canonical and grand ensembles of quantum mechanical systems, with applications to the calculation of thermodynamic properties of simple crystals and ideal gases. The main topic of the course is the study of the effect of intermolecular forces upon the thermodynamic functions of classical fluids via the theory of the configuration integral, the theory of molecular distribution functions, and the McMillan-Mayer solution theory. This includes a study of some approximation methods such as cluster expansions and integral equations. The course concludes with an introduction to the theory of transport and relaxation coefficients of systems of interacting molecules. This course is identical to CHE 528.

3 credits

ESC 528 Introduction to Experimental Stress Analysis

Elementary theory of elasticity, electrical and mechanical strain gauges, introduction to photoelasticity and moire method. Brittle coating and analog methods. Application of different methods to the study of static and dynamic problems.

3 credits

ESC 529 Vehicular Dynamics

The study of applications of fluid dynamics theory to practical devices is undertaken in this course. Both internal flow and external flow are considered. Elements of subsonic and supersonic airfoil design are discussed. The effects of boundary layer growth on design and performance are studied. The stability of hydrodynamics systems is introduced.

3 credits

ESC 530 Viscous Fluids

The role of viscosity in the dynamics of fluid flow is explored. The Navier-Stokes equations are developed, some exact solutions obtained, dynamical similarity established, and Reynolds number introduced. Low Reynolds number behavior is studied including lubrication theory, percolation through porous media, corner flows, viscosity of dilute suspensions of small particles, and flow due to moving bodies. Behavior of flow due to moving bodies at moderate Reynolds number is described as is high Reynolds number behavior including vorticity dynamics, steady, unsteady, and detached boundary layers, flow due to steadily moving bodies, jets, free shear layers, and wakes.

3 credits

ESC 531 Compressible Gas Dynamics

One-dimensional gas dynamics and wave propagation, shock waves in supersonic flow, Prandtl-Meyer expansion, and hodo graph plane. The calculation of supersonic flows by small-perturbation theory and the method of characteristics. Effects of viscosity and conductivity, and concepts from gas kinetics.

3 credits

ESC 532 Structural Dynamics

The mechanical behavior of engineering structures is studied by choosing topics from the quasi-static and dynamic response of elastic and inelastic beams, bars, columns and shells subjected to mechanical and thermal loading.

3 credits

ESC 533 Statistical Theory of Fluids

A study of the bulk properties of fluids, especially the equilibrium properties of dense fluids determined through the use of molecular distribution functions and various perturbative procedures. During the latter half of the course one or more particular systems and/or problems (e.g., ionic or polar fluids, critical phenomena)

are examined in some detail to illustrate the use of the general methods developed.

3 credits

ESC 534 Magnetofluid Dynamics

An integration of the concepts of fluid mechanics and electromagnetic theory. The interactions between an electrically conducting fluid and an applied electromagnetic field are studied, and the ramifications of these with respect to engineering applications such as power production, thermo-nuclear confinement, flow control, drag reduction, and signal distortion are considered. Special consideration is given to the study of plasmas and magnetohydrodynamics.

3 credits

ESC 535 Dynamical Oceanography

The hydrodynamic equations in rotating systems; status and dynamics of functionless ocean currents; thermohaline circulations and frictional coupling between wind and water; radiation budget of the Northern Hemisphere; wind waves, gravitational and tidal forces, turbulent diffusion at the surface, and the role of density stratification in dynamical oceanography.

3 credits

ECS 537 Experimental Fluid Mechanics

Fundamentals of measurements and instrumentation. Operating principles and performance characteristics of instruments for measurements of physical quantities such as velocity, pressure, and temperature. Flow visualization in liquid and gases. Optical methods in compressible flow: interferometry, schlieren, shadow. Fundamentals of acoustics. Introduction to analysis and measurement of random variables. Laboratory demonstrations.

3 credits

ESC 540 Geophysical Fluid Dynamics

Inertia and gravity effects of entropy or density variations in fluids. Small amplitude waves, gravitational and Helmholtz instabilities, internal waves and turbulence. Coriolis effects of the earth's rotation. Comparison of gravity and rotation effects on the behavior of non-homogeneous fluids. Applications to natural phenomena.

3 credits

ESC 541, 542 Elasticity I and II

Derivation of linear equations of elasticity. Stress equations of motion. Displacement and strain. Stress-strain relations for crystalline solids. Compatibility equations. Uniqueness theorem. Reciprocity theorem. Applications to static three-dimensional problems. Contact theory. Two-dimensional problems. Wave propagation in infinite and bounded media. Elastic lattice vibrations and theories of microstructure.

3 credits each semester

ESC 543 Plasticity

The concepts of stress and deformation of solids are reviewed. Yield criteria and flow rules for plastically deforming solids are presented. The notion of a stable inelastic material is introduced. Static and dynamic analyses of plastic bodies under mechanical and thermal loadings are illustrated. The use of load bounding theorems and the calculation of collapse loads of structures are considered.

3 credits

ESC 545 Theoretical Meteorolgy

This course is an introduction into the quantitative interpretation of the thermal and dynamical structure of planetary atmospheres. Topics to be covered include: hydrostatic equilibrium, hydrostatic stability and convection, solar and terrestrial radiation, the atmospheric equations of motion for a rotating planet, atmospheric energy relationships and general circulation.

3 credits

ESC 551 Mechanics of Continua

An introduction to the study of continuous media. The Cartesian tensor calculus is employed in the description of the statics and kinematics of such media under the assumption that the deformations are infinitesimal. The fundamental

equation of continuity, momentum and energy for a general continuum are derived. The treatment is specialized to various media by the introduction of constitutive equations for elastic, viscoplastic, and viscoelastic solids and for perfect and viscous incompressible fluids.

3 credits

ESC 552 Analysis of Composite Solids

An introduction to the study of the mechanics of composite solids. The main emphasis of the course is on the analysis of layered composite materials. The Cartesian tensor calculus is used. Homogeneous anisotric media are studied first. The effect of layering is then analyzed. Applications to plates and shells are considered. Current theories of inelastic mechanical behavior of composite solids are introduced.

3 credits

ESC 561 Photoelasticity

Theory of two- and three-dimensional photoelasticity, frozen stress technique, oblique incidence method, scattered light photoelasticity, birefringent coating, fringe multiplication, and sharpening. Technique of absolute retardation. Dynamic photoelasticity and photothermoelasticity.

3 credits

ESC 591 Thermodynamics

An advanced course in classical thermodynamics presented from the postulational point of view. Also considered are such topics as Pfaff differentials and Caratheodorys principle, thermodynamics of irreversible processes, and the thermodynamics of small systems and solutions.

3 credits

ESC 599 Research

Variable and repetitive credit

ESC 601 Nonlinear Mechanics

Stability theory and Liapunouv functions. Phase plane analysis, Limit Cycles, and Bifurcation Theory. Discussions of generalized Volterra, Van der Pol, Riccati, Emden and Poisson-Boltzman equations. Isocline and Liénard Methods of graphic construction. Poincaré and Lindstet's Method of small perturbations. Asymptotic process of Krylov and Bogoliubov for autonomous and non-autonomous systems. Dorodnitzin Method and singular perturbation theory in relaxation oscillations. Problems in chemical kinetics, nerve conduction, population dynamics, and mechanical and electrical oscillations.

3 credits

ESC 611 Advanced Reactive Media I

Thermodynamics, rate processes, flow and stability of reactive media. Thermokinetic and thermophysical properties of non-equilibrium systems. Spectroscopic states and energy transfer in reactive systems. Non-equilibrium radiative properties of reactive gases. Laser action. Laser initiation and breakdown. Nonadiabatic theory of reaction wave structure, initiation, propagation, and extinction. Fundamentals of theory and experiment for combustion, condensation, crystallization, solid state phase transitions, and selected other transport processes.

3 credits

ESC 612 Advanced Reactive Media II

Continuation of Advanced Reactive Media I. Application of previously discussed principles and techniques to current problems. Examination of the modern literature with emphasis on detailed discussion of selected journal articles.

3 credits

ESC 613 Phase Transitions and Critical Phenomena

Traditional approaches (Weiss mean field, Bragg-Williams, and van der Waals-like theories) as well as more recent work (scaling laws of Kadanoff and Widom, functional expansions, "semi-invariant" expansions) are examined. Various useful models such as the Ising model (of a fluid, binary alloy, and ferromagnetic material) are discussed. In addition to liquid-gas and order-disorder transitions, to which the above remarks

are relevant, the nature of the solid-liquid transition is also considered.

3 credits

ESC 614 Applications of Equilibrium Statistical Mechanics

The relation between the thermodynamical properties of a system at equilibrium and its Hamiltonian is considered. The emphasis is on developing a set of techniques that enables one to assess the properties of fluids and certain solids over a wide range of thermodynamic conditions, including those found near a critical or Curie point. The use of cluster expansions and functional Taylor series are among the techniques stressed.

3 credits

ESC 615 Seminar in Radiative Transfer

Topics of current interest concerning radiative energy transfer in gases are discussed.

3 credits

ESC 620, 621 Combustion Theory I and II

Thermal, chain, and unified theories of explosion. Kinetic and thermokinetic oscillations. Combustion kinetics. Theory of flame propagation, extinction limits, source ignition, and turbulent combustion. Detonation theory of gases and condensed phase explosives; initiation mechanism, detonability limits, and spinning detonation.

3 credits each semester

ESC 622 Environmental Fluid Mechanics

Fluid mechanical principles applied to selected problems of the environment. Interactions of the air-land-sea environment will be emphasized. Heat and mass transfer phenomena will be considered in relation to thermally-driven microcirculations. Experimental methods will be studied.

3 credits

ESC 625 Turbulent Diffusion

Eulerian description of passive contaminants in homogeneous turbulence. Closure techniques and their flaws. Lagrangian description of single particle and relative diffusion. Similarity in shear flows. The role of buoyancy forces and chemically reactive scalars.

3 credits

ESC 627 Special Topics of Combustion in Propulsion

Burning of fuel droplets in an oxidizing atmosphere. Flames and detonations in fuel sprays. Steady state combustion in rockets. Mixing and injection dynamics. Non-linear oscillations. Chugging and screaming modes of instability in liquid engines. Combustion processes and stability of solid rockets.

3 credits

ESC 631 Kinetic Theory

Theory of the Boltzmann equation. The Hilbert, Chapman-Enskog, and Grad solutions, and the transition to fluid dynamics, determination of transport coefficients. Relationship of normal solutions to actual solutions of the Boltzmann equation.

3 credits

ESC 632 Non-Equilibrium Statistical Mechanics

Theory of the BBGKY equations. Derivation of the Boltzmann and generalized Boltzmann equations. The correlation function approach to transport theory. Some explicit results for dense gases are considered.

3 credits

ESC 642 Advanced Mechanics of Continua

The curvilinear tensor calculus is reviewed. Basic equations which govern the behavior of continuous media are derived in which finite deformations are permitted. Coupling between mechanical, thermal, electromagnetic, and other effects is considered. The thermodynamics of continuous media are studied. Singular surfaces and waves are examined.

3 credits

ESC 661 Measurements System Design

Design of research instrumentation in the context of the research problem. Selection of appropriate transducers for response to a given phenomenon and design of appropriate intermediate and readout components. Specific problems may be selected, depending upon the students' interest.

3 credits

ESC 671 Interferometric Methods in Experimental Stress Analysis

Theory of moire fringes, two- and three-dimensional methods, Lightenberg technique, shadow moire, Salet-Ikeda and Mantinelli-Ronch techniques and holography. Applications to thermal stress and residual stress problems, vibration analysis, wave propagation, plastic strain, deformation of plates and shells, and structural model analysis.

3 credits

ESC 681 Planetary Atmospheres

A survey of current knowledge about the compositions, structures, and dynamics of the atmospheres of planets in our solar system. Models for upper and lower regions and probable evolutionary histories will be discussed. Emphasis will be placed on the most recent results obtained from space craft and ground-based observations. Student participation is encouraged. This course is identical to ESS 611.

3 credits

ESC 696 Special Problems in Mechanics

Conducted jointly by graduate students and one or more members of the faculty.

3 credits, repetitive

ESC 698 Practicum in Teaching

3 credits, repetitive

ESC 699 Research

Variable and repetitive credit

Allied Health Sciences
Basic Health Sciences
Dental Medicine
Medicine
Nursing
Social Welfare

The Health Sciences

The Health Sciences Center is an integral part of the Stony Brook campus, offering a comprehensive education in the health professions. It consists of six schools set up to provide the special education needed for the training of the total range of health professionals: the School of Allied Health Professions, the School of Basic Health Sciences, the School of Dental Medicine, the School of Medicine, the School of Nursing, and the School of Social Welfare. These schools are served by four divisions offering close cooperation in the support of those academic, scientific and administrative functions that are common to the programs and needs of more than one school: Health Sciences Communication, Laboratory Animal Resources, Social Sciences and Humanities and the Health Sciences Center Library.

The Health Sciences Center has also established a partnership with four Long Island hospitals, referred to as "clinical campuses," where students receive their essential patient care experience in the "field." These are: Brookhaven National Laboratory Hospital; Long Island Jewish-Hillside Medical Center/Queens Hospital Center; Nassau County Medical Center; and Northport Veterans Administration Hospital. An agreement has also been signed between the Health Sciences Center and the hospital currently being built in Westhampton Beach, establishing this as a future clinical campus for Stony Brook. In addition, the six schools have limited affiliation agreements with other hospitals in the region including: Central Islip Hospital, Good Samaritan Hospital, Huntington Hospital, Mercy Hospital, Nassau Hospital, North Shore Hospital, Saint Charles Hospital, Saint John's Hospital, South Nassau Communities Hospital, South Oaks Hospital and Southside Hospital.

With the opening of the School of Dental Medicine in September 1973, all the schools of the Health Sciences Center were in operation, with a combined full-time student enrollment of approximately 800. At present, the Health Sciences Center is located in temporary facilities located on the south campus occupying nine "surge" buildings and the laboratory/office building on main campus. By the end of the 1970's when the Health Sciences Center is expected to be fully functioning, this 250-acre campus site will house a total of 3500 full-time undergraduate and graduate students and an equal number of students in continuing and part-time clinical education. Construction is planned in three stages. The permanent facility, stage one, will be housed in a three-tower megastructure on the east side of Nicolls Road adjacent to the main campus. The six Schools—Allied Health Professions, Basic Health Sciences, Dental Medicine, Medicine, Nursing and Social Welfare—will occupy this one building which will also have a library, classrooms, and a computer center.

Second stage plans encompass a 550-bed university hospital that will serve the Nassau-Suffolk community as a tertiary care facility. The final stage of the Health Sciences Center complex will be a Basic Health Sciences building and Dental School.

School Organization: With the exception of the School of Social Welfare, the schools of the Health Sciences Center are organized structurally around departments and divisions:

SCHOOL OF ALLIED HEALTH PROFESSIONS:

Division of Administrative Programs
Division of Community and Mental Health Programs
Division of Diagnostic Programs
Division of Therapeutic Programs

SCHOOL OF BASIC HEALTH SCIENCES:

Department of Anatomical Sciences
Department of Biochemistry
Department of Biomathematics
Department of Microbiology
Department of Pathology
Department of Pharmacological Sciences
Department of Physiology and Biophysics

SCHOOL OF DENTAL MEDICINE:

Department of Children's Dentistry
Department of Dental Health
Department of Oral Biology
Department of Oral Surgery

Department of Periodontics
Department of Restorative Dentistry

SCHOOL OF MEDICINE:

Department of Anesthesiology
Department of Community Medicine
Department of Family Medicine
Department of Medicine
Department of Neurology
Department of Obstetrics and Gynecology
Department of Pediatrics
Department of Psychiatry
Department of Radiology
Department of Surgery

SCHOOL OF NURSING:

Department of Adult Health
Department of Advanced Nursing Studies
Department of Community Health
Department of Maternal and Child Health
Department of Mental Health

School Information: Specific and detailed information about the professional programs offered by the six schools is contained in the *Health Sciences Center Bulletin.* Since the Center's training of health professionals requires special academic programming and supportive services, significant sections of the data contained in this *Graduate Bulletin* are *not* applicable to the Health Sciences Center; e.g. admission procedures and requirements; registration; student services; educational expenses; financial aid; and academic calendar.

The *Health Sciences Center Bulletin* can be obtained by writing or telephoning the Health Sciences Center Office of Student Services (516-444-2109) , or the Office of the Dean of a specific school.

Graduate Programs

THE SCHOOL OF ALLIED HEALTH PROFESSIONS: The Division of Administrative Programs offers a masters program in Health Services Administration where qualified candidates are trained in the theory and methodology of administering high quality medical service. Requirements for the masters degree include 48 semester hours of didactic work, 12 semester hours of administrative residency, and a masters thesis. All

questions concerning admissions to the graduate programs of the School of Allied Health Professions should be addressed to:

Robert O. Hawkins,
Associate Dean,
School of Allied Health Professions,
Health Sciences Center,
State University of New York at Stony Brook,
Stony Brook, New York, 11790
(516-444-2253).

THE SCHOOL OF BASIC HEALTH SCIENCES offers programs leading to the Ph.D. degree in Anatomical Sciences, Microbiology, Pathology, Pharmacological Sciences and Physiology and Biophysics. These programs are designed to lead to careers in research and teaching. The currently-offered programs are described on the following pages.

THE SCHOOL OF DENTAL MEDICINE: Admission to the school is highly selective. The School of Dental Medicine does not have a separate application form but participates in the centralized American Association of Dental Schools Application Service. The pre-doctoral program will lead to a dental degree after a period of approximately 3½ years of study containing about 4900 hours of clinical and non-clinical instruction.

THE SCHOOL OF MEDICINE: Admission to the school is highly selective and students must take the Medical College Admissions Test to be considered for acceptance. The school offers a three-year program leading to the M.D. degree.

All questions concerning admission to the Schools of Dental Medicine and Medicine should be addressed to:

Dr. Gerald Green,
Associate Dean,
Schools of Dental Medicine and Medicine,
Health Sciences Center,
State University of New York at Stony Brook,
Stony Brook, New York
(516-444-2113).

THE SCHOOL OF NURSING: The school has recently completed a feasibility study which gives ample evidence that a graduate program in nursing should be developed with the goal of producing very skilled practitioners in the nursing profession. Plans are now being formulated to work out a curricula for a graduate program in close collaboration with the other schools of the Health Sciences Center.

THE SCHOOL OF SOCIAL WELFARE: This school offers an MSW degree, a 4-semester program which includes academic courses and field work. The

curriculum in the School of Social Welfare is organized into three concentrations:

1. intervention with individuals, families and small groups,
2. theory and analysis,
3. policy planning, research, administration and community organization.

All questions concerning admission to the School of Social Welfare should be addressed to:

John Haynes,
Director of Admissions,
School of Social Welfare,
Health Sciences Center,
State University of New York at Stony Brook,
Stony Brook, New York, 11790
(516-444-2143).

School of Basic Health Sciences

Dean:	*Associate Dean:*	*Assistant Dean:*
UPTON	KIM	WINGATE

The preclinical disciplines fundamental to the health professions are organized in a School of Basic Health Sciences. These disciplines are represented by Departments of Anatomical Sciences, Microbiology, Pathology, Pharmacological Sciences, and Physiology and Biophysics. Also included for certain administrative purposes are Departments of Biomathematics and Biochemistry. The latter, however, are housed in the Division of Biological Sciences. These departments, in conjunction with appropriate components of the Division of Biological Sciences, have principal responsibility for preclinical instruction of students in all schools of the Health Sciences Center. They also have university-wide responsibility to students in all other schools on the campus, as well as on affiliated clinical campuses, for undergraduate and graduate training and research in the disciplines basic to health.

The faculty listing that follows includes only those members sharing major responsibility for graduate education. A comprehensive listing of all Health Sciences faculty members is presented in the *Health Sciences Center Bulletin.*

Department of Anatomical Sciences

Professors: DEWEY *(Chairman)*, FUSCO, INKE

Associate Professors: CREEL, STERN, WILLIAMSON

Assistant Professors: BLAUSTEIN, BROWN, IRVING, LAFER, WALCOTT, WELLS

Department of Biochemistry*

Professors: CIRILLO, E. SHAW *(Adjunct)*, M. SIMPSON *(Chairman)*

Associate Professors: DUDOCK, FREUNDLICH, GESTELAND *(Adjunct)*, INOUYE, MOOS, RILEY, STUDIER *(Adjunct)*

Assistant Professors: ARNHEIM, SARMA, SCHMIDT, S. SIMON, R. STERNGLANZ

Department of Biomathematics

Assistant Professor: ROBINSON

Department of Microbiology

Professor: KATES *(Chairman)*

Associate Professor: ABRAHAMS, BAUER, DELIHAS, KIM

Assistant Professors: GOUGH, KEEGSTRA

Department of Pathology

Professors: ACKERMAN, BERKMAN, CONARD, ISENBERG, JANOFF, KLAVINS, KUSCHNER *(Chairman)*, PALLADINO, SAWITSKY, SHELLABARGER, SOKOLOFF, UPTON, WEINBERG

Associate Professors: CARSTEN, CHANANA, DUFFY, FARRIS, JOEL, LANE, MILLER, PHILLIPS, ROSENTHAL, WEISBROTH

Assistant Professors: POLLACK

Department of Pharmacological Sciences

Professors: GROLLMAN *(Chairman)*, JOHNSON, REICH *(Visiting)*, ROSEN

Assistant Professor: WILLIAMS

Department of Physiology and Biophysics

Professors: LEFEVRE, LEVY, ROBERTSON, STROKE, VAN DER KLOOT *(Chairman)*

Associate Professor: MENDELSON

Assistant Professors: FARA, MASIAK, MCLAUGHLIN

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* See programs listed under Division of Biological Sciences (page 90).

Graduate Programs in Basic Health Sciences

In cooperation with the Division of Biological Sciences, newly organized doctoral programs are being offered in Anatomical Sciences, Microbiology, Pathology, Pharmacological Sciences, and Physiology and Biophysics. Each program is under the direction of its own program chairman and executive committee. Students wishing to pursue a combined M.D.-Ph.D. program should apply for admission to both Schools (BHS and Medicine), since admission to one program does not guarantee admission to the other. The programs are briefly described in the following sections.

Anatomical Sciences

The program in Anatomical Sciences offers graduate studies in four broad areas: Developmental Anatomy, Microscopic Anatomy, Macroscopic Anatomy, and Neuroscience. The Program in *Developmental Anatomy* includes genetics, embryology, developmental mechanisms, and fetal biometrics. The *Microscopic Anatomy* Program emphasizes the structure and function of biological membranes, cells and excitable tissues. The program in *Macroscopic Anatomy* consists of biomechanics and biometrics in human and vertebrate anatomy, and physical anthropology, including primatology. The *Neuroscience* Program emphasizes mammalian neuroanatomy and neurophysiology, and it includes neurocytology, neurohistology, electrophysiology, and animal behavior. Further details of the program in Anatomical Sciences may be obtained from the program chairman, Dr. Madeline Fusco.

Microbiology

The Department of Microbiology offers a variety of programs leading to the Ph.D. degree. The general areas of research being conducted in the Department encompass all aspects of modern microbiology. These consist of *prokarytotic systems,* including bacteria and bacteriophages; *animal viruses* and the virus-host relationship; *eukaryotic cells,* including the biochemistry of cell surfaces; and *subcellular systems,* including nucleic acids and biological control mechanisms. The required course work will be designed to cover cell biology, biochemistry, genetics, molecular biology and developmental biology. Students are given the opportunity initially to conduct short-term research projects in two or three different laboratories, followed by concentration on a major, dissertation research project. Further details may be obtained from the Graduate Advisor, Dr. William Bauer.

Pathology

This program provides a broadly-based approach to research in the pathology of human disease, including immunopathology, oncology, mechanisms of tissue injury, and environmental pathology. The curriculum initially is similar to that for first-year medical students, except for

modification of clinical training as may be appropriate. Later, the student pursues advanced courses, selected to provide expertise in the investigative area of his major interest, leading ultimately to dissertation research. Further details of the program may be obtained from the program chairman, Dr. Aaron Janoff.

Pharmacological Sciences

The program in Pharmacological Sciences is interdisciplinary and includes the opportunity for graduate studies in *Endocrinology, Neurobiology, Biochemical Pharmacology* and *Medicinal Chemistry.* Alternatively, graduate students and their preceptors may choose to participate in interdepartmental programs of *Molecular Biology* and *Chemical Biology.* The curriculum is directed towards developing a broad understanding of chemical and biological principles that underlie the action of drugs, chemicals, and hormones on living cells. Further details may be obtained from the program chairman, Dr. David Williams.

Physiology and Biophysics

Two curricular tracks are available, the first for students with broad interests in Physiology and Biophysics, and the second for students who are interested in those aspects of physiology more closely related to clinical medicine. As many of the departmental members are actively engaged in research in neurobiology and the molecular biology of cell membranes, the first track should be particularly attractive to students with interests in these areas. Students with a solid background in some branch of the natural sciences but with little formal training in biology are especially invited to inquire further about the program. For the second track, the first year curriculum is similar to that for beginning medical students, save for appropriate modification of clinical training. Further details concerning the programs in Physiology and Biophysics may be obtained from the program chairman, Dr. Stuart McLaughlin.

Admission Requirements

A. A baccalaureate degree with the following minimal preparation is required: mathematics through one year of calculus, chemistry including organic chemistry, general physics, and one year of biology, including laboratory.

B. A minimum grade point average of 2.75 (B−) in all undergraduate course work, and 3.00 (B) in science and mathematics courses.

C. Letters from three previous instructors and results of the Graduate Record Examination.

D. Acceptance by the Division of Biological Sciences and the Graduate School.

In special cases, students not meeting requirements A through C may be admitted on a provisional basis. These students must act to remedy deficiencies within the first year, according to individual departmental requirements.

Requirements for the Ph.D. Degree

A. Minimum residence: Two years of full-time graduate study.

B. Language proficiency: Whether or not foreign language proficiency or a substitute (such as computer programming) is required, is left to the discretion of individual departmental programs.

C. Formal course requirements: Successful completion of an approved course of study (approval is the responsibility of the respective program committee).

D. Candidacy (Preliminary) Examination: At the discretion of the department, the Preliminary Examination may be oral, or written, or both and may consist of a series of examinations. Students will normally apply for the examination after completing the major portion of course work, but no later than the end of the fifth semester of course work. In those departments which require foreign language proficiency tests, the latter must be passed before permission can be granted to take the Candidacy Examination.

E. Advancement to candidacy: The School's recommendation with respect to candidacy for the Ph.D. degree will be based upon satisfactory completion of the above requirements. Advancement to candidacy is granted by the Dean of the Graduate School.

F. Research and dissertation: The general requirements of the Graduate School regarding the Dissertation Examination will be followed.

The M.S. Degree

Where the circumstances surrounding a student's failure to complete the Ph.D. program are sufficiently extenuating, the M.S. degree may be awarded, provided that the following requirements are met:

A. One year residence.

B. Successful completion of an approved course of study (at least 30 graduate semester credits).

C. A comprehensive examination based on course work, and/or departmental approval of a written masters thesis and its successful defense in an oral examination.

Preparation for Teaching

As part of their graduate training, all students are required to participate in teaching activities and to demonstrate mastery of teaching skills.

Graduate Courses

The following is a comprehensive listing of courses in the various programs. For prerequisite requirements, students should consult the *Health Sciences Center Bulletin.* For the availability and calendar schedule of individual courses, students should consult the respective program chairman.

HBA 500 Structure of the Human Body

An integrated course in anatomy stressing the functional organization of the organ systems (nervous, musculoskeletal, cardiovascular, respiratory, gastrointestinal, urinary, reproductive, and endocrine) will be covered with emphasis on the relationship between structure and function. Instruction will consist of lectures and laboratory demonstrations using slide projections, models and prosections.
Prerequisite: Introductory biology or permission of instructor.

Q1 and Q2, 9 credits

HBA 501 Regional Anatomy of the Human Body

Detailed knowledge of diagnostically and therapeutically important structural relationships of the human body will be obtained from dissection of cadavers, study of prosections, radiograms and models. Surface anatomy and cross-sectional anatomy will be included where necessary for physical diagnosis and radiographic interpretation.
Prerequisite: HBA 500 or permission of instructor.

Q3 and Q4, variable 1 to 4 credits

HBA 561 Techniques in Neurohistology

The structure of the nervous system studied by light and electron microscopy. The course includes the methods of processing, sectioning, and staining normal and experimental neural tissues. Emphasis is placed on the use of modern methods of staining degenerating axons and axon terminals, correlating light microscopy findings with those of electron microscopy.

Spring, 2 credits

HBA 562 Techniques in Electron Microscopy

A laboratory course designed to teach students how to fix and embed tissues, prepare ultrathin sections, obtain and process electron microscope photographs, and interpret ultrastructural details. Theory of electron optics will be discussed where applicable to the above techniques. Methods in routine maintenance of an electron microscope will also be stressed.

Fall and spring, 2 credits each semester, repetitive

HBA 590 Projects in Anatomical Sciences

Individual laboratory projects closely supervised by faculty members, to be carried out in staff research laboratories.

Fall and spring, 2 credits each semester

HBA 651 Comparative Structure of Muscle

Smooth, cardiac, and skeletal muscles of the vertebrates are compared structurally. Functional considerations are studied in relationship to contractile mechanisms of these muscle types. Selected invertebrate muscles will be studied to elucidate additional functional principles.

Spring, alternate years 3 credits

HBA 652 Current Aspects of Human Genetics

The active areas of research in human genetics are explored. Emphasis is placed

on such aspects as cytologic methods of human chromosome identification, genetic mapping of human chromosomes, certain metabolic disorders, and inherited developmental abnormalities.

Spring, alternate years 2 credits

HBA 653 Mammalian Genetics

A detailed consideration of certain aspects of the genetics of eukaryotic organisms. Topics to receive emphasis are: ploidy, recombination mechanisms, cell hybridization, and extrachromosomal inheritance.

Spring, alternate years 2 credits (1976)

HBA 654 Comparative Neuroanatomy

Emphasis will be placed on the comparative approach to the study of the central nervous system. The form, structure and functional organization of various orders of mammals will be discussed.

Spring, alternate years, 3 credits

HBA 655 Advanced Neurosciences

An integrated approach to the study of the mammalian and human nervous system. The anatomy, physiology, pharmacology, and, to some extent, the chemistry of the central nervous system will be studied.

Spring, 3 credits

HBA 656 Comparative Cell and Tissue Biology

The purpose of the course is to introduce students to the structural organization of cells and tissues and to the way the structure relates to function. Particular emphasis will be placed on cell organelle structure and function in specialized cells in tissues. The organization and interaction of cells in tissues also will be covered. The course will be comparative and will include examples of tissues from vertebrates and invertebrates.
Prerequisite: Baccalaureate degree in science or permission of instructor.

Spring, 3 credits

HBA 661 Methods in Research

Students are involved in research projects supervised by staff members in their research laboratories on a rotational basis.

Fall and spring, 3 credits each semester

HBA 662 Methodology of Macroscopic Anatomy

Study of the means of displaying structure on the gross level (dissection, sectioning, maceration, cleaning, injection) of all organ systems. Principles of radio-logic and ultrasonic demonstrations, their applications to the cadaver. Introduction to measuring techniques (linear, planimetric, volumetric, 3-dimensional).

Fall and spring, 2 credits each semester

HBA 690 Graduate Seminar

Seminars by graduate students on current literature in the areas of the Anatomical Sciences.

Fall and spring, 2 credits each semester

HBA 691 Advanced Seminars

Advanced research seminars by staff, students, and visiting lecturers. Subjects will vary from year to year and will be determined by the needs of the graduate program and the interest of the students.

Fall and spring, 2 credits each semester

HBA 694 Thesis Research

Original investigation under supervision of thesis advisor and committee.

Fall and spring, variable and repetitive credit

HBA 695 Practicum in Teaching

Practice instruction in the teaching of Anatomical Sciences, carried out under faculty supervision.

Fall and spring, variable and repetitive credit

HBC 531 Human Biochemistry

Major aspects of the biochemistry and metabolism of cells, tissues, and organs, of particular relevance to an understanding of health and human disease.

Q1 and Q2 variable credit

HBH 531 Principles of Pharmacology

Basic principles that underlie actions of drugs on physiological processes with particular reference to their therapeutic and toxic actions.
Prerequisite: Permission of staff

Q3 and Q4, 3 credits

HBH 572 Pharmacology: Biochemical Aspects of Drug Action

This lecture and discussion course, designed for advanced undergraduate and graduate students, presupposes a certain degree of familiarity with organic chemistry and biochemistry. Basic principles underlying the actions of drugs, chemicals, toxins, and hormones on biological systems will be reviewed. Topics include receptors, interactions between drugs and macromolecules, structure-action relationships, metabolic inhibitors, selective toxicity, action of chemotherapeutic agents, drugs affecting the nervous system, drugs acting on membranes and drug metabolism.
Prerequisite: Permission of the instructor. Enrollment in this course is limited.

Spring, beginning 1975, 3 credits

HBH 690 Pharmacology Seminars

Advanced research seminars by staff and visiting lecturers.

Fall and spring, 1 credit, repetitive

HBH 694 Thesis Research in Pharmacolgy

Original investigation undertaken as part of the Ph.D. program under supervision of thesis advisor and committee.

Fall and spring, variable and repetitive credit

HBI 540-549 Organ Systems Analysis

Integrative consideration of the fundamental aspects of the following organ systems with reference to the relevant anatomy, biochemistry, microbiology, pathology, pharmacology, and physiology: HBI 540—Cardiovascular; HBI 541—Central Nervous; HBI 542—Endocrine; HBI 543—Gastrointestinal; HBI 544—Musculoskeletal; HBI 545—Reproduction, Growth and Development; HBI 546—Respiratory; HBI 547—Reticuloendothelial; and HBI 548—Urinary. Primarily for medical students and qualified graduate students.
Prerequisite: Permission of graduate advisors.

Q1, 2, 3, 4, variable credit

HBI 561 Research Methods in Basic Health Sciences

Introduction to theory and practice of major laboratory techniques and instruments used in molecular and cellular biology; e.g., spectrophotometry, microscopy, ultracentrifugation, electrophoresis, chromatography, scintillation counting.

Spring, variable credit

HBI 690 Seminar in Basic Health Sciences

Bi-weekly seminars by students, staff, and visiting scientists on major topics of current interest in basic health sciences.

Fall and spring, 1 credit each semester, repetitive

HBM 509-510 Experimental Microbiology

An introduction to modern microbiological research. During this course, the student rotates through two professors' laboratories spending approximately one half semester in each. The selection of laboratories is made by the student in consultation with his advisory committee. By taking part in ongoing projects the student will learn experimental procedures and techniques and become acquainted with research opportunities in the departments.

Fall and spring, variable credit

HBM 531 Medical Microbiology

Information derived from molecular and experimental cellular biology will be presented to provide a foundation for understanding the basic aspects of the growth, regulation, structure, and function of viruses, prokaryotic, and eukaryotic cells. Where appropriate, extrapolation and application of basic concepts of microbiology to human disease will be made.

Q3 and Q4, 4 credits

HBM 590 Literature Reports in Microbiology

A discussion of current literature in microbiology.
Prerequisite: Permission of Instructor.

Fall and spring, 1 credit each semester and repetitive

HBM 599 Graduate Research

Original investigations undertaken with the supervision of a faculty member.

Fall and spring, variable credit

HBM 601 Nucleic Acid-Protein Interactions

This course will examine at an advanced level the structure and dynamics of the complexes formed by proteins and nucleic acids. Representative topics include the recognition of nucleotide sequences; nucleic acid; enzymology; specific and non-specific binding of proteins to nucleic acids; nucleohistones and chromatin; ribosome structure; and the changing of transfer RNA.

Prerequisite: General Biochemistry.

Spring, odd years, 3 credits

HBM 603 The Biology of Bacteriophages

Classical and contemporary experiments with bacteriophages will be considered in lecture and discussion. Studies which generated ideas now common to most fields of molecular biology will be emphasized. As part of the course the student will read current literature concerning both lytic and lysogenic phage systems.

Fall of alternate years beginning in 1974, 3 credits

HBM 604 Microbial Genetics (*was HBM 552*)

Systems of genetic analysis will be illustrated in lectures, discussions, and readings. These will include conjugation in *E. coli*, transformation in *B. subtilis*, and transduction in *E. coli* and *S. typhimurium*. The *E. coli*-lambda system is presented to illustrate current investigations into the functioning of regulatory genes. The pleasures and pitfalls of nondiscriminate extension of the concepts generated by microbial genetics to other areas of genetics are considered.

Spring of alternate years beginning in 1976, 3 credits

HBM 605 Microbial Structure and Function

A series of lectures and discussions devoted to major aspects of microbial physiology and molecular biology of microorganisms. Included is a study of the structure and function of cellular components with specific reference to bacterial structures. Emphasis on components of protein synthesis, antibiotics that inhibit protein synthesis and a review of current literature on these topics.

Fall of alternate years beginning in 1974, 3 credits

HBM 606 Animal Virology

The major classes of animal viruses will be described. Emphasis will be on the molecular biology of virus replication, virus carcinogenesis and the use of viruses as tools in understanding cellular functions.

Spring of alternate years beginning in 1975, 3 credits

HBM 607 Immunity to Parasites

This course considers current concepts and research relative to immunity to helminthic and protozoan infections. The emphasis will be on the mechanisms of the immune response to living parasites and antigens.

Prerequisite: Parasitology, Immunology or Permission of Instructor.

Fall of alternate years, beginning in 1975, 3 credits

HBM 690 Microbiology Seminar

A weekly meeting devoted to current work in the department and lectures by invited speakers.

Fall and spring, 1 credit each semester, repetitive

HBM 694 Thesis Research in Microbiology

For the student who has been admitted to candidacy. Original research will be

undertaken with the supervision of the thesis advisor and advisory committee.

Fall and spring, variable credit

HBP 531 General Pathology

Introduction to the nature and causes of disease, death, reaction to injury, and repair. Analysis of associated structural changes in cells and tissues, with reference to their functional correlates.

Q3 and Q4, variable credit

HBP 532 Immunology

A general introduction to the principles of immunology, including: definition of antigens and antibodies; description of cellular events in the immune response; theories of antibody formation; mechanisms of inflammation; hypersensitivity states; and diseases associated with altered responsiveness of the immune system.

Q3 and Q4, 3–5 credits

HBP 551 Lysosomes

A consideration of the role of lysosomes in physiologic and pathologic events of cells and tissues.

Fall, 2 credits

HBP 552 Radiopathology

A consideration of the biological and pathological effects of ionizing radiations in living organisms, with emphasis on cellular, molecular, and atomic mechanisms.

Spring, 1 credit (1976)

HBP 553 Biology of Cancer

The natural history and classification of tumors; host-tumor interrelationships; tumor ultrastructure; tumor immunology; viral, radiation and chemical oncogenesis; membrane changes in cell transformation; lysosomes and cancer.

Spring, 2 credits

HBP 554 Immunopathology

Mechanisms of injury produced by immunological reactions in tissues. Auto-immune diseases. Immunodeficiency diseases.

Spring, 2 credits

HBP 561 Electron Microscopy for Experimental Pathologists

Use of the electron microscope (EM), alone and in conjunction with other methodologies, in studies of biological dysfunction. Special techniques include histochemistry, enzyme histochemistry, immunohistochemistry, diffraction, stereo-EM and scanning EM. Design of protocols, preparation and interpretation of data.

Fall and spring, Q3 and Q4, variable credit

HBP 562 Practicum in the Use of Experimental Animals

Lectures and supervised practical exercises dealing with handling, injection, anesthesia and surgery of a variety of standard laboratory animal species.

Spring beginning in 1975, 2 credits

HBP 563 Histochemistry

Application of histochemical techniques (enzyme histochemistry, radioautography, cytophotometry, electron histochemistry, and immunohistochemistry) to the analysis of chemical components of cells and tissues.

Fall, 3 credits

HBP 690 Seminar in Pathology

Seminar in major topics in experimental pathology, by students, staff, and visiting scientists.

Fall and spring, variable and repetitive credit

HBP 694 Directed Research in Pathology

Original investigation undertaken with the supervision of a member of the staff.

Fall and spring, variable and repetitive credit

HBP 695 Teaching Practicum in Pathology

Practice instruction in the teaching of pathology, carried out under faculty orientation and supervision.

Fall and spring, variable and repetitive credit

Applied Mathematics and Statistics
Computer Science
Mathematics

The Mathematical Sciences

Department of Applied Mathematics and Statistics

Professors:	*Associate Professors:*	*Assistant Professors:*
BELTRAMI, CHEN, DICKER, DOLEZAL, FRISCH, GERST, KALMAN (*Adjunct*), ROHLF (*Adjunct*), SELVIN (*Adjunct*), SRIVASTAV, TAINITER, TEWARSON, ZEMANIAN (*Chairman*)	DUNCAN, KIM, LEIBOWITZ, TUCKER	CHERNIAVSKY, GRAN, SCHREIBER

The graduate program of this department provides a course of study in modern applied mathematics with a view to its utilization in the physical, social, biological, and behavioral sciences, as well as in engineering. The course offerings and the research program cover both the theories and principles which are common to the application as well as the more specialized methods which arise in specific areas.

Faculty research programs currently in progress include studies in network analysis and synthesis, transformation calculus, control theory, information theory, numerical methods, distribution theory, approximation theory, diffusion methods, vibrations, random processes, signal detection, wave propagation, stochastic differential equations, programming languages and systems, boundary value problems, partial differential equations and their applications, optimization, the urban sciences, and mathematical economics.

Requirements for the M.S. and Ph.D. degrees are listed on pages 109-110. The option concerning the M.S. thesis is at the discretion of the student.

The residence requirement for the Ph.D. degree is two consecutive semesters of full-time study; there is no residence requirement for the M.S. degree. For the Ph.D. degree, a reading ability in one foreign language (French, German, or Russian) is required; this requirement must be fulfilled before the dissertation defense.

Admission to Graduate Study

In addition to the requirements for admission given on page 109, the department requires a course in advanced calculus or equivalent material.

Courses

MSA 501 Differential Equations and Boundary Value Problems I

Examples of initial and boundary value problems in which differential equations arise. Existence of solutions. Systems of linear differential equations and the fundamental solution matrix. Reduction to canonical forms and the matrix exponential. Solutions of ordinary differential equations using Laplace transforms. Sturm Liouville theory and eigenfunction expansions. Green's functions.
Prerequisite: MSA 505.
Recommended prerequisite: MSA 504.

Spring, 4 credits

MSA 502 Differential Equations and Boundary Value Problems II

Classification of partial differential equations and characteristics. The initial and boundary value problems for hyperbolic, elliptic, and parabolic equations illustrated by a number of examples. Transform techniques and separation of variables.
Prerequisite: MSA 501.

Fall, 4 credits

MSA 503 Complex Analysis

A study of those concepts and techniques in complex variable theory which are of interest for their engineering applications. Pertinent material is selected from the following topics: complex algebra, analytic functions, harmonic functions, integration in the complex plane, Taylor and Laurent expansions, singularities, calculus of residues, entire and meromorphic functions, conformal mapping. Application is made to problems in heat conduction, potential theory, and fluid mechanics.

Spring, 4 credits

MSA 504 Foundations of Applied Mathematics

An introductory course for the purpose of developing certain concepts and techniques which are fundamental in modern approaches to the solution of applied problems. An appropriate selection of topics is based on the concepts of metric spaces, convergence, continuity, compactness, normed and Hilbert spaces. Included is an introduction to measure and integration.

Fall, 4 credits

MSA 505 Applied Algebra I

Review of matrix operations. Elementary matrices and reduction of general matrices by elementary operations, canonical forms and inverses. Applications to physical problems.

Fall, 4 credits

MSA 506 Finite Structures

Sets, mappings, and relations; algebraic structures (finite groups, fields) and polynomials. Some topics in number theory (congruences, etc.) and combinatorial

analysis. Applications of discrete structures: commodity flows, information nets, experimental (block) designs, random number generation, molecular chains, etc.

4 credits

MSA 507 Introduction to Probability and Stochastic Processes

Review of the basic concepts of probability: sample spaces, probability measure, random variables, the law of large numbers, and the central limit theorem. The Poisson process, Brownian motion and processes with independent increments. Stationary processes; the spectral power density and the Wiener-Khinchin theorem. Gaussian processes. Introduction to prediction and noise filtration theory. Basic ideas of information theory following the Shannon papers. Applications to biology, physics, and engineering according to interests of the class.

4 credits

MSA 514 Applied Algebra II

This course develops and then applies those concepts and techniques of modern algebra which have been found useful in the treatment of various computer-oriented disciplines such as automata theory, the theory of machines, and the mathematical theory of language. Included are selected topics from the following areas: general theory of algebraic systems, lattice theory, semigroups, groups, and ring theory.
Prerequisite: MSA 505.

4 credits

MSA 515 Non-Linear Differential Equations

Existence, uniqueness, and continuity theorems. Approximate solutions by method of iteration. Study of autonomous systems. Phase plane analysis, periodic solutions. Singular points, cycles, limit cycles. Theory of bifurcation. Stability theory, Liapunov functions. Analytical and geometrical investigations of second-order equations such as van der Pol's and Lienard's equations. Approximate solutions by the small-parameter method of Poincaré.
Prerequisite: MSA 501.

4 credits

MSA 516 Special Functions of Applied Mathematics

A study of the more common higher mathematical functions which are required for the analytical solution of engineering and scientific problems. The Bessel, Legendre, hypergeometric and Mathieu functions are among those considered. Topics include: orthogonal sets of functions, recursion formulas, series solution of linear differential equations, Fourier-Bessel expansions, asymptotic expansions, functional equations, application to boundary value and initial value problems.

4 credits

MSA 517 Ordinary Differential Equations

This course deals with theory and properties of ordinary differential equations which are of importance in the application of this subject. Among the topics covered are solutions of singular equations; boundary value problems; the Green's function method; eigenvalue problems; oscillation and nonoscillation theorems; asymptotic behavior of linear systems; non-linear autonomous systems; focal, nodal, and saddle points; cycles; stability; Lyapunov functions; the van der Pol, Lienard, and Duffing equations; approximate solutions.

4 credits

MSA 524 Theory of Approximation

A survey of various situations which present special problems in approximation theory, followed by an extensive development of methods for treating these problems. Topics covered include: smoothing of data, least squares methods, Chebyshev approximation, approximation by rational functions, orthogonal functions, Hilbert space methods, general aspects of approximation in normed linear spaces.

4 credits

MSA 526 Numerical Analysis I

Direct and indirect methods for solving simultaneous linear equations and matrix inversion, conditioning and round-off er-

rors. Computation of eigenvalues and eigenvectors.

4 credits

MSA 527 Numerical Analysis II

Numerical integration. Solution of ordinary differential equations. Different methods for partial differential equations; consistency convergence and stability. Numerical solution of integral equations. (MSA 527 may be taken whether or not the student has completed MSA 526).

4 credits

MSA 537 Methods of Operation Research I

Elementary maxima and minima problems and Lagrange multiplier. Linear programming including the simplex technique. The transportation problem. Queuing problems under different assumptions on input, service mechanism, and queue discipline. Dynamic programming. Basic ideas of inventory theory. PERT techniques.

4 credits

MSA 538 Methods of Operations Research II

Non-linear programming and programming under uncertainty; introduction to statistical decision theory and game theory. Monte Carlo techniques. Problems in maintenance and reliability applications such as inventory or traffic analysis according to the interest of the class.

4 credits

MSA 541 Network Synthesis

Approximation methods in the frequency and time domains. Properties of positive real functions and Hurwitz polynomials. Derivation of positive real character of RLCT driving-point emittances. Synthesis of two-element-kind networks. Use of Bott-Duffin and Darlington techniques for synthesis of positive real functions. Synthesis of transfer functions using RC or RLC elements and design of lossless filters with loading. Use of negative impedance converter and controlled source in the design of active-RC networks. Sensitivity analysis.

4 credits

MSA 545 Graph Theory and its Applications

Concepts in linear graph theory applicable in mathematics, the physical sciences, engineering, and the social and behavioral sciences. Undirected graphs: isomorphisms, circuits, connectivity, spanning trees, cut-sets. Directed graphs: paths, cycles, strong connectivity, directed trees. Euler and Hamiltonian circuits minimal length problems. Planar and non-planar graphs, Kuratowski theorem, dual graphs. Matrix description of linear graphs. Application to network flows, economics, switching networks, eigenvalue problems, games, and other problems of class interest.
Prerequisite: Permission of instructor.

4 credits

MSA 550 Algebraic Coding Theory

Utilizing concepts and results from modern algebra and number theory which are developed in the course, a study is made of those error-correcting codes whose basic structure is algebraic. Among the classes of codes considered are those designated, respectively, as: linear, cyclic, BCH, perfect, and residue.
Prerequisite: Permission of instructor.

4 credits

MSA 551 Introduction to Applied Probability and Statistics I

Elements of combinatorial analysis. Random variables and expectations. Laws of large numbers. The central limit theorem and its applications. Recurrent events and Markov chains. Applications to information theory, methods of coding, queuing problems, theory of games, problems of strategy, decision-making, etc.

4 credits

MSA 552 Introduction to Applied Probability and Statistics II

Basic statistical concepts. Probability. Distribution functions and moment generating functions. Frequency distributions. Central limit theorem. Sampling. Regression and correlation. Analysis of variance. Testing of hypotheses. Applications to interpretation of engineering and industrial data by means of statistical methods, curve fitting, methods of quality control

and preparation and use of control charts, reliability, various experimental designs, estimation of response relationships, determination of optimum conditions.

4 credits

MSA 553 Introduction to Mathematical Control Theory

State variables of dynamic systems, linearized perturbation analysis, adjoint systems, controllability and observability, stability analysis, introduction to variational calculus and dynamic programming.
Prerequisite: MSA 501.

4 credits

MSA 557, 558 Elasticity I and II

This course is identical with ESC 541, 542.

4 credits each semester

MSA 563 Computational Fluid Dynamics

Finite difference methods and relaxation methods for solving the incompressible flow equations. Methods of characteristics, finite difference methods using explicit artificial viscosities and implicit artificial damping for solving the compressible flow equations. Numerical treatment of shocks. Various mighty hydrodynamic codes.
Prerequisite: Permission of the instructor.

4 credits

MSA 565 Wave Propagation I

Theory of propagation of vector and scalar waves in bounded and unbounded regions. Equivalence theorems of field theory. Development of methods of geometrical optics. Propagation in inhomogeneous and in anisotropic media. Green's function for boundary-value problems.

4 credits

MSA 599

Variable and repetitive credit

MSA 604, 605 Probability Theory I, II

Mathematical foundations of probability, distribution functions and characteristic functions, limit theorems, random walks, conditional expectation, Markov property, Brownian motions, Poisson process, infinitely divisible processes, martingales, stochastic integral and stochastic differential equations.
Prerequisite: MSA 504 or MSM 512.

4 credits

MSA 606 Statistics

Probability theory. Probability distributions and generating functions. Statistical inference. Small sample theory. Tests of hypotheses. Distribution-free methods. Applications to processing and interpretations of engineering and industrial data, design of experiments, quality control, sequential analysis, decision functions, reliability studies, curve fitting, estimation to response relationships, time series, optimization techniques, factor analysis.
Prerequisites: MSA 504 and MSA 552.

4 credits

MSA 608, 609 Stochastic Processes II, III

Selected topics from among: diffusion processes and resolvents and infinitesimal generators, relation of probability to potential theory, abstract-valued processes, absolute continuity of probability measures, decomposition of supermartingales, ergodic theory.
Prerequisite: MSA 605.

4 credits

MSA 611 Theory of Partial Differential Equations and Their Applications

Theorem of Cauchy and Kowalesky; classification of partial differential equations in general; characteristics; potential theory and elliptic equations; hyperbolic equations and propagation of discontinuities, parabolic equations; various methods of solving partial differential equations; applications to problems in electromagnetics, hydrodynamics, solid mechanics, plasma physics, and many other problems in engineering analysis.
Prerequisite: MSA 502.

4 credits

MSA 623 Distribution Theory and its Applications

Spaces of testing functions and distribution. The calculus of distributions. Distributions as derivatives of continuous functions. Direct product, convolution, and convolution algebras. The distributional Fourier and Laplace transformations. Applications to the analysis of linear systems.
Prerequisite: MSA 504.

4 credits

MSA 627 Theory of Integral Equations and Their Applications

Integral equations with degenerate kernels, equations of the second kind, iterative solutions, contraction mapping principle, Fredholm theory, spectral theory for symmetric kernels. Volterra equations of the first and second kind, equations with weakly singular kernels, simultaneous systems, applications.
Prerequisites: MSA 504 and MSA 505.

4 credits

MSA 628 Functional Analysis

Function spaces. Compactness (Theorems of Arzela, Rellich), with applications. Linear functionals and the Hahn-Banach theorem. Unbounded operators and the closed graph theorem. Convexity and weak convergence in Hilbert space. Monotone operators and the stability of nonlinear systems. Sobolev spaces, Schwartz distributions and passive linear systems. Dissipative operators, contraction semigroups and positive resolvents, with applications.

4 credits

MSA 635, 636 Realizability Theory I and II

Banach-space-valued distributions. The postulational foundations of linear system theory. Time-varying Banach systems, the kernel theorem and composition. Causality and realizability. Time-in-variant Banach systems and convolution. Hilbert ports and passivity. The admittance and scattering formulisms. Representation theorems. ∞ ports. Synthesis of Hilbert ports.
Corequisite: MSA 628 or MSM 554, MSM 555.

4 credits each semester

MSA 651 Nonlinear Analysis and Optimization

Iterative methods for solving nonlinear operator equations. Frechet differentials. The Newton-Raphson method in function space and nonlinear boundary value problems. The Courant penalty concept and constrained optimization. General multiplier rules. Variable metric gradient techniques and gradient projection for nonlinear programming. Linear and nonlinear least square methods, with applications. Topics in search theory.

4 credits

MSA 690-691 Topics in Applied Mathematics

Varying topics, selected from the following list when there is sufficient interest on the part of the instructor and students. (Several different topics may be taught concurrently by various faculty members.) Detailed descriptions are avoided so as to allow maximum flexibility in the choice of subject matter.
Numerical analysis
Stochastic processes
Applied algebraic techniques
Network theory
Control theory and optimization
Mixed boundary value problems in elasticity
Cavity flows
Applications of distribution theory and functional analysis
Advanced operational methods in applied mathematics
Advanced boundary value problems in applied mathematics
Approximate methods in the boundary value problems of applied mathematics
Foundations of passive system theory
Probability and statistics
Partial differential equations

4 credits each semester

MSA 698 Practicum in Teaching

4 credits, repetitive

MSA 699 Research

Variable and repetitive credit

Department of Computer Science

Professors:	*Associate Professor:*	*Assistant Professors:*
FINERMAN, GELERNTER, HELLER, KIEBURTZ (*Chairman*), D. SMITH, TYCKO	BERNSTEIN	AKKOYUNLU, CHERNIAVSKY, FIDUCCIA, ZALCSTEIN

Admission to Graduate Study

For admission to graduate study in computer science, the following are normally required:

A. Baccalaureate degree in a physical science, biological science, mathematics, or engineering.

B. Two years of college-level mathematics including ordinary differential equations and linear algebra.

C. One year of a natural science at college level, with physics strongly preferred.

D. At least two college-level courses in computer science covering programming in both a language such as FORTRAN and assembly language.

E. A grade average of at least B in all undergraduate course work and in science, mathematics, and engineering courses.

F. Acceptance by the Department of Computer Science and by the Graduate School.

All applicants must submit Graduate Record Examination scores for the general aptitude tests. Applicants are encouraged to submit GRE test scores for the advanced examination in their undergraduate major field as well. Although the GRE score requirement may be waived for students coming from a university well known to members of the faculty, the student who fails to submit such scores is placed at a decided competitive disadvantage when applying for admission in comparison with the student who does submit scores, other factors being more or less equal.

Whatever the area of undergraduate specialization, students offering additional preparation in computer science (computer organization, systems programming, digital logic, and systems), or mathematics (probability and statistics, logic, finite mathematics, modern algebra, numerical analysis) can expect more favorable consideration. It is highly recommended that students include courses in digital systems, numerical analysis, and modern algebra as part of their undergraduate preparation. Ph.D. bound students, in particular, will be seriously handicapped without preparation in either digital systems design or modern algebra.

Students of exceptional promise who are deficient in preparation will be considered for admission to the program on a provisional basis. Upon entrance, students will be informed of the requirements they must satisfy for the termination of provisional status.

Requirements for the M.S. Degree

Students in the terminal M.S. degree program choose between two options, the M.S. with thesis and the M.S. without thesis. Students choosing the no-thesis option are required to take the course MSC 524 Laboratory in Computer Science which extends over a full academic year and provides experience in dealing with large-scale computer-oriented problems.

A. *Course requirements:* (30 graduate credits)

1. M.S. without thesis:

   a. Core courses (MSC 502, 521, 522, and 525). (16 credits)
   b. MSA 506 Finite Structures *or* MSC 541 Theoretical Foundations of Computing I. (3 credits)
   c. MSC 524 Laboratory in Computer Science, extending over two semesters. (5 credits)
   d. Six credits of elective graduate courses, chosen with advisor's approval.

2. M.S. with thesis:

   a. Core courses (MSC 502, 521, 522, and 525). (16 credits)
   b. Six credits of elective graduate courses, chosen with advisor's approval.
   C. MSC 599 Research. (8 credits)

A grade average of B or better is required in the above courses of study.

B. *Supplementary requirements:* Demonstration of knowledge of numerical analysis and digital systems at the level of MSA 226 and ESE 318, respectively. The following are considered evidence of such knowledge:

1. A grade of at least B in equivalent courses on the student's undergraduate record.

2. Taking and passing the above courses with grade B or higher.

3. Taking the final examination in the above courses, obtaining grade B or higher.

C. *Thesis requirements:*

1. M.S. without thesis: None.

2. M.S. with thesis: A student choosing the thesis option must select a research advisor who agrees to serve in that capacity. The advisor will supervise research studies and advise on choice of courses. The thesis must be approved by a department faculty committee of no less than three members, appointed by the chairman of the department. At the discretion of the committee, the student may be required to present a seminar on the thesis topic.

D. *M.S. degree requirements for Ph.D. bound students:* A student enrolled in the Ph.D. program may satisfy the requirements for the M.S. degree by completing 30 graduate credits of course work with a B average or better and passing the Ph.D. Qualifying Examination.

E. *Deficiencies in Preparation:* A student who does not meet *all* of the listed entrance requirements, *including* proficiency in numerical analysis and digital systems design, can not in general expect to earn the M.S. degree in less than three semesters. Undergraduate courses that must be taken to make up deficiencies or to acquire proficiency in numerical analysis and digital systems design may not be applied toward meeting graduate degree credit requirements.

Students with insufficient preparation to enroll in MSC 521 and MSC 522 during their first fall semester of residence will generally suffer a full year of delay in satisfying the requirements for the M.S. degree, for these core courses, offered only in the fall, are prerequisites for core course MSC 525, offered only in the spring, as well as most of the spring electives open to M.S. students. Such students should plan their course of study with these restrictions in mind.

If the applicant's deficiency in preparation can be remedied in one semester, and if the required undergraduate courses are offered in the spring, he should consider applying for special spring admission to the graduate school in order to avoid prolonging the duration of matriculation needlessly.

F. *Thesis:* A student who elects the thesis option generally must have substantial undergraduate background in computer science and well defined subject preferences in order to select a problem area and begin thesis research during the first semester of residence. More often, a full semester of exploration is necessary on the part of the student, and the thesis research is completed during the next two semesters (or occasionally, during the next semester and the following summer). Students who have majored in Computer Science as undergraduates will usually have no difficulty in completing the requirements for either option in one year.

Requirements for the Ph.D. Degree

A. *Residence:* Two consecutive semesters of full-time study.

B. *Qualifying Examination:* The student must satisfactorily pass a comprehensive, written examination to demonstrate ability to undertake the course of study leading to the Ph.D. degree. The examination is given during the fall semester each year. The student must take the examination within three semesters of admission to the graduate school.

Students who perform satisfactorily on the qualifying examination are required to demonstrate their ability to undertake a creative research problem by preparing an oral presentation to the faculty during the spring semester of the same academic year in which the qualifying examination was passed.

C. *Course requirements:* The student seeking the Ph.D. degree shall initially follow a relatively highly structured program of courses in order to acquire basic knowledge in computer science. The following program of courses will be followed by the majority of students in the Ph.D. program. Students with exceptional strengths or weaknesses follow appropriately modified programs, worked out in consultation with their advisors. In the second year, the program is more variable than the first year of the program in order to allow each student to pursue in greater depth the topics of greatest interest to him.

First Year

Fall Semester

1. MSA 514 Applied Algebra II or
   ESE 318 Digital Systems Design
2. MSC 541 Theoretical Foundations of Computing I
3. MSC 521 Data Structures
4. MSC 522 Algorithmic Languages and Compilers

Spring Semester

1. MSA 506 Finite Structures
2. MSC 542 Theoretical Foundations of Computing II
3. MSC 502 Computer Organization
4. MSC 525 Systems Programming

Second Year

Fall Semester

1. MSC 543 Automata Theory I
2. MSC 641 Mathematical Theory of Computation
3. MSC 530 Simulation and Modelling
4. MSC 620 Analysis of Computer Systems

Spring Semester

1. MSC 544 Automata Theory II or
   MSC 642 Algorithmic Analysis
2. MSC 526 Programming Language Design
3. MSC 532 Information Organization and Retrieval
4. Seminar in appropriate subject.

D. *Preliminary Examination:* The Preliminary Examination must be scheduled within two years from the time the student has passed the Qualifying Examination. This is an oral examination to ascertain the student's depth of knowledge in the field chosen for thesis research and the breadth of knowledge in other areas of computer science.

The major requirement of the preliminary examination is a complete and detailed Ph.D. thesis research proposal. The student is expected not only to be thoroughly familiar with the background and current status of his research area, and to have clear and well-defined plans for pursuing his research objectives, but also to offer evidence of progress in achieving these objectives. He must be prepared to justify the effort to be expended in his research in terms of the value of the results expected, and to justify the extent and challenge of his research as evidence of research competence at the Ph.D. level.

E. *Dissertation:* The most important requirement of the Ph.D. program is the completion of a dissertation which must be an orignal, scholarly investigation. The dissertation shall represent a significant contribution to the scientific literature, and its quality shall be compatible with the publication standards of appropriate reputable scholarly journals.

F. *Approval and defense of dissertation:* The dissertation must be orally defended before the Dissertation Examination Committee, and the candidate must obtain approval of the dissertation from this committee.

Courses

MSC 502 Computer Architecture

Covers both computer structure (physical characteristics of computer subassemblies) and computer architecture (machine characteristics as viewed by the assembly programmer or the microprogrammer). Register transfer language, sequential and microprogrammed control, I/O structures, hardware for memory management and speed up, pipelines, stacks, parallel processing illustrated with examples from contemporary machines. Prerequisites: MSC 102 and ESE 318.

Spring, 4 credits

MSC 521 Data Structures

Representation and organization of information as data inside and outside the computer. Basic concepts and formal de-

scriptions of data structures: linear lists, strings, arrays, stacks, trees, rings, graphs, and hierarchical structures. Storage systems and structures, storage allocation, collection and manipulation from the higher language point of view. Multilinked structures, list structures, and their connections to partially ordered and quasi-ordered sets. Formal specification of data structures.

Fall, 4 credits

MSC 522 Algorithmic Languages and Compilers

The first half of this course is dedicated to the development of a conventional compiler for a limited algorithmic language. The second half is used to explore advanced algorithmic languages, such as ALGOL, and the techniques used in their compilation. Study of syntax, semantics, ambiguities, procedures, and recursion in these languages.

Fall, 4 credits

MSC 524 Laboratory in Computer Science

A significant programming problem or digital system design will be undertaken. Solutions are to include all aspects of large-scale problem-solving including cost analysis, design, testing, and documentation. The course will extend over two semesters.

Fall semester, 2 credits; spring semester, 3 credits

MSC 525 Systems Programming

Review of batch process systems programs, their components, operating characteristics, user services, and their limitations. Implementation techniques for parallel processing of input-output and interrupt handling. Overall structure of multiprogramming systems on multiprocessor hardware configurations. Details of addressing techniques, core management, file system design and management, system accounting, and other user-related services. Traffic control interprocess communication, design of system modules, and interfaces. System updating, documentation, and operation.
Prerequisites: MSC 521 and MSC 522.

Spring, 4 credits

MSC 526 Programming Language Design

Design and implementation of programming languages. Syntax and semantics. Data and control structures. Parallelism. Implementation problems of ALGOL 68. Other examples from LISP, SNOBOL, MACROGENERATOR, PL/I, CPL, L6. Machine dependence, interface problems, and portability considerations. Systems specification and implementation languages.
Prerequisite: MSC 522.

Spring, 3 credits

MSC 530 Simulation and Modeling

Statistical aspects of systems modeling. Syntax and usage of General Purpose Systems Simulator (GPSS). Mathematical-analytic tools of systems modeling. Analog computer as a modeling guide. Construction of GPSS working models in engineering, biology, and the social sciences. Simulation using the FORTRAN language in physics, chemistry, and engineering.
Corequisite: MSC 521.

Fall, 3 credits

MSC 532 Information Organization and Retrieval

The construction of natural language or textual data banks. String manipulation and text editing. Methods to input, edit, and output textual information with a view to reorganization and presentation of texts and their derived data. Frequency dictionaries, concordances, combinatorial concordances, indices, permuted indices, selected indices, and catalogs. List processing techniques on direct access devices and their use in information retrieval, selective dissemination of information, and real-time interrogation of data banks.
Prerequisite: MSC 521.

Spring, 3 credits

MSC 541 Theoretical Foundations of Computing I

The mathematical and logical foundations of computing considered at an advanced level. General syntax of formal languages, formal logistic systems, proof theory, the deduction theorem. Consistency and completeness of formal systems,

many-valued logics, independence of axioms and rules of inference, decision procedures, theorem proving by machine. Post canonical systems. Recursively enumerable and recursive sets. The informal notion of an algorithm. Formal characterizations of the algorithmic functions. Introduction to recursive function theory. Turing machines, computability, and unsolvability.

Fall, 3 credits

MSC 542 Theoretical Foundations of Computing II

Recursive function theory and effective computability. The partial recursive functions, Godel numberings, the primitive recursive functions, the general recursive functions. Church's thesis. The universal partial function, the halting problem for Turing machines, recursive unsolvability, Rice's theorem. Recursive invariance. Reducibilities, degrees of unsolvability. Recursive definitions of number-theoretic functions. Course-of-values recursion. Simultaneous recursion, recursion with respect to several variables, recursion with substitutions for parameters. The primitive recursiveness of large classes of number theoretic functions. Reductions in the primitive basis of the primitive recursive functions. The elementary functions. The Ackermann function.

Spring, 3 credits

MSC 543 Automata Theory I

Finite-state machines and regular expressions, context-free languages and pushdown automata, Turing machines and the halting problem, complexity of computation.
Prerequisite: MSA 514.

Fall, 3 credits

MSC 544 Automata Theory II

The basic notions are the semigroups of a machine, the canonical form of a machine, and simulation. The necessary semigroup and group theory is included in the course. Loop-free decomposition is defined and a proof is given for the decomposition theorem using lemmas due to Krohn-Rhodes and Zeiger. Irreducibility results are developed for cascade decomposition. The last topics treated are the decomposition theory of Hartmanis and Stearns, which is based on lattice theory rather than semigroups and Zeiger's results on covers and decomposition into premutation-reset machines.
Prerequisite: MSA 514.

Spring, 3 credits

MSC 599 Research

Variable and repetitive credit

MSC 620 Analysis of Computer Systems

This course will be devoted to an examination of various models of computer systems. The basic mathematical tools which will be introduced include elementary queuing theory and Markov chain theory. Topics to be discussed include models of time sharing systems and their components as well as algorithms used for scheduling, resource allocation, and the management of virtual memory.
Prerequisite: MSC 525.

Fall, 3 credits

MSC 621 Seminar in Programming Languages

3 credits, repetitive

MSC 622 Seminar in Operating Systems

3 credits, repetitive

MSC 630 Seminar in Artificial Intelligence

3 credits, repetitive

MSC 631 Seminar in Information Organization and Retrieval

3 credits, repetitive

MSC 641 Mathematical Theory of Computation

This course develops mathematical models of computation which are distinct from the models furnished by automata theory. The basic tools of this theory are mathematical logic and recursive function theory. The questions of equivalence, correctness, and termination of programs and program schemes are studied. A second thrust of the theory is an investigation of the complexity of computations,

both for specific functions of practical interest and for recursive functions in general.
Prerequisite: MSC 542.

Fall, 3 credits

MSC 642 Algorithm Analysis

Complexity as measured by the number of algebraic operations required in computations of general interest, such as polynomial evaluation, matrix multiplication, sorting and related topics. Techniques will be developed for establishing lower bounds on the number of operations required to compute several functions. Optimality will be proved for several algorithms, such as Horner's rule and the row-times-column rule for matrix-vector multiplication. Also considered will be computation with preconditioning, Strassen's method for matrix multiplication, the time required for computation and related topics in the current literature.
Prerequisite: MSA 514.

Spring, 3 credits

MSC 645 Seminar in Theory of Computation

3 credits, repetitive

MSC 698 Practicum in Teaching

3 credits, repetitive

MSC 699 Research

Variable and repetitive credit

Department of Mathematics

Professors:	*Associate Professors:*	*Assistant Professors:*
ADLER, AX, BARCUS, CHARLAP, CHEEGER, DOSS, DOUGLAS, FARKAS, GROMOLL, KRA, KUGA, LISTER, MASKIT *(Chairman)*, MEYER, PINCUS, SAH, SIMONS, STRASSER, SZÜSZ	EBIN, W. FOX, FRANK, FRIED, HELTON, HILL, HOWE, KUMPEL, LAUFER, OSHER, PHILLIPS, THORPE, ZAUSTINSKY	BROWN, STONE, STRAUSS, YAU
		Lecturer: O'DONOVAN

Degree Programs

Masters Program

This program consists of three options: the Secondary Teacher Option (two years, part time) for secondary school mathematics teachers seeking permanent certification; the College Teacher Option (one-two years, full time) designed for students who plan teaching careers in two-year colleges; and the Professional Option (one year, full time) designed for students who plan careers as professional mathematicians in industry, government, or the academic world.

Doctoral Program

This program (three to four years, full time), an extension of, and the main reason for, the Professional Option in the Masters program, is designed for students who plan careers as research mathematicians.

Admission to the Masters Program

Any student who presents convincing evidence that he or she will benefit from a year of graduate work in mathematics is eligible for admission. Normally that evidence consists of records of prior training in mathematics and letters of recommendation from three mathematicians under whom the student has taken courses. Applicants to the Secondary Teacher Option are expected to have at least the equivalent of a temporary certificate in mathematics. Applicants to the College Teacher Option must present at least a complete calculus sequence and at least one upper division course in mathematics plus strong evidence of both potential and motivation. An able student who has completed work in linear and modern algebra, real and complex analysis, and metric topology is well prepared for admission to the Professional Option. If he has also competed successfully in graduate courses he may be admitted directly to the Doctoral Program.

An applicant whose prior training is seriously deficient may be offered provisional admission for one year after which he or she may apply for regular admission.

Requirements for the M.A. Degree

A. Residence
   Two successive semesters of full time residence in a program of courses approved by the department, or, for students in the Secondary Teacher Option, four successive semesters of part time residence in a program of courses approved by the department.

B. 30 Graduate Credits.
C. Passing the Comprehensive Examination.

The "program of courses approved by the department" depends on the option. The program for the Secondary Teacher Option normally includes:

MSM 512 Algebra for Teachers
MSM 513, 514 Analysis for Teachers I, II
MSM 515 Geometry for Teachers
MSM 519 Seminar in Mathematics Teaching
MSA 551 Probability and Statistics I
CED 560 Introduction of Computing

for a total of 27 graduate credits. In the other two options, the program is worked out individually with each student.

The Comprehensive Examinations are also designed separately for each option. They consist of the final examinations of MSM 512, 513, 514 and 515 for the Secondary Teacher Option.

For the Professional Option, Comprehensive Examinations are offered twice a year, at the start and finish of the spring semester. These examinations are designed to test mastery of the fundamentals in algebra, algebraic topology, complex analysis, and real analysis.

Comprehensive Examinations for the College Teacher Option are a combination of the ones listed above designed for each student individually.

Admission to the Doctoral Program

A student who presents convincing evidence of significant potential for research in mathematics is eligible for admission. That evidence normally consists of an outstanding performance on the Comprehensive Examination (Professional Option) or on comparable examinations at other universities. However, students who have not as yet entered full-time graduate work in mathematics are also considered for admission to the doctoral program. Each applicant to this program must present rec-

ords of prior training in mathematics and letters of recommendation from three members of the mathematics faculty under whom the applicant has taken courses, preferably from teachers of graduate courses taken by the applicant.

Requirements for the Ph.D.

A. Passing the Comprehensive Examination (Professional Option).

B. Passing the doctoral Preliminary Examination.

C. Demonstrating proficiency in reading mathematics in two of the following: French, German, and Russian.

D. Four semesters of full-time residence, at least two of which are successive semesters.

E. Advancement to candidacy.

F. Approval by the Dissertation Examining Committee.

The Comprehensive Examination

This examination was described above in connection with the Professional Option of the Masters Program. Students who transfer from graduate programs in other universities may in some cases be granted exemption from this requirement at the time they are admitted. Otherwise, such students must take the Comprehensive Examination at their first opportunity.

The Doctoral Preliminary Examination

This examination is oral. Each student must take this examination no later than two years after passing the Comprehensive Examination or receiving an exemption therefrom. The chairman of the examining committee is chosen by the student.

Professional Academic Training Program

All full-time graduate students in mathematics are required to participate in this program. It consists of supervised teaching or tutoring at the lower undergraduate levels, as well as paper grading at all levels.

Handbook

The Mathematics Department publishes a handbook for graduate students. This handbook contains a detailed statement of the duties and responsibilities of trainees and of the policies and regulations which bear on admission, awarding and renewing support, and procedures for meeting the various degree requirements. A copy is sent to every applicant who submits a completed application form.

Courses

Core Courses for Teacher Options

Courses MSM 512 through MSM 518 may be elected only by students in the Secondary Teacher and the College Teacher Options of the Masters Program, MSM 519 only by students in the former Option.

MSM 512 Algebra for Teachers

Linear algebra, the algebra of polynomials, algebraic properties of the complex numbers, number fields, solutions of equations.

Fall, 4 credits

MSM 513, 514 Analysis for Teachers I, II

The topology of the real line, theory of differentiation and integration of functions of one variable.

Fall and spring, 4 credits

MSM 515 Geometry for Teachers

A re-examination of elementary geometry using concepts from analysis and algebra.

Fall, 4 credits

MSM 519 Seminar in Mathematics Teaching

Study of recent curricular and pedagogical developments in secondary school mathematics.

Spring, 4 credits

Core Courses for Professional Option

MSM 520 Algebra I

Introduction to theory of groups, modules, and fields; Sylow theorems, duality, and Galois theory. The language of categories will be introduced to clarify analogies among the structures treated.

4 credits

MSM 521 Algebra II

The structure and use of algebras including tensor and exterior algebras, semi-simple algebras, theorems of Wedderburn and Brauer.

4 credits

MSM 522 Algebraic Topology I

General topology; the homology and cohomology of a chain complex; simplicial, singular, and cell complexes; the Eilenberg-Steenrod axioms, the fundamental group, and covering spaces.

4 credits

MSM 523 Algebraic Topology II

Homotopy groups and the Hurewicz theorem, the universal coefficient theorem, cup and cap products. Poincaré duality, an introduction to spectral sequences.

4 credits

MSM 524 Complex Analysis I

The first term is a self-contained treatment of basic complex analysis: holomorphic, meromorphic, and harmonic functions on plane domains. The Cauchy theory. Series of holomorphic and meromorphic functions including Taylor and Laurent series expansions. Geometric properties of holomorphic functions. Moebius transformations. Riemann's mapping theorem.

4 credits

MSM 525 Complex Analysis II

The course will normally be an introduction to Riemann surfaces with concentration on uniformization of simply-connected Riemann surfaces. Further topics will be selected from the following: Dirichlet problem, Green's function, conformal mapping, elliptic and automorphic functions, introduction to several complex variables.

4 credits

MSM 526 Real Analysis I

Measures and associated integrals particularly Lebesgue measure and the Lebesgue integral, the Riesz representation theo-

rem, linear functionals on L_p, absolute continuity, functions of bounded variation, product measures, Lebesgue decomposition theorem, derivative of measure.

4 credits

MSM 527 Real Analysis II

Banach space, Hahn-Banach and uniform boundedness, theorems, topics in topological vector spaces, vector-valued integration theory, uniform integrability, Dunford-Pettis theorem.

4 credits

Intermediate Courses

MSM 530 Homological Algebra

Introduction to the basic concepts and techniques. Modules, constructions; direct products and direct sums, free modules, tensor products. Hom, exact sequences. Projective and injective modules, resolutions, the structure theorem for semi-simple rings with minimum condition. Complexes, Tor and Ext, the long exact sequence theorem. Functors, connected sequences. Characterization of Ext^1 and Tor_1 by extensions and torsion modules. Homological dimension; dimension and Ext. Cohomology of groups.

4 credits

MSM 532 Group Theory

Free groups, factor groups of free groups, presentations, combinatorial methods, unsolved problems. The symmetric groups, factor groups of the symmetric groups, presentations, graphs. Other topics according to student interest.

4 credits

MSM 534, 535 Theory of Numbers

Topics in diophantine equations with indications of methods from algebraic geometry, algebraic number theory, analysis, logic, transcendental number theory, and valuation theory.

4 credits each semester

MSM 536, 537 Algebraic Geometry

First semester—Introduction to the theory of schemes with emphasis on projective varieties. Topics to be covered include: the relevant sheaf theory from semi-continuity of the fibre dimensions of a morphism, the Segre imbedding of a projective variety, normalization of a variety, and Zariski's main theorem. Second semester—Topics may be selected from: curve theory, Grothendieck's Riemann-Roch theorem, cohomology of affine and projective spaces, the arithmetic aspects of algebraic geometry applied to curves and abelian varieties.

4 credits each semester

MSM 550, 551 Riemann Surfaces and Automorphic Functions

Analytic continuation, the complete analytic function and analytic configuration. Covering manifolds, monodromy theorem and covering transformations. Algebraic topology of manifolds. Harmonic and analytic differentials. Function theory on compact Riemann surfaces: Weierstrass points, Riemann-Roch theorem, Abel's theorem and the Jacobi inversion problem. The relation of compact Riemann surfaces to algebraic functions. Discontinuous groups, functions automorphic with respect to groups, automorphic forms. Function theory on open Riemann surfaces.

4 credits each semester

MSM 552, 553 Complex Manifolds

Examples of complex manifolds, sheaves and cohomology, holomorphic vector bundles, connections in vector bundles, curvature and characteristic classes, Hodge theorem, topology of Kähler manifolds, Hodge index theorem, vanishing theorems, Kodaira imbedding theorem, Hirzebruch-Riemann-Roch theorem, deformations of complex structure.

4 credits each semester

MSM 554, 555 Functional Analysis

First semester will cover Banach spaces, uniform boundedness principle, Hahn-Banach theorem, closed graph theorem, Krein-Milman theorem, Alaoglu's theorem, Banach algebras, Gelfand theory. Hilbert spaces, Riesz representation theorem, spectral theorem for normal operators, compact operators, Fredholm operators. Examples and applications to

classical analysis. Second semester will cover topics chosen from Toeplitz operators, H_p spaces, function algebras, isometrics on Hilbert space, introduction to von Neumann algebras, multiplicity theory for normal operators, theory of spectral operators.

4 credits each semester

MSM 556, 557 Harmonic Analysis

The classical theory of trigonometric series, amost periodic functions, harmonic analysis on R^n, distributions, the Fourier-Schwarz transform. Locally compact groups, the Haar integral, convolutions, unitary representations. Characters and duality of locally compact abelian groups, the Fourier and Plancherel transforms, positive definite functions, Sidon and Helson sets, closed ideals in L^1 (G), spectral synthesis of bounded functions.

4 credits each semester

MSM 560, 561 Partial Differential Equations

Analytic equations and the Cauchy-Kowalewski theorem, hyperbolic, elliptic, and parabolic equations, characteristics, fundamental solutions, smoothness of solutions, basic inequalities, weak and strong solution, local existence theorems, and the Schauder estimates. Further topics may be covered depending on the interest of students and faculty.

4 credits each semester

MSM 566 Differential Topology

Manifolds, imbedding and immersion theorem, vector bundles, characteristic classes. Further topics such as cobordism, Morse theory.

4 credits

MSM 568, 569 Differential Geometry

Differentiable manifolds, bundles, tensor and exterior algebra, differential forms, Stokes' theorem, geometry of submanifolds of R^n, method of integral formulas, applications to global extrinsic theorems, 1-dimensional Gauss-Bonnet theorem, connections, geodesics, completeness, Riemannian curvature and geometric interpretation, first and second variation formulas, conjugate points and Jacobi fields, Rauch's comparison theorem and applications, Morse theory.

4 credits each semester

MSM 570, 571 Lie Groups and Homogeneous Spaces

Standard material on Lie groups and Lie algebras, homogeneous and symmetric spaces, spaces of constant curvature. Geometric as well as group theoretic aspects will be stressed.

4 credits each semester

MSM 572 573 Analysis on Manifolds

Elliptic PDE, Hodge theorem and applications, infinite dimensional manifolds and applications, introduction to pseudo-differential operators, the Laplacian and its spectrum.

4 credits each semester

MSM 574 Minimal Varieties

Classical examples and connection with complex variables, geometric measure theory, currents, Bernstein theorem and counter examples, recent work on minimal varieties in constant curvature manifolds.

4 credits

MSM 576 Characteristic Classes

DeRahm's theorem, Gauss-Bonnet theorem, Weil-homomorphisms, characteristic classes of homogeneous spaces, vector fields foliations, and characteristic numbers.

4 credits

MSM 578 Comparison Theorems in Riemannian Geometry

Rauch's comparison theorem, Toponogov's theorem, cut locus injectivity radius and closed geodesics, pinching theorems, finiteness theorems, curvature and the fundamental groups, complete manifolds of nonnegative curvature, existence of closed geodesics on manifolds. The course will center around applications of second variation methods and Morse theory.

4 credits

MSM 580, 581 Student Seminar in Geometry

Sard's theorem, transversality, Whitney imbedding, Frobenious theorem, Hopf theorem on vector fields, deRahm decomposition theorem, holonomy and Ambrose-Singer theorem, isometry groups and Killing fields, Carton-Ambrose-Hicks theorem, canonical spaces of constant curvature.

4 credits each semester

MSM 590, 591 Logic

Sentential and predicate calculus. The notions of proof and model. The deduction theorem, the completeness theorem, Skolem-Lowenheim theorems, the compactness theorem. Introduction to recursive function theory. Elementary number theory. The first Gödel incompleteness theorem. Introduction to model theory and to set theory. Further topics of interest to instructor and students as time permits.

4 credits each semester

MSM 597 Seminar

(May be elected only with approval of the Director of the Graduate Program).

Variable and repetitive credit

MSM 598 Independent Study

(May be elected only with approval of the Director of the Graduate Program).

Variable and repetitive credit

MSM 599 Directed Research

(May be elected only with approval of the Director of the Graduate Program).

Variable and repetitive credit

MSM 600 Practicum in Teaching

(May be elected only with approval of the Director of the Graduate Program).

Variable and repetitive credit

Topics Courses

MSM 650, 651 Topics in Algebra

Topics from among the following: structure of rings, combinatorial group theory, finite groups, the theory of categories. The algebraic theory of semi-groups, non-associative algebras, universal algebra, partially ordered algebraic systems, varieties of groups, algebraic number theory, ideal theory, algebraic geometry, Galois theory, differential algebra, linear algebra, group representations, homological algebra.

4 credits each semester

MSM 652, 653 Topics in Algebraic Topology

Topics such as: cohomology operations, spectral sequences, fiber bundles, K-theory, sheaves, category theory, piecewise linear topology, Poincaré and Alexander duality.

4 credits each semester

MSM 654, 655 Topics in Analysis

Topics in abstract and concrete analysis selected from among the following: summability theory, partial differential equations, probability theory, operators on Hilbert space, harmonic analysis, Banach algebras, topological vector spaces, normed linear spaces, integral equations.

4 credits each semester

MSM 658, 659 Topics in Complex Analysis

Topics selected from the following: several complex variables, moduli of Riemann surfaces, Kleinian groups, univalent and multivalent functions, theta functions, conformal mapping of multipli-connected regions.

4 credits each semester

MSM 660, 661 Topics in Logic

Topics will vary from term to term so that students may take repeatedly for credit. Topics will be chosen from model theory, set theory, proof theory, recursion theory, etc.

4 credits each semester

MSM 698 Independent Study

Variable and repetitive credit

MSM 699 Directed Research

Variable and repetitive credit

Chemistry
Earth and Space Sciences
Physics

The Physical Sciences

Department of Chemistry

Professors:

ALEXANDER, BONNER, CHU, FRIEDMAN, HAIM, HIROTA, F. JOHNSON, KOSOWER *(Adjunct)*, LAUTERBUR, LE NOBLE, OKAYA, PORTER, RAMIREZ, SUJISHI *(Chairman)*, WHITTEN

Associate Professors:

L. ALTMAN, F. FOWLER, GOLDFARB, P. JOHNSON, KERBER, SCHNEIDER, WEISER, WISHNIA

Assistant Professors:

J. DOLL, D. HANSON, KRANTZ, LLOYD, MCDANIEL, S. SCHWARTZ, SPRINGER

Director of Chemical Laboratories and Lecturer:

FUNKHOUSER

The Department of Chemistry offers programs leading to the degrees of Master of Science for students seeking an education at an advanced level in chemistry; Master of Science (Research) for those seeking, in addition, the experience of solving a problem in chemical research, and Doctor of Philosophy for those preparing for careers in which chemical research is a central activity. A student in the Ph.D. program may choose the dissertation research in any one of the diverse areas of chemistry represented by the interests of the departmental faculty, or he or she may choose an interdisciplinary study under the guidance of a faculty member in another department. Coordinated activities with the Departments of Biochemistry, Earth and Space Sciences, Electrical Sciences, Mechanics, and Physics include formal degree options in chemical physics and chemical biology.

Admission to Graduate Study

The following are required for admission to graduate study in chemistry:

A. A baccalaureate degree in chemistry earned in a curriculum approved by the American Chemical Society, or an equivalent course of study.

B. A minimum grade point average of 2.75 (B−) in all undergraduate work, and 3.00 (B) in all courses in the sciences and mathematics.

C. Acceptance by the Department of Chemistry and by the Graduate School.

In exceptional cases, a student not meeting requirements A and B may be admitted on a provisional basis.

Qualification to Candidacy

Proficiency examinations in inorganic, organic, and physical chemistry, based upon undergraduate course material typical of programs approved by the American Chemical Society, are given a few days before the first class each semester and are used to advise new students concerning their course of study. Deficiencies in undergraduate preparation may be remedied by independent study or by formal course work. At the end of the second semester each student is qualified to candidacy for the graduate degree he or she has chosen provided that progress is satisfactory. Course work and research are considered in the proportion appropriate to the student's program.

Requirements for the M.S. Degree

A. Courses: Successful completion of an approved course of study comprising a minimum of 30 graduate credits, including the CHE 532 Seminar, the CHE 590 Term Paper, and at least three courses from: CHE 501–530, 601–604, 620–683. Up to 12 credits of seminar, tutorial and CED courses are permitted in addition to the term paper.

B. Successful completion of the CHE 532 Seminar and the CHE 590 Term Paper.

C. Thirty credits of graduate course work are required for this degree.

Requirements for the M.S. (Research) Degree

A. Residence: One year.

B. Courses: Successful completion of an approved course of graduate study comprising at least six formal graduate courses as well

as CHE 532 and two semesters of CHE 610 or the equivalent. Qualification to candidacy is based, in part, on achievement in four 500-level chemistry courses to be taken during the student's first year. In consultation with his or her faculty advisors each student selects his or her course work program to acquire a good background for research in the area of chemistry chosen.

C. Language: Reading proficiency in German, French, or Russian.

D. Research, thesis, and thesis defense.

E. Thirty credits of graduate course work are required for this degree.

Requirements for the Ph.D. Degree

A. Residence: Two years.

B. Courses: Successful completion of an approved course of study comprising at least six formal graduate courses as well as CHE 532 and two semesters of CHE 610 or the equivalent. Qualification to candidacy is based, in part, on achievement in four 500-level chemistry courses to be taken during the student's first year. In consultation with his or her faculty advisors each student selects his or her course work program to acquire a good background for research in the area of chemistry chosen.

C. Language: Reading proficiency in German, French, or Russian.

D. Cumulative examinations and a proposition: Intended to enhance and demonstrate breadth and depth of knowledge in chemistry, the cumulative examinations are offered at eight stated dates each year in the four major areas of physical, inorganic and organic chemistry, and chemical biology. A student normally takes the examinations in his or her area during the two semesters following qualification. At some time during the same period he or she presents and defends a proposition for original research not directly related to the dissertation research.

E. Research, dissertation, and dissertation defense.

F. Presentation of a departmental colloquium.

Research

Each student selects a research advisor from among the faculty at some time between the middle of the first and second semesters. The research advisor also serves on the committee which advises the student on his or her entire degree program.

Doctoral Program in Chemical Physics

The doctoral program in chemical physics is provided for students whose interests lie in both chemistry and physics. A graduate student who is admitted to either the Chemistry or Physics Department may elect the program with the consent of the department chairman. A chemistry student elects this program if he or she wishes to obtain more extensive training in physics than is normally required by chemistry departments. A physics student elects the program if he or she wishes to obtain more extensive exposure to chemical systems than is normally obtained in physics departments. The program is a course option for graduate students in chemistry or in physics; furthermore a student in the chemical physics program may select his or her research advisor from either department subject to the approval of the chairmen. For a chemistry student the requirements are the same as for the Ph.D. in chemistry described above with the following exceptions.

B. Courses: As well as CHE 532 and two semesters of CHE 610 a minimum of nine formal graduate courses is required, including the following:
   CHE 523 Chemical Thermodynamics
   PHY 343 Mathematical Physics
   Two courses from among CHE 521, 522 Quantum Chemistry I, II and PHY 511, 512 Quantum Mechanics I, II
   CHE 528 or PHY 540 Statistical Mechanics
   PHY 501, 502 Classical Physics I, II
   One course in chemistry from among CHE 501, 502, 503, 511, and 512

D. Cumulative examinations and proposition: In some cases a hybrid of the chemistry program and the Physics Department preliminary exams may be used.

Doctoral Program in Chemical Biology

The doctoral program in chemical biology is provided for students whose interests lie in both chemistry and biology. A graduate student who is admitted to the Chemistry Department, the Department of Pharmacological Sciences, or the molecular biology program may elect, with the consent of the chairmen, the chemical biology program. A chemistry student elects the program if he or she desires more extensive training in biology than is normally accommodated in a chemistry graduate program. A pharmacology or molecular biology program student elects the program if he or she wishes to obtain more extensive exposure to fundamental chemical studies. Thus, the program is a course option for graduate students in chemistry, the pharmacological sciences, or molecular biology; furthermore, a student may select his or her research advisor in the Chemistry Department, the Department of Pharmacological Sciences, or the molecular biology program, subject to the approval of the chairmen.

Each student in the program will have an advisory committee consisting of at least one member each from molecular biology, pharmacology and chemistry. When he or she begins research, his or her thesis advisor will join his or her advisory committee. The committee advises the graduate student and helps him or her prepare for a research career in some area of chemical biology.

Qualification for candidacy in this program requires, in addition to the general requirements in chemistry, a satisfactory background in undergraduate biology as judged by the student's advisory committee or as demonstrated by satisfactory performance in course work.

The requirements for this program are the same as for the Ph.D. program in chemistry described above, with the following exception.

B. Courses: As well as CHE 532 and two semesters of CHE 610 a minimum of seven formal graduate courses is required as specified by the student's advisory committee. A typical program might include CHE 523 Chemical Thermodynamics, CHE 521 Quantum Chemistry, CHE 502 Mechanistic Organic Chemistry, CHE 530 Physical Chemistry of Macromolecules or BIO 502 Physical Biochemistry, BIO 503 Protein and Nucleic Acid Synthesis, BIO 507 Molecular Genetics.

Courses

CHE 501 Structural Organic Chemistry

A discussion at an advanced level of the most important features in structural theory, such as steric hindrance and strain, conformation analysis, stereochemistry, aromaticity, applied molecular orbital theory, and the modern methods of structure determination.

Fall or spring, 3 credits

CHE 502 Mechanistic Organic Chemistry

A consideration of the most important means of dissecting the detailed pathways of organic reactions. The use of substituent and medium effects on reactions proceeding through heteropolar, free radical and isopolar transition states is discussed; some unstable intermediates and unusual molecules are included.

Fall or spring, 3 credits

CHE 503 Synthetic Organic Chemistry

A survey of the most important organic reactions from the viewpoint of synthetic utility, including many recent innovations in this field. The mechanisms of these reactions are discussed with the purpose of bringing out unifying features among them.

Fall or spring, 3 credits

CHE 511 Structural Inorganic Chemistry

The properties and reactions of inorganic compounds are considered from the viewpoint of molecular and electronic structure. The various models used to describe and/or predict molecular structures are considered. Valence bond, crystal field, and molecular orbital theory are applied to inorganic compounds, and the relationships between molecular and electronic structure are discussed.

Fall, 3 credits

CHE 512 Physical Methods in Inorganic Chemistry

Information from modern physical methods concerning the molecular and electronic structures of inorganic compounds is surveyed. The relationship of this in-

formation to the chemical and other physical properties of these compounds is discussed. Typical methods discussed in some detail include Mössbauer, Photoelectron, Circular Dichroism, Infrared, Electron Spin Resonance, and Nuclear Magnetic Resonance Spectroscopy, and X-ray Diffraction.

Spring, 3 credits

CHE 513 Reaction Mechanisms in Inorganic Chemistry

Reactions of inorganic and organometallic compounds taken from throughout the periodic table are studied from a mechanistic viewpoint. Modern techniques used in the elucidation of mechanisms are surveyed, experimental results are evaluated, and theoretical interpretations are discussed in the context of thermodynamic and structural parameters. Types of reactions that are treated include acid-base, substitution, and oxidation-reduction reactions.

Spring, 3 credits

CHE 521 Quantum Chemistry I

Quantum theoretical concepts are discussed in their historical and modern scientific perspectives. Schrödinger wave mechanics and related mathematical techniques are illustrated by treatment of systems of chemical interest. Development of the subject is designed to form the theoretical basis for the study of chemical bonding, molecular structure, spectroscopy, and molecular collision phenomena.

Fall, 3 credits

CHE 522 Quantum Chemistry II

Matrix representations of quantum mechanical operators. Problems in time dependent quantum mechanics with the derivation of both approximate and exact solutions. The elements of group theory with applications to atomic, molecular, and solid state systems.

Spring, 3 credits

CHE 523 Chemical Thermodynamics

A rigorous development of the fundamentals of thermodynamics and its application to a number of systems of interest to chemists. These systems include electrolytic and nonelectrolytic solutions, electrochemical cells, gases, homogeneous and heterogeneous equilibirum systems. An introduction to statistical mechanics will also be included in order to relate the microscopic properties of molecules to the classical thermodynamic functions.

Fall, 3 credits

CHE 526 Chemical Kinetics

An intensive study of rates of chemical reactions and in particular the relationship of kinetic studies to the determination of reaction mechanisms. Experimental methods will be discussed with emphasis on the determination of rate laws. The theoretical treatment will include discussions of the kinetic theory and the transition-state theory approaches to chemical kinetics. Topics will include gas reactions, chain reactions, and the new approaches to the study of very rapid chemical reactions.

Spring, 3 credits

CHE 528 Statistical Mechanics

The course begins with the theory of the canonical and grand ensembles of quantum mechanical systems, with applications to the calculation of thermodynamic properties of simple crystals and ideal gases. The main topic of the course is the study of the effect of intermolecular forces upon the thermodynamic functions of classical fluids via the theory of the configuration integral, the theory of molecular distribution functions, and the McMillan-Mayer solution theory. This includes a study of some approximation methods such as cluster expansions and integral equations. The course concludes with an introduction to the theory of transport and relaxation coefficients of systems of interacting molecules.

Spring, 3 credits

CHE 529 Nuclear Chemistry

Topics include the properties of radioactive substances and their use in the study of chemical problems; nuclear structure; a study of nuclear reactions; radioactive

decay and growth; interactions of radiation with matter; detection and measurement of radiation, including a discussion of statistics; application of radioactivity to chemical problems such as kinetics, structure and analysis; artificially produced elements; and nuclear reactions.

Fall or spring, 3 credits

CHE 530 Physical Chemistry of Macromolecules

An investigation of the gross and fine structure of macromolecules in solution as revealed by hydrodynamic behavior (e.g., ultracentrifugation, viscosity), spectroscopic properties (e.g., ultraviolet hypochromism, circular dichroism, magnetic resonance spectra), and the thermodynamics of interaction with small molecules. Theory of conformation changes (e.g., helix-coil transitions, allosteric effects).

Spring, 3 credits

CHE 589 Directed Study

Subject matter varies according to needs of student.

Variable and repetitive credit

CHE 590 M.S. Term Paper

Independent study leading to a term paper on a selected topic in chemistry, chemical applications, or chemical pedagogy.

Summer, fall, or spring, 3 credits

CHE 601 Special Topics in Synthetic Organic Chemistry

The subject matter varies depending on interests of students and staff. It may cover such areas as heterocyclic chemistry, organometallic chemistry and the chemistry of organic molecules containing second-row elements. The emphasis is on fundamental considerations and recent developments.

Variable and repetitive credit

CHE 602 Special Topics in Physical Organic Chemistry

The subject matter varies depending on interests of students and staff. It may cover such areas as photochemistry, theoretical organic chemistry and the chemistry of unstable intermediates; the emphasis is on fundamental considerations and recent developments.

Variable and repetitive credit

CHE 604 Molecular Biochemistry

An inquiry into memory and learning on the molecular level, including discussion of all or some of the following topics: evolution of neural systems and their organization, chemical transmission of neural impulses, molecular basis of learning and memory, composition of neurons and biochemistry of the important constituents, and mechanisms of biochemical transformations from the point of view of physical organic chemistry.

Spring, 2 credits

CHE 610 Practicum in Teaching

Practice instruction in chemistry at the undergraduate level, carried out under faculty orientation and supervision. A minimum of two semesters of CHE 610 is required of all candidates for graduate research degrees in chemistry, unless explicitly waived by the chairman.

Variable and repetitive credit

CHE 623 Molecular Spectroscopy

A detailed description of the theory and practice of molecular spectroscopy. Topics in the time evolution of molecular energy states encompassing both theory and recent developments in experimental techniques also are presented.

Fall, 2 credits

CHE 624 Magnetic Resonance

A study of the theory of magnetic and electrostatic interactions among nuclei and electrons, and of the magnetic resonance methods used to investigate them. Applications of magnetic resonance spectroscopy to a number of topics, including rate processes, the electronic structures, conformations, and motions of molecules, the structures and electronic properties of solids, and biological problems.

Spring, 2 credits

CHE 625 Molecular Structure and Crystallography

Experimental methods in the determination of molecular structure. The relationship of structure to chemistry. The emphasis will be on the determination of structure in the solid state, particularly by X-ray crystallography.

Fall, 2 credits

CHE 626 Computer-Controlled Experimentation in Chemistry

Basic concepts and practice in on-line data acquisition and display, interfacing techniques, feedback control as applied to chemical instrumentation. Students will design, simulate, and/or perform actual experiments with the computer.

Fall or spring, 3 credits

CHE 682 Special Topics in Inorganic Chemistry

Subject matter varies, depending on interests of students and staff, but will cover recent developments in inorganic chemistry.

Variable and repetitive credit

CHE 683 Special Topics in Physical Chemistry

Subject matter varies, depending on interests of students and staff but will cover recent developments and advanced topics in physical chemistry.

Variable and repetitive credit

CHE 699 Research

Variable and repetitive credit

Seminars

The following seminars are offered on a regular basis. The participation of graduate students who are not registered is also encouraged.

CHE 531 Departmental Research Seminar

Meetings at which first-year graduate students learn about the research activities of the departmental faculty.

Fall, 1 credit

CHE 532 Literature Seminar

Students select and discuss topics from the current literature.

Spring, 1 credit

CHE 694 Chemical Biology Seminar

1 credit, repetitive

CHE 695 Inorganic Chemistry Seminar

1 credit, repetitive

CHE 696 Organic Chemistry Seminar

1 credit, repetitive

CHE 697 Physical Chemistry Seminar

1 credit, repetitive

CHE 698 Colloquium

1 credit, repetitive

Department of Earth and Space Sciences

Professors:	*Associate Professors:*	*Assistant Professors:*
CARTER, DODD, LINDSLEY, OWEN, PALMER, PAPIKE *(Chairman)*, PREWITT, SCHAEFFER, SOLOMON	BENCE, BRETSKY, G. HANSON, HARDORP, KNACKE, PETERSON, M. SIMON	FLESSA, GOLDSMITH, HANNY, LEVINTON, LUTZ, MEYERS, WEIDNER

The Earth and Space Sciences Department offers degree programs in astronomy, geochemistry, paleobiology, planetary sciences and tectonophysics.

Admission to Graduate Study

For admission to graduate study in the earth and space sciences, the following are required:

A. A baccalaureate degree in one of the earth or space sciences, or in biology, chemistry, or physics.

B. A minimum average of B for all undergraduate course work and an overall B average for courses in the sciences.

C. Acceptance by the Department of Earth and Space Sciences and by the Graduate School.

In special cases, a student not meeting requirements A and B may be admitted on a provisional basis. Upon admission, the student will be informed of the requirements that must be satisfied for termination of the provisional status.

Requirements for the M.S. Degree

A. *Residence:* None

B. *Language:* None

C. *Formal course work:* Completion, with a B average, of an approved course of graduate study not to exceed the equivalent of two full academic years. This course of study will be prepared by the student and his or her advisor (s) to suit his or her particular needs, and must be approved by the departmental Graduate Committee. It must consist of at least 30 credits of graduate work, which may include 6 credits of research toward an M.S. thesis or equivalent research papers.

D. *Evaluation:*

a. M.S. with thesis: approval of the thesis by an examining committee.

b. M.S. without thesis: Oral examination on the material covered in the approved course of study.

E. *Departmental recommendation:* When all departmental requirements are completed, the chairman may recommend to the Dean of the Graduate School that the Master of Science degree be granted.

F. *Time limit:* All requirements for the M.S. degree must normally be completed within three years of the time of the student's first registration as a graduate student.

Requirements for the Ph.D. Degree

A. *Residence:* One year of full-time graduate study.

B. *Language:* None.

C. *Formal course work:* Successful completion with grades of B or better of an approved course of study leading to the Preliminary Examination.

D. *Preliminary Examination:* This examination will consist of the presentation, acceptance, and oral defense of three research proposals.

E. *Advancement to candidacy:* The student may be advanced to candidacy for the Ph.D. when he or she has completed all Graduate School and departmental requirements for the degree other than the dissertation. Advancement to candidacy is recommended by the department Graduate Committee, to the Dean of the Graduate School through the department chairman.

F. *Research and dissertation:* The dissertation must be approved by a Dissertation Examining Committee of at least five members of the faculty, including at least one from outside the department, appointed by the Dean of the Graduate School. A formal oral defense of the thesis will be conducted by the Dissertation Committee. This will be open to all members of the faculty.

G. *Time limit:* All requirements for the Ph.D. degree must be completed within four years after advancement to candidacy.

Courses

ESS 501 Geology of Long Island

Intensive student involvement in a selective field problem will be central to a theoretical and investigative appraisal of classical Long Island Geology, hydrology, coastal processes and modern geo-environmental problems. Three lecture hours and one field trip per week.

Summer, 3 credits

ESS 506 Theoretical Petrology

Theory of phase diagrams, Schreinemaker's Rules, heterogeneous equilibria, experimental systems of petrologic interest. Laboratory: problems, experimental petrology.
Prerequisites: Metamorphic and Igneous Petrography, Physical Chemistry or Thermodynamics, or permission of instructor.

Fall, 3 credits

ESS 507 Petrogenesis

Study of igneous and metamorphic rock suites, with emphasis on their histories of formation. Suites may be of a given rock type (e.g., basalts, granites) or a variety of types from a geographic region. As far as possible, subjects will be chosen to meet the interests of the class. Laboratories: detailed examination of rock suites in-hand specimen and thin section, examination of specimens in immersion oils, by X-ray diffraction, or by electron microprobe where necessary, phase equilibrium experiments where useful.

Spring, 3 credits

ESS 508 The Rock Forming Minerals

Study of the crystal chemistry, intracrystalline cation distributions (homogeneous equilibria), stability and paragenesis of the rock forming minerals. Special emphasis will be placed on amphiboles, feldspars, micas, and pyroxenes. Laboratory work will deal with the determination of composition and structural state of these phases using X-ray powder diffraction methods, and the relation of intergrown phases using X-ray single crystal diffraction methods.

Spring, 3 credits

ESS 509 Electron Probe X-ray Microanalysis

Lectures cover the theory of electron excitation of X-rays; matrix effects; microprobe configuration; techniques in qualitative, semiquantitative, and quantitative microanalysis; and computer applications. Laboratory includes a study of an approved petrologic problem of limited scope selected by the student. Registration limited to ten students.
Prerequisites: Petrology, Petrography and permission of instructor.

Spring, 3 credits

ESS 510 Global Geology

A study of the global distribution and geologic history of platforms and orogenic belts. The course includes lectures on the geographic distribution of the major geologic features of the continents and student-led seminars on sedimentary, tectonic and igneous patterns in the world's modern and ancient orogenic belts. Assigned readings of major geologic syntheses and a term paper are included.

Fall, 3 credits

ESS 511 Advanced Paleontology

Intensive study of selected fossil invertebrate groups stressing morphology, systematics, evolution, ecology, biogeography, and techniques for study. One or two groups are studied each semester that the course is offered. Different groups are studied in different years so the course may be taken more than once.

Fall, 3 credits

ESS 514 Advanced Stratigraphy

Study of the evolution of ideas concerned with interpretation of the physical and historical interrelationships of layered rocks and of the application of these ideas to selected stratigraphic problems.

Fall, 3 credits

ESS 515 Seminar in Detrital Sedimentation

Focus will be on continental margin and adjacent oceanic sedimentation. Topics will include formation of continental shelves; sedimentary processes on continental slopes including mass gravity processes and canyon formation; sedimentation on continental rises including turbidite fan models; concepts of geosynclines; relationship of continental margin sedimentation to plate tectonics.

Spring, 3 credits, alternate years

ESS 516 Paleoecology

A course devoted to the relation of ecological theory and practice to paleoecological problems. Lectures will be divided into several general topics which will each consist of a discussion of principles and then a discussion of relevance to the fossil record. The contribution of paleoecological studies to ecological hypothesis testing will be emphasized. Topics to be considered are: mode of formation of fossil assemblages; biotic diversity; communities, provinces and their evolution throughout geologic time; estimation and significance of survivorship in the fossil record; measurement and meaning of calcification rates; autoecology of selected fossil invertebrate groups; and spatial distribution.

Fall, 3 credits

ESS 517 Evolution and Geography

A seminar focusing on the evolutionary significance of geographical patterns in space and time. The potential interactions among ecological theory, evolutionary patterns and continental drift will be stressed. Topics to be discussed include biogeographical theory, evolution of biotic provinces, global and Phanerozoic biotic patterns, and the evolutionary consequences of continental drift.

Spring, 3 credits, alternate years

ESS 518 Carbonate Sediments

An intensive study of the formation, deposition, lithification and diagenesis of carbonate sediments. Lectures and seminars will emphasize principles of carbonate deposition, facies relationships, and chemistry. Laboratories will emphasize binocular and petrographic analysis of recent and ancient carbonates.

Spring, 4 credits, alternate years. Not offered 1974–75.

ESS 519 Major Features of Evolution

A seminar exploring the concept of pattern and rate in evolution. The emphasis will be on those evolutionary patterns seen in the fossil record. Topics to be discussed include: types of evolutionary rates; evolutionary trends; extinction; adaptation and adaptive radiation; the origin of higher taxa; and large scale interactions between biological and physical history of the earth.

Spring, 3 credits, alternate years. Not offered 1974–75.

ESS 521 Isotope Geology

Radioactive decay schemes useful for determining the age of rocks and minerals. Evaluation of the various methods and consideration of problems of interpreting data. Application of radioactive and stable isotopes to the study of geologic processes, as for example, metamorphic and magmatic activity, ore deposition, and crustal evolution.

Fall, 3 credits

ESS 522 Meteoritics

A survey of extraterrestrial materials which strike the earth: their sources and orbits; fall and impact phenomena; chemical and mineralogical relationships; thermal histories; and origin. These data are used to place meteorites in the context of early solar system history.

Fall, 3 credits

ESS 525 Marine Geochemistry

The chemistry of the oceans will be considered. The various mechanisms for regular ocean chemistry and the influence of ocean circulation on ocean chemistry will be discussed. The chemistry of the sea floor, including the ocean sediments, will be considered.
Prerequisite: Physical Chemistry.

Fall, 3 credits

ESS 531 Crystallography

Principles of symmetry, single crystal and powder X-ray diffraction techniques and elements of crystal structure determination. Use of crystallographic data in the study of mineral systems. Laboratory in diffraction techniques includes extensive use of digital computers.

Fall, 3 credits

ESS 532 Crystal Chemistry

The application of crystallographic techniques to problems in mineral chemistry. Concepts of the crystalline state, order-disorder, atom radii, chemical bonding, atom coordination, solid solutions, and physical properties of minerals. Emphasis on silicate and sulfide crystal structures.

Spring, 3 credits

ESS 543, 544 Laboratory Course in Astronomical Techniques I, II

A course designed to introduce the theory, design and operation of modern astronomical instrumentation and to familiarize the student with the use of telescopes. Current astronomical techniques will be discussed with emphasis on methods of observational measurements and reduction of data. Fall term will emphasize optical techniques appropriate for wavelengths shorter than one micron, while spring term will deal with infrared and radio techniques. Either term may be taken independently of the other. Extensive laboratory and observing exercises may be expected.

Fall and spring, 3 credits each semester

ES 546 Chemistry and Physics of the Atmosphere

Comprehensive treatment of the chemistry and physics of the earth's upper and lower atmosphere including the D, E, and F regions of the ionosphere, the stratosphere and troposphere. Discussion of ion composition and reactions, photochemical processes, aerosols, chemistry of neutral gases, and airglow phenomena. Emphasis is on the application of kinetic theory, thermodynamics, reaction kinetics, and aerosol mechanics to an understanding of the natural cycles of atmospheric and environmental importance.
Prerequisite: Physical Chemistry.

Spring, 3 credits

ESS 548 Cosmochemistry

The chemical composition of parts of the galaxy, the cosmic rays, stars, the sun, the solar wind, comets, meteorites and other solid objects in the solar system will be studied. Relationships and evolutionary changes in chemical composition will be considered. Additional topics to be discussed are: 1) cosmochronology as evidenced by isotopic variations in meteorites; and 2) the interaction of cosmic rays with solid objects in the solar system.

Spring, 3 credits

ESS 550 Global Tectonics

Displacements of lithospheric plates in time and space. Geological and geophysical evidence related to the concept of plate tectonics. Kinematics and dynamics of plate motions. Origin of first-order crustal structures of continents and ocean basins.

Spring, 3 credits, alternate years. Not offered 1974–75.

ESS 552 Physics of the Earth

Study of the internal structure of the Earth as revealed by field and laboratory observations. Topics to be discussed include seismology, elasticity, thermal structure, rheological properties and magnetic and gravitational fields.

Fall, 3 credits

ESS 553, 554 Stellar Physics I, II

A survey of the physical principles and the results of astrophysical importance in the study of stellar structure and composition. Fall term treats the problem of stellar interiors and evolution. Specific topics include: the equation of state, nuclear reactions, stellar opacity sources, and energy transfer mechanisms. Spring term treats stellar atmospheres and chemical abundance determinations. Topics will include: radiative transfer, thermodynamics in the presence of a radiation field, line formation, and the determination of stellar temperatures, surface gravities and compositions. Either term may be taken independently of the other. Two one and one-half hour lectures per week.

Fall and spring, 3 credits each semester

ESS 581, 582 Astrophysical Processes I, II

A course designed to introduce and treat in depth the physical processes of importance in Astronomy. Topics will include:

transport processes of astrophysical importance such as radiative transfer, convection, diffusion, turbulence and the general problem of waves in astrophysical fluids and plasmas; the conditions of thermal equilibrium and the kinetic theory of gases; the theory of thermal and non-thermal emission of electromagnetic radiation and a discussion of the origin of cosmic ray, x-ray and infrared sources. Applications will be made to the study of highly evolved stars, supernovae remnants, radio galaxies and quasars. This is a full year course. Two one and one-half hour lectures per week.

Fall and spring, 3 credits each semester

ESS 583, 584 Galactic Astrophysics I, II

A study of the Galaxy and galaxies. Specific areas to be treated are: the interstellar medium including H-I regions and the two phase equilibrium model, the dynamics, thermodynamics and chemistry of dense clouds, H-II regions and the onset of star formation; the dynamics and kinematics of the Galaxy and, specifically, the theory of differential rotation, the concept of stellar populations, the problem of the formation of spiral structure and the methods of constructing mass models, and self-consistent models of the Galaxy; the theoretical and observational aspects of galaxy morphology and evolution; and the dynamics of star clusters and clusters of galaxies with special reference to the problems of evaporation and missing mass. This is a full year course. Two one and one-half hour lectures per week.

Fall and spring, 3 credits each semester

ESS 590 Experimental Rock Deformation

Introduction to tensor analysis of stress, strain, elasticity; experimental and theoretical fracture of rocks; elementary dislocation theory and plastic deformation of rock-forming minerals; recovery and recrystallization of rocks; mechanical behavior and theoretical empirical creep flow laws.

Fall, 3 credits

ESS 591 Experimental Structural Geology

Application of the fundamentals of ESS 590 Experimental Rock Deformation to selected problems in structural geology. Prerequisite: ESS 590.

Spring, 3 credits

ESS 599 Research

Fall and spring, variable and repetitive credit

ESS 600 Practicum in Teaching

1 to 3 credits, repetitive

ESS 601-605 Special Topics Courses

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics will be discussed, particularly those that are of current interest. Each special topics course carries one to three credits, with repetitive credit permitted.

ESS 601 Advanced Topics in Astronomy-Astrophysics

Designed to treat specific subject areas in depth, either extending material introduced at the 500 level or covering topics not presented there. Topics recently offered or anticipated in the near future include: Observational Cosmology, Atomic and Molecular Processes, Planetary Atmospheres, Interstellar Molecules, Advanced Topics in Radiative Transfer, and Galactic Nuclei.

Fall and spring, 3 credits per semester, repetitive

ESS 603 Topics in Petrology

ESS 604 Topics in Geo-Cosmochemistry

ESS 605 Topics in Sedimentary Geology-Paleontology

ESS 607 Topics in Geophysics

Variable, 1 to 3 credits

ESS 612 Solar System Seminar

Recent developments in studies of the solar system will be reviewed with special emphasis on the relationship of these re-

sults to fundamental astronomical and geological problems. The course will include a survey and some specialization on topics to be selected by the class.

Fall, 3 credits

ESS 699 Thesis Research

Independent research for Ph.D. degree. Open only to candidates for the Ph.D. who have passed Preliminary Examination.

Each semester, variable and repetitive credit

Department of Physics

Professors:

[b]ARIMA, BALAZS, BLUME *(Part-time)* [c]G. BROWN, COURANT *(Part-time)*, DRESDEN, EISENBUD, FEINGOLD, FINOCCHIARO, FOSSAN, D. FOX, M. GOLDHABER *(Adjunct)*, M. GOOD, KAHN, KAO, KIRZ, [a]KUO, LAMBE, [a]B. LEE, L. LEE JR., MUETHER, NATHANS, PAUL, PHILLIPS *(Visiting)*, POND, SILSBEE, STRASSENBURG *(Part-time)*, SWARTZ, TOLL, WEISBERGER, WILCOX, C. N. YANG *(Einstein Professor)*

Associate Professors:

DEZAFRA, FREEDMAN, A. GOLDHABER, GRAF, GRANNIS, JACKSON, LEE-FRANZINI, [a]MCGRATH, METCALF, MOULD, NIEH, SPROUSE

Assistant Professors:

ALLEN, ENGELMANN, JÖSTLEIN, LUKENS, R. MCCARTHY, MCCOY, PALDY *(Part-time)*, QUIGG, J. SMITH, J. WANG

Admission to Graduate Study

For admission to graduate study in physics, the following are required:

A. Baccalaureate degree in physics, from an accredited institution, with departmental course requirements in physics equivalent to those at this institution (including courses at the junior and senior level in electromagnetic theory, mechanics, methods of theoretical physics, quantum mechanics and modern physics, advanced laboratory).

B. A minimum grade average of B in all undergraduate course work, and of B in physics, mathematics, and chemistry.

C. Acceptance by the Department of Physics and by the Graduate School.

In special cases, a student not meeting requirement A (or, in unusual cases, requirement B), may be admitted on a provisional basis. Upon en-

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[a] On leave academic year 1974–75

[b] On leave fall semester 1974

[c] On leave spring semester 1975

trance, the student will be informed of the requirements he must satisfy for the termination of the provisional status.

For admission to the M.A. (T.) program students will be required to exhibit a proficiency in physics equivalent to that attained by successful completion of the University's general program in physics (see the *Undergraduate Bulletin* for details).

First-Year Program

The student's program for the first year of graduate study will be determined on the basis of past records and an interview given at the beginning of the first semester.

Requirements for the M.A. Degree

A. One year of residence, with registration in a program of graduate courses approved by the advisor.

B. Satisfactory performance in a program of studies (30 graduate credits) approved by the Graduate Committee. Normally, such a program would include PHY 599 (Graduate Seminars), Classical Mechanics and Electrodynamics, and Quantum Mechanics I, II.

C. Passing of the Masters Examination.

Requirements for the M.A. (Teaching) Degree

The Master of Arts (Teaching) degree is designed for those students who plan to teach or who are teaching physics at the secondary school level. The degree program will ordinarily involve two semesters of course work and one semester of a supervised intern experience teaching physics in a secondary school.

30 Graduate Credit-Hour Program

1. Nine credit hours of graduate courses in physics. Some or all of this credit may be for PHY 585, Special Study, with permission of the student's advisor.
2. Three credit hours of CEN 552 Contemporary Methods and Curriculum Innovations in the Teaching of Physics (see *CED Bulletin* for details).
3. Six credit hours in appropriate courses in education or educational psychology chosen with the approval of the student's advisor.
4. Six credit hours (one semester) of supervised intern teaching in a secondary school.
5. Three credit hours of a seminar in connection with the intern teaching experience.

6. Three credit hours of project work (PHY 580) on a topic in physics associated with classroom teaching at the secondary level. This will generally be an experimental topic. All candidates will be required to demonstrate their proficiency in laboratory techniques associated with the teaching of secondary school physics.
7. Successful performance on an oral examination in which the candidate demonstrates his proficiency in explaining physics at a level appropriate for secondary school students.
8. All candidates will be required to pass a comprehensive written examination in physics.

Credit for Previous Work

Students who already have provisional teaching certification or who have taken the required courses in education or the teaching internship will substitute appropriate additional courses in science, mathematics, education, or history and philosophy of science with the approval of their advisor. These course requirements will not automatically be waived, however. Credit for such courses or work done elsewhere may depend upon demonstrated proficiency.

Requirements for the Ph.D. Degree

A. Two years of residence.

B. During the first year of graduate study each student will select a program which can be a combination of courses, PHY 599 Graduate Seminars, PHY 585 Special Study, and PHY 580 Special Research Projects. The first-year program will be determined on the basis of past records and consultation with an advisor. Readmission to the second year and the granting of financial support will depend on performance in this first-year program.

C. The Preliminary Examination shall consist of two parts:

Part A: A three-section written examination of a comprehensive nature designed to test a student's background in the fundamentals of physics and his ability to think physically. Each section of this examination shall be of three hours length. The topics to be covered are:

I. Mechanics, electricity and magnetism, optics

II. Thermodynamics, kinetic theory, statistical mechanics, solid state, low temperature physics

III. Quantum mechanics, atomic, nuclear, elementary particle physics

This examination will be given in September and February. It shall be taken no later than February of the second year. This examination will

serve also as a masters degree examination.

Part B: An oral examination on a broad range of topics relevant to the student's intended area of thesis research. This examination will be given before the end of the second year of graduate study. It will be administered by a committee of three faculty members appointed by the Graduate Committee before the end of the first year of graduate study. This panel will determine the specific nature of the oral examination and will also advise the student during his or her second year. In the event that the student changes his or her intended area of thesis research, a new committee may be appointed.

D. Advancement to candidacy: The department's recommendation to the Graduate School for advancement to candidacy to the Ph.D. is based primarily on the satisfactory completion of requirement C.

E. Teaching experience at least equivalent to that obtained in a one-year appointment as a teaching assistant.

F. Research, dissertation, and the passing of the dissertation examination.

Doctoral Program in Chemical Physics

The program in chemical physics is intended to meet the needs of students whose interests lie in areas common to chemistry and physics. A graduate student in either the Chemistry or the Physics Department may, with the consent of his or her chairman, elect to participate in the program. Degree requirements for a chemistry student in this program may be found in the Department of Chemistry's section of this *Bulletin*. The basic degree requirements for a physics student are the same as those for other students in this department, as described above. The student will normally be advised to take one or more appropriate courses in chemistry, such as CHE 511, 523, 528, 529, 623, 624, 625. He or she will take the physics examination, as required of all physics students. The oral part of the preliminary examination will be in chemical physics; one member of the committee will be from the Department of Chemistry. A research advisor may be selected from the Department of Chemistry, subject to the approval of the department chairmen.

Doctoral Program in Astrophysics

The doctoral program in astrophysics is provided for students whose interests lie in both physics and astronomy. A graduate student who is admitted to the Department of Physics may elect this program, with the consent of the chairman of the Physics and of the Earth and Space Sciences Departments. The program is designed for those students who

wish to gain a greater exposure to current astrophysical problems, observational or theoretical, than would be the case in the usual doctoral program in physics.

For a physics student, the basic degree requirements are the same as for other students in this Department, as described above. The student should have a background in astronomy appropriate to his areas of interest. The student who does not have such a background may be advised to take certain undergraduate courses (such as ESS 343, 344) before embarking on the program. A Physics student enrolled in the astrophysics program will take the physics Comprehensive Examination, as required of all physics students. The oral part of the exam will be in astrophysics, and one member of the committee will be from Astronomy. The advisor may be from either department, subject to the approval of the chairmen of the Department of Physics and of Earth and Space Sciences.

Courses

PHY 501 Classical Mechanics

Lagrangian and Hamiltonian formulations, variational principles, Hamilton-Jacobi theory, mechanics of fields, special relativity.

3 credits

PHY 503, 504 Methods of Mathematical Physics, I, II

A selection of mathematical techniques useful for physicists. Topics will be selected from the following: linear vector spaces, matrices, Green's functions, complex analysis, differential equations, special functions, boundary value problems, integral transforms, integral equations, probability. This course should be taken only by entering graduate students who have a deficiency in this area.

3 credits each semester

PHY 505, 506 Classical Electrodynamics

Electrostatics and magnetostatics with emphasis on the solution of boundary value problems through the use of eigenfunction expansions and Green's functions: dielectrics, magnetic materials, Maxwell's equations, electromagnetic waves, wave guides, diffraction, plasma physics, special relativity, relativistic particle kinematics and dynamics, energy loss and scattering of charged particles in matter, radiation, multipole fields, spin resonance, and superconductivity. Applications are wide ranging and will be stressed.

3 credits each semester

PHY 509 The Nature and Significance of Physical Science

A course for Humanities and Social Science graduate students with philosophical, literary, and humanistic interests in the physical sciences. The structures of major physical theories are investigated and analyzed in qualitative terms. In relation to each theory the manner of its development, its successes and limitations, and its relation to the total structure of physical science are studied. A central objective of the course is the examination of the interactions between the Physical Sciences and philosophic thought, art, technology, social change, etc.

3 credits

PHY 511, 512 Quantum Mechanics I, II

Aimed principally at developing complete familiarity with the nature of quantum mechanical systems. Topics include basic quantum physics and mathematical apparatus, angular momentum, symmetries, semiclassical theory of radiation, Dirac theory, and numerous concrete applications to atoms, nuclei, etc.

Prerequisite: Undergraduate course in quantum mechanics.

3 credits each semester

PHY 515 Methods of Experimental Research

A laboratory-lecture course designed to help start beginning graduate students on a path toward independent, professional research. Students undertake three modest but original projects. Lectures cover tools, techniques, and concepts considered indispensable in the laboratory, such as passive networks, servo-mechanisms, dimensional analysis, inductive logic, mechanical design, electrical instruments, optical instruments, machine shop practice, special techniques by invited specialists. One two-hour lecture and three-hour laboratory.

3 credits

PHY 540 Statistical Mechanics

Brief review of thermodynamics with emphasis on thermodynamical potentials, their external properties, and the basic features of thermal equilibrium. The notion of thermal equilibrium ensembles, classical systems; the notion of phase space, the role of the additive constants of motion, Boltzmann lottery, microcanonical ensemble, canonical ensemble, grand canonical ensemble, the same repeated for quantum systems. Applications for systems for which the Hamiltonian is separable; ideal classical gas, ideal quantum gas, radiation field, crystals. Approximate treatment of nonseparable Hamiltonians; imperfect gases, critical phenomena.

3 credits

PHY 541 Advanced Statistical Mechanics

High temperature properties—cluster expansions, ionized systems; low temperature properties—elementary theory of quantum fluids, model calculations; phase transitions—transfer matrix, Ising and ferroelectric models; introduction to fluctuation and nonequilibrium phenomena.

3 credits

PHY 551 Nuclear Physics I

Basic properties of nuclei, radioactivity and electromagnetic properties; experimental techniques, accelerators and nuclear detectors; the two-body problem and nuclear forces.

3 credits

PHY 552 Nuclear Physics II

Nuclear models and their relations to properties of nuclei, theory of nuclear reactions, nuclear beta decay.

3 credits

PHY 555 Introduction to Solid State Physics

An introduction to the foundations of theoretical and experimental solid state physics, including such topics as crystal structure, lattice vibrations, electronic structure, transport phenomena, magnetic and dielectric properties.
Prerequisites: One semester of quantum mechanics and one semester of statistical mechanics, either graduate or advanced undergraduate.

3 credits

PHY 556 Experimental Solid State Physics

An advanced course with emphasis on basic experimental methods and how these have contributed to our present understanding of the solid state. Typical topics include magnetic resonance, Mössbauer effect, quantum oscillations, Josephson effects and other low temperature phenomena.
Prerequisite: PHY 555.

3 credits

PHY 557, 558 Elementary Particle Physics I, II

Introduction to elementary particle characteristics and phenomena, symmetry and invariance principles, partial wave analysis and resonance phenomena, models for strong interaction, high energy phenomena, weak interactions, accelerator and detector development.

3 credits each semester

PHY 561, 562 Theory of Solids I, II

A survey of the modern theory of solids and an introduction to contemporary research. Topics to be covered include: theory and interpretation of optical, transport, and Fermi surface measurements; theory of electron and phonon bands; theory of alloys and amorphous materials; collective and many electron effects; theory of magnetism and superconductivity.
Prerequisites: Introductory solid state physics, one semester of graduate level quantum mechanics, and one semester of statistical mechanics.

3 credits each semester

PHY 580 Special Research Projects

Research under the direction of a faculty member. Not open to Ph.D. candidates who have passed the Preliminary Examination.

Each semester, variable and repetitive credits

PHY 585 Special Study

Reading course in selected topics.

Each semester, variable and repetitive credits

PHY 599 Graduate Seminars

Special research topics centered on a monograph, conference proceedings or journal article. Normally not more than eight students per section. Seminars are supervised by faculty members or postdoctoral fellows who assign topics, lead the assault of questioning, and keep the discussion moving. Satisfactory performance in two semesters work will be required as part of the teaching experience of all graduate students. Topics include Solid State Physics, Elementary Particles, Atomic Physics and Quantum Electronics, Nuclear Physics.

Required for all first year graduate students.
1 credit per semester

PHY 600 Practicum in Teaching

2 credits

PHY 610, 611 Quantum Field Theory I, II

Field quantization: interacting fields; S-matrix theory; Feynman diagrams; charge and mass renormalization; dispersion relations; general field theory.

3 credits each semester

PHY 620 Relativity

General theory of relativity; cosmology.

3 credits

PHY 630 Low Temperature Physics

Subject matter varies from semester to semester, depending on interest of students and staff. Topics covered may include quantization effects in superfluids and superconductors, superfluid hydrodynamics, tunnelling in superconductors, low temperature properties of solids.

3 credits

Seminars

Each semester, several seminars for advanced graduate students will be offered. These courses are intended primarily for students doing research in the area, although other students may enroll with permission of the faculty seminar leaders. Seminars for 1974-75 are listed below; additional ones may be offered if there is sufficient faculty and student interest. Each seminar carries one credit, with repetitive credit permitted.

PHY 670 Seminar in Theoretical Physics

PHY 671 Seminar in Statistical Mechanics

PHY 672 Seminar in Elementary Particle Physics

PHY 674 Seminar in Nuclear Physics

PHY 676 Seminar in Solid State Physics

Special Topics Courses

The subject matter of each special topics course varies from semester to semester, depending on the interests of students and staff. Advanced topics will be discussed, particularly those that are of current interest. Each special topics course carries three credits, with repetitive credit permitted.

PHY 680 Special Topics in Theoretical Physics

PHY 681 Special Topics in Statistical Mechanics

PHY 682 Special Topics in Solid State Physics

PHY 684 Special Topics in Nuclear Physics

PHY 685 Special Topics in Mathematical Physics

PHY 686 Special Topics in Elementary Particles

PHY 688 Special Topics in Astrophysics

PHY 690 Special Topics in Quantum Electronics

PHY 698 Colloquium

1 credit

PHY 699 Thesis Research

Independent research for Ph.D. degree. Open only to candidates for the Ph.D. who have passed the Preliminary Examination.

Each semester, variable and repetitive credit

Anthropology
Economics
History

The Social Sciences

Department of Anthropology

Professors:	*Associate Professors:*	*Assistant Professors:*
P. Brown, Carrasco, Faron, Lanning	Stevenson, Weigand *(Chairman)*, Wheeler	Arens, Gardner, Hicks, R. L. Jones, Newton, Regelson, Starr

Admission to Graduate Study

In addition to the admission requirements of the Graduate School, the Anthropology Department requires:

A. A baccalaureate degree from an accredited college.

B. A minimum grade point average of 3.00 (B) in all undergraduate course work, and 3.25 (better than B) in the major or field of concentration.

C. Applicants need not have majored in anthropology as undergraduates but will be expected to make up deficiencies in their backgrounds by taking additional courses.

D. Acceptance by the Department of Anthropology and the Graduate School.

In special cases, students not meeting requirements A and B may be admitted on a provisional basis.

Graduate Program

The Department of Anthropology offers graduate work leading to the Master of Arts and Doctor of Philosophy degrees. The program for the first year is designed to give the students a general knowledge of social and cultural anthropology, including culture history, ethnography and linguistics. Students entering with advanced standing may take the Qualifying Examination during their first semester. The examination is given two or three times each year, usually in September, December and April or May.

Graduate students should gain some practical experience and training in teaching and research. All graduate Trainees are assigned as Teaching Assistants in at least one undergraduate course. They assist in all aspects of teaching. Research training is gained through independent study, field-work, and assisting in departmental research projects. Museology and the analysis of material culture are taught in the University Museum.

The M.A. Degree in Anthropology

The Master of Arts program is designed for students who desire graduate anthropology training for a career in education, health, applied social sciences, or community professions. The M.A. may be granted to those students who complete the requirements and who wish to terminate their studies, or who wish to obtain the M.A. as a mark of progress towards the Ph.D. It is not required for the Ph.D. candidacy. Requirements for the M.A. are:

1. One year minimum residence, during which a minimum of 30 graduate credits are completed.
2. Pass the Qualifying Examination at an appropriate level.
3. The student plans and carries out a study as approved by his or her M.A. Guidance Committee. This may require library research, laboratory study, and/or fieldwork. The research is the basis of the M.A. thesis, which must be accepted by a committee appointed by the department. No final defense is required.

The Ph.D. in Anthropology

This program is designed to provide specialized training in social, cultural, linguistic and ecological anthropology. After the student demonstrates his or her general knowledge by satisfactory performance in course work and the Qualifying Examination, he or she chooses four fields of specialization. Two of these are normally topical or theoretical fields and two are ethnographic areas. One or more fields may be cross-disciplinary, or interdisciplinary, and involve study with faculty in other departments or universities. A guidance committee supervises his or her

studies. He or she prepares a research proposal, plans and carries out an independent field research project. This project usually is the basis of his or her dissertation.

The student's general knowledge in anthropology qualifies him or her for advanced and independent study. He or she critically examines and evaluates studies in his or her principal fields of interest, and demonstrates his or her ability to organize and present his or her own ideas in the Preliminary Examination. His or her dissertation represents original, independent research that advances knowledge.

Minimum residence is four semesters of full-time study beyond the baccalaureate, including at least two consecutive semesters. The Preliminary Examination should be completed in two years.

Requirements for the Ph.D.:

Qualification:

A. Achieve competence in the general theory of social and cultural anthropology.

B. Acquire a general knowledge of world ethnography.

C. Acquire a broad knowledge of culture history.

D. Acquire a working knowledge of descriptive linguistics.

Course work and the Qualifying Examination establish the student's eligibility to proceed towards the Preliminary. Students then select their major fields of interest and choose a guidance committee of three to five faculty members. These subjects are defined by the student's interests, research and teaching plans.

Preliminary:

A. Demonstrate the ability to use library materials in largely independent research.

B. Demonstrate an understanding of the use of quantitative methods in social sciences, by successfully completing ANT 505 or equivalent work.

C. Demonstrate reading proficiency in the language or languages necessary for the fields of specialization as determined by the department. The language or languages should be used in preparing preliminary essays and tested by a procedure approved by the student's guidance committee.

D. Acquire a detailed knowledge of two ethnographic areas (such as Central America or Melanesia). Write an essay on each area defining research problems, presenting views about the problems, and including a bibliography.

E. Acquire a detailed and specialized knowledge of two topical, theoretical fields (such as culture history or political anthropology). Write an essay on each field outlining his or her views on the subject, theoretical and research problems and including a bibliography.

F. Prepare a dissertation research project. This will demonstrate the application of the fields studied (in D and E above) to an independent research project.

Passing the written and oral preliminary examination, with the guidance committee and additional faculty consultants within and outside the Anthropology Department, will then establish the student's preparation for candidacy. If field research is not a part of the thesis project, a period of field work, and report on this, will be required before the student may be advanced to candidacy.

Candidacy

Satisfactory performance in the Preliminary Examination is required for advancement to candidacy. Research, including field work gathering material for the dissertation, is frequently carried out away from the Stony Brook campus. Dissertation procedures and award of the Ph.D. follow Graduate School requirements. A final defense and/or presentation to a colloquium is required.

Courses

ANT 500 Social and Cultural Anthropology

Study of the forms of social organization: family, kinship, economic, political and religious, as found among simple and complex societies. A basic graduate course designed for students whose previous background is in other fields.

3 credits

ANT 501, 502 Theory in Cultural and Social Anthropology

Discussion of selected issues and approaches in cultural-social anthropological theory. Problems treated may vary from year to year.

3 credits each semester

ANT 503 Evolution of the State

The theories of a number of seminal thinkers in social history, political theory, economics, sociology, and anthropology are tested against the empirical results of contemporary anthropological research, both archaeological and ethnographic. Emphasis is upon Asia and Africa but New World materials are also introduced for purposes of comparison.

3 credits

ANT 504 Problems in Political and Economic Development

An examination of the political and economic problems faced by undeveloped peoples as they become modern nations, and discussion of some of their successes and failures in political and economic development. Each student carries out independent research on a nation, people, or problem, presents material in a seminar, and writes a paper on the research.

3 credits

ANT 505 Quantitative Methods of Anthropology

General statistics. Computer analysis of anthropological data, hypothesis construc-

tion, tests of significance, and analysis of variance.

3 credits

ANT 506 Readings and Research in African Ethnology

Intensive readings in research in select problems of African ethnology. Particular attention is given to aspects of social and ecological anthropology as well as culture history.

3 credits

ANT 508 Seminar in Latin American Cultures

Research and discussion about selected topics in the culture and social structure of Indian and peasant communities in Latin America.

3 credits

ANT 512 Patterns of Empire

A comparative analysis of the social institutions of the early empires will be offered. The evolution of militarism, secular bureaucracies, long distance trade, land use and tenure, and other topics will be examined.

3 credits

ANT 520 Readings in Topical Problems

Topics will be selected on the basis of the needs of the graduate program. Seminars may consider such topics as: social systems and their models, kinship and marriage, family structure, ecology and economy, political systems, ritual, religious belief, myth, symbols.

3 credits

ANT 525 Method in Ethnography and Social Anthropology

An examination of the methods used by ethnographers and social anthropologists in observation, data collection and analysis. Ethnography is discussed as field inquiry and the organization of data for a monograph. Different interests, aims and results will be studied as they characterize ethnographers and social anthropologists. Contemporary studies of social relations will be stressed.

3 credits

ANT 526 Anthropological Geography: Theory and Applications

Field geographical techniques and skills necessary for anthropologists will be examined from the point of view of ecological evaluations in the progressive formation of cultural landscapes. Settlement pattern analysis (zonal and community), cartographic techniques, aerial-photographic analysis, soil typing, determinants for plant and animal communities, and succession principles will be presented in terms of their geomorphological articulations with cultural ecology.

3 credits

ANT 528 Kinship and Social Organization

The significance of kinship systems and their relationships to other social institutions (e.g., political, economic, religious) in selected societies will be examined through the use of ethnographies and theoretical statements by important contributors to the field.

3 credits

ANT 529 Ecology and Social Organization

The relation between societies and their environment: evaluation of resources, technology, land tenure, subsistence, local groups, economy, kin and political relations will be examined. Examples will include food collecting, hunting, agricultural, pastoral and mixed economies.

3 credits

ANT 540 Readings in Ethnography and Ethnology

A survey of the more important and better documented cultures and societies of selected world ethnographic areas and the implications of data from these for current approaches and problems in ethnology.

3 credits

ANT 550 Readings in Cultural History

Application of the ecological approach to the study of evolutionary process and culture history.

3 credits

ANT 551 Economic Anthropology

Economic life of primitive peoples and pre-capitalistic civilization with emphasis on the integration of the economy with technology and with social and political institutions.

3 credits

ANT 553 Political and Legal Anthropology

Description and analysis of political and legal institutions. Selected examples will be taken from many areas of the world to show government, internal regulations and external relations in small bands, villages, tribes, and states. Forms of social control, conflict and the resolution of conflict, law and legal procedures will be considered.

3 credits

ANT 557 Seminar in Comparative Religion

Various theoretical and methodological problems in the cross-cultural study of ritual and belief will be examined. Students will be encouraged to review critically a broad spectrum of ethnographic materials in the study of these problems. Emphasis will be on religious systems not generally covered in the nonanthropological literature of religion.

3 credits

ANT 560 Readings in Descriptive Linguistics

The findings of linguistic science in terms of their application to field anthropology.

3 credits

ANT 561 Peasant Societies and Cultures

The concept of peasantry will be examined from political, religious, and social class viewpoints as well as from the more traditional economic view. These agricultural peoples, who are essentially preliterate and preindustrial, are described and analyzed especially in relation to the national societies of which they form a part.

3 credits

ANT 562 Prescriptive Alliance Systems

A comparative analysis of social and symbolic forms associated with prescriptive alliance, together with a survey of the various institutional and symbolic expressions of the principle of binary opposition. Special attention is paid to Southeast Asia.

3 credits

ANT 568 Symbolism

An analysis of ritual, oral literature, and other art forms as they operate as modes of symbolic expression in preliterate societies, and an investigation into the structural and functional relationships between these and the institutions and structures of a selected range of societies.

3 credits

ANT 600 Practicum in Teaching

Variable and repetitive credit

ANT 601, 602 Research Seminar in Anthropological Theory

Variable and repetitive credit

ANT 604 Tutorial in Anthropological Theory

Variable and repetitive credit

ANT 610 Individual Research

Variable and repetitive credit

ANT 620 Research Seminar in Topical Problems

Variable and repetitive credit

ANT 640 Research Seminar in Ethnography and Ethnology

Variable and repetitive credit

ANT 650 Research Seminar in Cultural History

Variable and repetitive credit

ANT 660 Language as an Analytical Tool

Variable and repetitive credit

ANT 699 Research Seminar in Fieldwork Problems

Variable and repetitive credit

Department of Economics

Professors:
E. AMES *(Chairman)*, HOFFMANN, JAMES, KALMAN, NEUBERGER, STEKLER

Associate Professors:
DUSANSKY, ENTINE *(Adjunct)*, KANOVSKY, KIHLSTROM, KRISTEIN, MIRMAN, STALEY, VAN ROY, ZSCHOCK, ZWEIG

Assistant Professors:
DAWES, KATZ, NIENHAUS, SATTINGER, SCHOEPFLE, WICHERS, WILE

Admission to the Ph.D. Program

For admission to the Ph.D. program, the following are required:

A. A baccalaureate degree, with an average of at least B in the undergraduate major subject.

B. Proficiency in a year course in introductory differential and integral calculus, demonstrated by a grade of at least B in such a course or by special examination. Students not meeting this requirement may be accepted provisionally upon their taking a year course in calculus and earning a grade of at least B prior to enrollment.

C. Results from the Graduate Record Examination (the Aptitude Test).

D. Acceptance by the Department of Economics and by the Graduate School.

Students who do not meet all these requirements may also apply if they feel that special circumstances should be considered.

Requirements for the Ph.D. Degree

1. The Ph.D. program is based on attaining competence rather than on registering for a predetermined number of courses. The following areas of proficiency are required of all students:

A. Mathematics: Proficiency may be demonstrated by a grade of at least B in ECO 590 and 591 or their equivalent, or in a special examination. This requirement should be met during the first year of study.

B. Core fields: Microeconomic theory, macroeconomic theory, and quantitative methods. Because of the necessity for maintaining a basic minimum level of competence in these fields, most students will probably take the basic courses offered by the department. Since these fields are tools of economic research, they should be taken as early as possible, although students who need to bring

their mathematics up to standard may wish to postpone quantitative methods to their second year.

C. Optional fields: Two optional fields must be offered by each student; at least one of these must be a field other than advanced theory or econometrics.

2. All students will be required to demonstrate proficiency in the three core fields and two optional fields by achieving a grade of at least B in special written examinations in each field, normally at the end of the second year. These examinations may be supplemented by an oral examination at the discretion of the examiners. The examination in one optional field may be waived if the student has achieved a satisfactory grade in all his course or other work in the field. The department will allow one repetition of a field examination in either the core or optional fields. In preparing for the examinations, experimentation and flexibility are expected and encouraged; the student may elect courses given by the department or other departments, an individual reading program under faculty supervision, research seminars, or appropriate part-time work for governmental or other agencies. Prior approval of such a program must be obtained from a qualified faculty member, and carried out under that person's general supervision.

3. The department requires demonstration of proficiency in a foreign language only in cases where the dissertation research involves knowledge of a foreign language for successful completion. In such cases, the dissertation advisor will notify both the student and the members of the Graduate Committee, who will arrange the details of the language proficiency examination.

4. The residency requirement for full-time students is four semesters of full time study beyond the baccalaureate including at least two consecutive semesters. Part-time students must achieve an equivalent amount of course and other work in the department. In all but exceptional cases, the student must be advanced to candidacy within five years after first enrolling in the graduate program.

5. Upon successful completion of the mathematics proficiency requirement, the language proficiency requirement (if necessary), and the field examinations in the core and optional areas, the student will be admitted to candidacy for the Ph.D. degree. A student who selects a dissertation topic involving language competency after advancement to candidacy must, however, fulfill the language requirement subsequent to such advancement.

6. Doctoral dissertation. Each candidate for the Ph.D. must complete a dissertation. The prospectus must receive approval of the thesis advisor and will ordinarily be presented before a research seminar. In general the dissertation should be short (50–75 pages) and of a quality suitable for publication in scholarly journals. Final approval will be by a depart-

mental committee including the candidate's principal advisor and two other faculty members. The results of the dissertation will be presented at a colloquium convened for that purpose.

Research work as an intern in an off-campus project or as an associate in an intra-university program, such as the Economic Research Bureau, Health Sciences Center, or Marine Sciences Research Center, or in extra-university bodies, such as the Bi-County Planning Board, may meet the dissertation requirement provided that it has had the continuing supervision of the principal advisor, that the student submits the results of independent research, and that it otherwise meets departmental standards.

Miscellaneous Information

1. Teaching. The department is committed to achieving a high quality of teaching and encourages all graduate students to acquire teaching experience during their graduate study.
2. Early completion. In order to encourage early completion of all degree requirements, departmental approval will be required to continue a student's program if it extends more than five years from the time of entry.
3. Certification of Ph.D. candidates. Students who satisfactorily complete all Ph.D. requirements except for the dissertation and who find it impossible to complete the dissertation may apply for a certificate of completion of all but thesis requirements.

The M.A. Program in Economics

Option A

Students admitted to the Ph.D. program are expected to have the aptitude for and an intention of obtaining the Ph.D. degree. For students who must terminate their enrollment before obtaining the Ph.D., the M.A. will be awarded under the following conditions:

1. Thirty hours of resident graduate credits (exclusive of Teaching Practicum) in which a grade of B or better has been received.
2. Not more than three years time since first registration as a graduate student.

Option B

This option is designed for part-time (evening) students, who desire training in economics for professional reasons, but who will probably not become students in the doctoral program. It presents surveys of major problems of economic policy and methods of economic analysis. A bachelors degree is required for admission, but no prior training in economics is necessary. Completion of this M.A. program does not generally

permit the student to transfer into the Ph.D. program. Students wishing to make such a transfer should consult the Department as soon as possible about how to do so with a minimal loss of time.

The Master of Arts degree will be awarded upon the completion of 30 hours of graduate course credit with an average grade of B. Normally, students should take *two courses per semester for two years, and two courses during the intervening summer.* Deviations from this rate of work may be permitted in special cases.

The only requirement is two semesters of economic theory; student programs will be planned to meet individual needs, guided by academic advisors. With the consent of the Department, students in this program may enroll in a research seminar and write a masters thesis, but a thesis is not required. Where appropriate, students may transfer credit earned in CED economics courses toward their M.A. degree. Courses in related social sciences, in mathematics, or other disciplines may be given credit toward the degree where such courses serve a useful part of the student's career objectives.

Courses appropriate for Option B to be offered in 1974–75 include ECO 573, 574, 575, 576, 577, 578, 579, 580. Additional courses will be offered in subsequent years, covering topics such as managerial economics, consumer economics, economic development, and international trade.

Courses

The department is prepared to offer the following courses, although not all of them in each academic year.

ECO 500 Microeconomics I

The first semester of a one-year course, ECO 500 deals with traditional microeconomic theory, including consumer choice theory, theory of production, cost curves, market equilibrium, market forms, and general equilibrium.

Fall, 3 credits

ECO 501 Microeconomics II

A continuation of ECO 500, focusing on decision-making under certainty, risk, and uncertainty. Topics include linear programming, non-linear programming, the Kuhn-Tucker theorem, utility theory, game theory, group decision-making and Arrow's Impossibility theorem.

Spring, 3 credits

ECO 505 Microeconomic Cybernetics

A mechanistic description of economic behavior, with emphasis on quantitative aspects and verifiability. Topics include: shape of the demand and supply functions; effects of interaction among economic agents (conspicuous consumption, interdependent utilities); a reconsideration of the nature and role of money, prices, commodities.

Fall, 3 credits

ECO 508 Development of Economic Analysis

Analysis of basic doctrinal issues in the development of the discipline as reflected in methodology, historical context, and the effort to develop and refine a logically coherent body of theory. Major schools and streams of thought and their divergent patterns of development will be emphasized as they apply to contemporary economic systems.

3 credits

ECO 509 Studies in Economic Theory

Variable and repetitive credit

ECO 510 Macroeconomics I

The first semester of a one-year course in the theory of income and employment, including examination of principal determinants of aggregate levels of income and employment, interactions of product and money markets, analysis of changes in the level of economic activity over time, growth and inflation.

Fall, 3 credits

ECO 511 Macroeconomics II

A continuation of ECO 510.

Spring, 3 credits

ECO 513 Business Cycles, Stabilization Policies, and Forecasting

An analysis of modern theories of the business cycle and the use of alternative stabilization policies to reduce the undesirable effects of cycles. Emphasis will be on the selection of optimal policies and the role of forecasting in the implementation of policy.

3 credits

ECO 514 Dynamic Economic Models

The role of time in economic models. Dynamic and sequential programming techniques. Elements of control systems. Probabilistic programming models in economic problems. Applications to economic growth and stability models.
Prerequisite: Introductory knowledge of mathematical programming, elements of ordinary differential equations and calculus of variation, or permission of the instructor.

3 credits

ECO 519 Studies in Macroeconomics

Variable and repetitive credit

ECO 520 Mathematical Statistics

The first semester in a one-year course in quantitative methods. Statistical methods and their properties of particular usefulness to economists. Topics include: probability theory and its empirical application; univariate and multivariate distributions; sampling distributions; limiting distributions; point and interval estimation.

Fall, 3 credits

ECO 521 Econometrics

A continuation of ECO 520. The application of mathematical and statistical methods to economic theory, including the concept of an explanatory economic model; multiple regression; hypothesis testing; simultaneous equations models and estimating techniques. Emphasis is placed on the application of econometric methods to economic issues and the interpretation of econometric studies.

Spring, 3 credits

ECO 522 Seminar in Applied Econometrics

A survey of econometric studies with illustrations from the current literature of various econometric techniques and the critical evaluation of numerical results. Topics include: problems of quantification and measurement, the structure and use of explanatory economic models, analyses of consumer behavior (e.g., demand and consumption functions), aspects of firm behavior (e.g., investment), econometric models of economies.
Prerequisites: ECO 521; ECO 501 and ECO 511 are recommended, or permission of instructor.

3 credits

ECO 525 Economic Applications of Probability Theory

An examination of the role and meaning of "uncertainty" in economic models, especially micro models (consumer behavior, producer behavior). Some elementary stochastic processes, with applications in theories of price formation, market penetration, traffic.
Prerequisite: two semesters of calculus, one semester of (graduate or undergraduate) statistics.

3 credits

ECO 527 Operations Research I

Offered concurrently with MSA 537. Elementary maxima and minima problems

and the Lagrange multiplier. Linear programming including the simplex technique. The transportation problem. Queuing problems under different assumptions on input, service mechanism, and queue discipline. Dynamic programming. Basic ideas of inventory theory.

3 credits

ECO 528 Operations Research II

Offered concurrently with MSA 538. Non-linear programming and programming under uncertainty; introduction to statistical decision theory and game theory. Monte Carlo techniques. Applications such as inventory theory or traffic theory according to the interest of the class.
Prerequisite: ECO 527.

3 credits

ECO 529 Studies in Quantitative Methods

Variable and repetitive credit

ECO 530 Welfare Foundations of Public Sector Economics

This is a one semester course designed to explore, in a concise manner, the micro basis of public sector economics. Emphasis is placed on the contrast between optimization in the private and public sectors, externalities, "second best" social optima, "public" goods, collective choice, public investment criteria and optimal pricing in the public sector. This course is designed to integrate with subsequent coursework in public finance, urban economics, environmental economics, medical economics and advanced welfare economics.

3 credits

ECO 531 Seminar in Public Sector Economics

Analytic and econometric approach to selected issues in public sector economics drawn from the areas of urban economics, medical economics, environmental economics, welfare economics and public finance. Some of the topics considered will be: urban financial crisis; corrective taxation and environmental damage; optimal pricing and economic growth; applied econometrics and the measurement of specific policy parameters. This course may be taken as a continuation of ECO 530, but 530 is not a prerequisite.

3 credits

ECO 533 Applied Welfare Analysis

Development of selected topics in advanced welfare theory, including intertemporal resource allocation, uncertainty, preference transformation and collective choice. Emphasis will be on using welfare economics as a research and analytic tool in a variety of fields, particularly those involving the public sector, such as education, health, urban problems, and the environment. Empirical and theoretical aspects of income distribution. Efficiency and equity of alternative economic systems. This course may be taken as a continuation of ECO 530, but 530 is not a prerequisite.

3 credits

ECO 540 Human Capital

An examination of the concept of human capital, including investment criteria, and rates of return to the individual consumer, worker, firm and society. Welfare analysis of market behavior and public policy in the fields of health, education and on-the-job training. Implications of imperfect capital markets, uncertainty and discrimination.

3 credits

ECO 541 Seminar in Human Capital

Use of theoretical and quantitative techniques to analyze specific topics in the human resources area, such as manpower problems and policies, financing of higher education, medical insurance, and production functions for health and education. Emphasis on student reports and research.

3 credits

ECO 542 Foundations of Urban Economics

Analysis of the nature and functioning of urban areas. The theoretical foundations of urban economics are developed: theories of the consumer and housing producer in economic space, land rent and use, urban structure, and the size distri-

bution and growth of urban areas are developed. Emphasis is placed on methodology and hypotheses generated by the theories. The hypotheses are then related to empirical observations.
Prerequisite: Economics 501.

3 credits

ECO 543 Problems in Urban Economics

The theories developed in Economics 542 are applied to specific urban problems. Urban problems are such as poverty, housing, slums and urban renewal, urban transportation, financing local government and environmental quality are analyzed. A great deal of emphasis is also placed on methodology. Economics 542 is recommended though not a prerequisite.

3 credits

ECO 549 Studies in Public Sector Economics

Variable and repetitive credit

ECO 550 International Economic Theory

The course stresses recent developments in the major aspects of international economics, including the balance of payments, the exchange rate, comparative advantage models, trade and growth, welfare aspects of international trade, the theory of customs unions and trade policy in advanced and less-developed countries.

3 credits

ECO 551 International Economic Policy

Application of theoretical and empirical analysis to policy issues in international trade and finance. Specific examples of commercial, exchange-rate and balance of payments policies of both advanced and less-developed countries.

3 credits

ECO 560 Comparative Economic Systems

A consideration of economic systems in terms of goals, decision-making processes and coordinating mechanisms. Theories of organization, information, and motivation are explored for light they shed on economic systems. The application of tools of economic theory, both micro and macro, to various economic systems, in order to explain the functioning of each system and to explore the relevance of the tools under differing institutional contexts.

3 credits

ECO 561 Theory of Economic Systems

Introduction to the theory of social preference and choice functions. Voting systems. Informationally decentralized systems. Centralized and coercive systems. Team theory.
Prerequisite: ECO 501 or consent of instructor.

3 credits

ECO 562 Economic Development I

Analysis of the major issues in development and the principal theoretical contributions of economists to developmental problems. An effort will be made to examine the relevance of existing economic theories of development in the light of post-World War II experience, and with regard to the growth of multidisciplinary insights into widely variable institutional patterns of economic organization.

3 credits

ECO 563 Economic Development II

A continuation of ECO 562, this course examines issues of development policy and plan formulation and implementation. Special attention will be devoted to selected regional, national, and sectoral cases.
Prerequisite: ECO 562 or the equivalent.

3 credits

ECO 564 Economic Anthropology

An investigation into the cross-cultural applicability of economic theories and into the relevance of anthropological theory and method in examining structure and change of economic systems.

3 credits

ECO 566 Political Economy I

Study of basic institutions and dynamics of the capitalist mode of production. The

method of dialectical and historical materialism is developed and applied to the problems of capital accumulation, control of resources, and imperialism. Important links to feudal and socialist modes of production are also considered.

3 credits

ECO 567 Political Economy II

Study of various institutions that aid in the reproduction of class society, with the object of discovering how the particular needs of class society shape the content and the form of these institutions. Particular attention is paid to the State, education, sexism and racism. The main focus of the course is the United States, but reference is made to other capitalist and non-capitalist experience.
Prerequisite: ECO 566 or permission of instructor.

3 credits

ECO 569 Studies in Economic Systems

Variable and repetitive credit

ECO 570 Price and Welfare Theory

Provides a concentrated introduction to price theory and welfare economics. Deals with the theory of consumer behavior, production theory, competitive and monopolistic markets, with special emphasis on the underlying assumptions. Surveys welfare theory, emphasizing social welfare functions, externalities, public goods, natural monopolies, consumers' surplus, and cost-benefit analysis. At the end of the course, some classic examples of urban economics will be analyzed in the light of this body of theory.

3 credits

ECO 571 Operations Research and Urban Problems

The theory and algorithms of linear and non-linear programs. Applications to networks, production models, and some industrial models. Decomposition techniques and decentralization methods. Some post-optimality techniques, interrelationships of mathematical programming, game theory, and economic analysis. Some examples from economic planning models.
Prerequisites: Linear algebra, elements of set theory.

3 credits

ECO 572 Macroeconomics and Public Sector Finance

The theory of national income determination, employment, distribution, price levels and growth, and the analysis of economic policies on the national level and their implications for state and local governmental finance. Examination of taxation theory, public goods, public expenditure theory, effects of alternative tax structures and intergovernmental fiscal relations.

3 credits

ECO 573 Prices and Markets

Price determination and the laws of supply and demand. The response of private enterprise to market conditions. The relation of labor and financial markets to the production process. Introduction to the concept of general economic equilibrium.

3 credits

ECO 574 Statistics and Data Analysis for Public Policy Analysis

First semester of a two semester introduction to statistical and econometric methods which are useful in analysis of data and the formation of public policy. Topics include frequency distributions and descriptive statistics; probability and probability distributions; sampling distributions; tests of hypotheses; estimation; regression and correlation analysis; time series and forecasting; formulation, estimation, and application of simultaneous equation systems; nonparametric methods; sampling theory; experimental design; simulation. Applications of methods will be presented in a workshop.

3 credits

ECO 575 Econometric Methods for Public Policy Analysis

Continuation of ECO 574.

3 credits

ECO 577 Economic History of the United States I

A study of topics in the development of the U.S. and Western Europe. Designed to show how historical events such as the growth of industries and trade, changes in occupations and income, and governmental policies, can be systematically analyzed.

3 credits

ECO 578 Economic History of the United States II

Continuation of ECO 577.

3 credits

ECO 579 Labor and Industrial Relations

The unique aspects of the labor market; wage determination and wage differentials; wages, productivity and inflation; unionism and its economic impact; governmental intervention; unemployment and poverty in the modern economy.

3 credits

ECO 580 National Income, Employment and Money

The determination of the level and rate of growth of income, employment, output and the price level. The influence of the banking system, money, and the government budget. Alternate fiscal and monetary policies to facilitate full employment of economic growth.

3 credits

ECO 581 Economic Aspects of Public Policy I

Selected problems of current interest, such as the economics of health, education, environmental protection, cities, community finance, poverty, etc. These will be studied so as to determine whether they arise from failure of the market mechanism, from inadequate public sector financing or from improper understanding of non-market economic processes.

3 credits

ECO 582 Economic Aspects of Public Policy II

Continuation of ECO 581.

3 credits

ECO 590 Mathematical Foundations of Contemporary Economic Theory I

Examination of those topics in set theory, topology, linear algebra that are relevant to economic theory. Application of these topics to economic theory will be developed as time permits.

Fall, 3 credits

ECO 591 Mathematical Foundations of Contemporary Economic Theory II

Examination of those topics in linear differential equation systems, convexity, fixed point theorems, n-variable calculus that are relevant to economic theory. Application of these topics to economic theory will be developed as time permits. Prerequisite: ECO 590 or the equivalent.

Spring, 3 credits

ECO 598 Economic Fundamentals

Directed work for individuals or small groups enrolled in graduate programs, on topics in which students are inadequately prepared at the time of their admission. Credit in this course will be part of a student's work load but may not count towards a degree.

Variable and repetitive credit

ECO 599 Research in Special Topics

Variable and repetitive credit

ECO 600 Advanced Microeconomic Theory I

Topics will be selected from the following: Neoclassical and modern consumer choice theory, optimization theory, general equilibrium theory, stability theory, game theory, etc. Necessary mathematical concepts will be developed as needed.
Prerequisites: ECO 501 and ECO 591, or the equivalent.

3 credits

ECO 601 Advanced Microeconomic Theory II

Continuation of ECO 600.

3 credits

ECO 620 Advanced Econometrics I

A two semester sequence in the foundations of econometric theory. Emphasis is placed on techniques frequently employed in econometric research and the problems of model formulation, identification, estimation, hypothesis testing, and model evaluation. Topics will be selected from the following areas: general linear model, non-linear models, multivariate analysis, time series analysis, simultaneous equations systems.
Prerequisite: ECO 521 or permission of instructor.

3 credits

ECO 621 Advanced Econometrics II

Continuation of ECO 620.

3 credits

ECO 668 Research Workship in Systems and Development

Preparation, presentation and discussion of student and faculty research on theoretical and applied topics in the fields of comparative systems and economic development. Topics covered by student papers will usually be related to students' long-run research interests. Open to second- and third-year students in Ph.D. program and interested faculty.

3 credits

ECO 698 Practicum in Teaching

Variable and repetitive credit

ECO 699 Thesis Research

Variable and repetitive credit

Department of History

Professors:
ANGRESS, CHINCHILLA, AGUILAR, LAMPARD, MAIN, ROSENTHAL, SEMMEL, TAYLOR, TRASK *(Chairman)*

Associate Professors:
ÅLIN, BOTTIGHEIMER, BURNER, CLELAND, D. M. FOX *(Adjunct)*, KUISEL, LEBOVICS, R. H. G. LEE, R. M. LEVINE, LIDA, MARCUS, PRATT, F. WEINSTEIN, WELTSCH, WILDMAN, J. A. WILLIAMS

Assistant Professors:
CARTER, COWAN, GARBER, LEMAY, MCCARTHY, RAPP

Admission to Graduate Study

For admission to graduate study in history, the following are required:

A. An official transcript of undergraduate record.

B. Letters of recommendation from *three* previous instructors.

C. Results of the Graduate Record Examination Aptitude Test.

D. A baccalaureate degree in history or its equivalent.

E. A minimum grade point average of 2.75 (B−) in all undergraduate course work, and 3.00 (B) in history courses.

F. Acceptance by the Department of History and the Graduate School.

In special cases, students not meeting requirements D and E may be admitted on a provisional basis.

With the approval of the Dean of the Graduate School and the History Department, a student holding an M.A. degree from another accredited institution may be admitted directly to the Ph.D. program at Stony Brook.

Foreign Languages

Ph.D. candidates are expected to be able to use whatever languages are necessary for research in their major field. The student and his advisor will decide what those languages should be, with the approval of the Graduate Committee. In most cases proficiency in at least one foreign language must be demonstrated by examination before a student may be examined for the M.A. or Ph.D.

Supervised Teaching

Teaching assistants in history are expected to perform either research or teaching functions in the department, up to a possible 12 hours a week.

Those who are teaching will enroll in HIS 581 Supervised Teaching for three units per semester of degree credit. Their work will be supervised by the member of the faculty to whom they are assigned.

All doctoral students beyond the M.A. level, whether teaching assistants or not, are expected to perform some kind of supervised teaching within their graduate career.

Master of Arts Degree

The department offers two options at this level: *Option 1* for those primarily interested in graduate study leading to university teaching or research positions and *Option 2* for those primarily interested in teaching history in the schools and community colleges. Those in the *Option 1* will be awarded a degree upon satisfactory completion of at least 30 graduate credits and upon demonstration in an oral examination of competence in a field of history. Those in *Option 2* will be awarded a degree upon satisfactory completion of at least 30 graduate credits and the submission of an acceptable M.A. Project. (For a description of the M.A. Project, see "Master of Arts" (History Education *Option 2*) section below.)

Advising

Upon registration, M.A. candidates will be assigned advisors in their anticipated area of study (e.g., U.S., Europe, Latin America, History Education). The students will work out fields of study and schedules of appropriate courses with their advisors.

Option I

Field of Examination

The M.A. examination field is a substantial area of study in which a significant historical literature exists and in which significant questions are raised. A field may be defined geographically or topically. Aspects of the field may be selected for special emphasis, but knowledge of the general contours of the whole field will always be assumed by the examiners. The examination field selected should be submitted to the Graduate Committee for approval.

Samples:

United States to 1824.

United States since 1824, with emphasis upon political/constitutional (or intellectual or diplomatic or social) history.

Europe since 1815, with emphasis upon Britain, France, and Germany.

Modern Europe, with emphasis upon intellectual history, 1715–1890.

Modern Europe, with emphasis upon Russia since 1600.

Latin America before Independence.

Latin America since Independence, with emphasis on Brazil, Argentina, and Mexico.

Expansion of Europe, 1500–1750 or 1750-recent times.

Courses

Each M.A. candidate must complete satisfactorily at least 30 units of appropriate graduate course work before taking the M.A. oral examination. These courses shall normally include:

1. Two reading and/or research seminars in the exam field (6 units).
2. At least one additional reading colloquium with a different instructor (3 units).
3. Electives chosen among further reading colloquia and individual directed readings.

Examination

An examining committee of three faculty members, chosen by the chairman of the History Department, shall assess the candidate's competence in his or her chosen field in oral examination.

Normally the M.A. examination shall be taken at the end of two semesters of study. It must be taken by the end of the third semester, except in exceptional circumstances by permission of the Graduate Committee.

Option II

Master of Arts Degree (History Education)

The History Education option is designed to provide new modes of graduate study in history for those who are primarily interested in teaching in the schools and community colleges. A student's program combines traditional graduate courses with a special seminar on teaching. In place of the oral examination in the Option I program, a student prepares an M.A. Project. The project may be an original instructional unit, or a research paper and smaller teaching unit based on the paper. Other options are possible, but the objective in all cases is to integrate in meaningful ways a student's reading and research with teaching in the classroom.

The admission requirements to this program are the same as those indicated above under "Admission to Graduate Study." Ordinarily no special language proficiency will be required.

Courses

Each candidate in the History Education option must complete satisfactorily 30 hours of appropriate graduate course work. He must also submit an M.A. Project, described above, which must be approved upon

completion by two members of the department. A student's program will normally include:

1. HIS 597, 598: The Teaching of History, I, II (6 units)
2. HIS 599: Research for M.A. Project (6 units)
3. Reading and/or research seminars, individual directed readings (18 units)

A "B" average will be a formal prerequisite for the degree. The History Education Committee, charged with the administration of this M.A. option, will recommend conferral of the degree when all requirements, including the M.A. Project, have been satisfied.

Doctor of Philosophy Degree

The Ph.D. is the highest professional degree in history. Candidates for the degree must hold an M.A. awarded either by the State University of New York at Stony Brook, or another institution which it recognizes. Candidates must have been formally admitted to the Ph.D. program in history and have completed the minimum residence requirements as defined by the Graduate School. The nature of a student's work will be prescribed by a Ph.D. preparation committee, made up of members of the graduate faculty in fields in which the student has an interest. A foreign language requirement will be set by this committee, and will in no case be less than a reading knowledge of one foreign language. The Ph.D. preparation committee will, most critically, assist the student to define and master three fields of knowledge:

Field 1: Dissertation Field: An area of historical knowledge which encloses the student's expected research interest, and which comprises a field sufficiently broad for the purpose of undergraduate teaching. Example: Modern European History, with emphasis upon 19th century Germany.

Field 2: Additional Teaching Field: a broadly defined area of historical study which comprises a second, distinct teaching field (although it may be chosen for the comparisons it evokes with the dissertation field). Examples: Latin American History After Independence; History of Science.

Field 3: Cognate Field: A specialty in another discipline, or in history but with a specific methodological emphasis. Examples: Econometrics; Political Theory; Art History. This field will not be formally examined. It will be considered to have been passed upon successful completion of at least six credits of formal course work on the graduate level, and the completion of a paper or project which attests to the student's ability to adapt this specialty to historical research. A student's Ph.D. preparation committee will certify satisfactory completion of this requirement which, like all of the above requirements, must have been completed before formal examination of fields 1 and 2 (qualifying examinations) is permitted.

Course Work

A student's program should be planned in consultation with his Ph.D. preparation committee. In every case, however, it must include two graduate seminars beyond the M.A., one of which must be a research seminar in the Dissertation Field. This requirement must be met before qualifying examinations are taken. All students holding full or partial traineeships must register for three credits of HIS 581, supervised teaching, in each semester in which they hold such an appointment. A requirement for students who have *not* held a traineeship in the course of their graduate careers is that they take HIS 581 for at least one semester during their Ph.D. program. Full-time students are expected to take their qualifying examinations at the end of their third, and not later than the end of their fourth, semester of post-M.A. work.

Qualifying Examinations

There are three examination options open to the student in consultation with his Ph.D. preparation committee:

Option 1: A single oral examination of not less than two hours duration in which both the dissertation field and teaching field are examined, the two fields being assigned equal importance. An examiner from another department, ordinarily representing the cognate field, will be present and welcome to examine where he sees appropriate. The examining committee will be expected to take into consideration a student's over-all graduate record before recommending advancement, or non-advancement to candidacy.

Option 2: *A* written examination of the teaching field followed, no more than one month later, by a written examination of the dissertation field. As soon as the second exam has been passed, a brief review oral examination will be held, the examiners to include at least two readers of each of the two written exams and an examiner from another department, ordinarily representing the cognate field. This committee may examine the student on any aspect of his three fields, but will be expected to take into consideration his over-all graduate record before recommending advancement, or non-advancement, to candidacy.

Option 3: A written examination of the teaching field followed, no more than one month later, by an oral examination, principally of the dissertation field. At least one reader of the written exam in the teaching field must be present and free to ask additional questions concerning that field. An examiner from another department, ordinarily representing the cognate field,

will be present and welcome to examine where he sees appropriate. The examining committee will be expected to take into consideration a student's over-all graduate record before recommending advancement, or non-advancement, to candidacy.

If failed, the oral and written examinations in all options may be repeated once, with the further stipulation that the oral in option 2, if failed, may be repeated only if not more than one of the written exams was failed as well.

Advancement to Candidacy

After the student has passed the Qualifying Examination, the department shall propose to the Dean of the Graduate School that the student be advanced to Ph.D. candidacy.

Dissertation

A dissertation is required for the Ph.D. degree. After advancement to candidacy, a student will register for dissertation credits in consultation with his or her advisor. The student will select a dissertation topic within the major field. At present, the department offers dissertation fields in United States, Modern European, Latin American history and Expansion of Europe.

The dissertation must upon completion be approved by a dissertation examining committee of at least four members of the faculty, appointed by the Dean of the Graduate School. This committee may include the dissertation supervisor and must include at least one person from outside the department.

Before final approval can be granted, the student must present the results of the dissertation research at an informal dissertation colloquium convened for that purpose by the department and open to interested faculty members and graduate students.

Time Limit

All requirements for the Ph.D. degree must be completed within four years after advancement to candidacy. In rare instances, the Dean of the Graduate School will entertain a petition to extend this time limit, provided it bears the endorsement of the chairman of the department.

For further details, see Item #8 of the Graduate School regulations.

Courses

To prepare students for examinations, research work, and teaching, the Department of History offers the following kinds of graduate courses. Students wishing to know the exact course offerings for 1974–75 should request this information from the Department of History.

HIS 501, 502 Reading Colloquia in Ancient and Medieval History

HIS 503-510, 515-517 Reading Colloquia in European History since 1500

HIS 521-534 Reading Colloquia in United States History

HIS 541-545 Reading Colloquia in Latin American History

HIS 552-555 Reading Colloquia in English History

HIS 561 Reading Colloquium in East Asian History

HIS 581 Supervised Teaching

HIS 582-586 Directed Readings for M.A. Candidates

Variable and repetitive credit

HIS 590 Reading Colloquium in Quantitative Methods

HIS 593 Reading Colloquium in Psychoanalysis and History

HIS 597, 598 Teaching History I, II

Permission of Instructor

HIS 599 Research, M.A. Project

HIS 601, 602 Research Seminars in Ancient and Medieval History

HIS 603-610, 615-617 Research Seminars in European History Since 1500

HIS 621-634 Research Seminars in United States History

HIS 641-645 Research Seminars in Latin American History

HIS 652-655 Research Seminars in English History

HIS 661 Research Seminar in East Asian History

HIS 682-686 Directed Readings for Ph.D. Candidates

Variable and repetitive credit

HIS 699 Research for Ph.D. Candidates

Variable and repetitive credit

Urban and Policy Sciences

Graduate School Programs

Program for Urban and Policy Sciences

Professors:
BELTRAMI, HAYES *(Adjunct)*, NATHANS, *(Chairman)*

Associate Professors:
ALTMAN, BODIN, CARROLL, CARTER *(Adjunct)*, EHLER, WEINER *(Adjunct)*

Assistant Professors:
SWINTON, YOUNG

Faculty Associates:
KRISTEIN, MARCUS, POLITE, SATTINGER, SHORT, TUCKER, WILE

The Program for Urban and Policy Sciences is an educational and research program whose principal objective is to develop competence in problem-solving skills and institutional knowledge for the systematic analysis and design of alternative solutions to public policy problems. Both the curriculum and an active research program emphasize the application of the mathematical and analytic tools of the natural and social sciences in transportation, health care, energy policy, housing, environmental quality management and other fields. The program is directed toward meeting the need for qualified professionals in the areas of analyzing, planning, and managing public systems in urban and non-urban settings. A Master of Science degree is awarded upon successful completion of the two year graduate program.

Most graduates of the program enter careers as analysts and planners in various types of line agencies at all levels of government, in university-

based or private research organizations, or in private industry. Others may go on for further university study.

To prepare students for these roles, Urban and Policy Sciences emphasizes:

- An interdisciplinary/integrated approach.
- Understanding the processes of implementation.
- Interaction with the public sector.

Curriculum

The educational curriculum of the Graduate Program is divided into five components:

1. *Core courses:* This set of courses, taken during the first year, provides the basic framework of the Program. Progress through these courses allows the student to develop a high level of competence in the tools and skills he will require to systematically analyze large-scale, complex public problems and to understand how decisions are made and policy formulated in social, political, and economic institutions. Topics covered in the core include statistics and data analysis, operations research techniques, decision-making, planning theory, urban economics and public finance.

2. *Case studies, workshops, and projects:* An underlying objective of the educational program, reflected in this component of the curriculum, is to develop within the student the ability to analyze unstructured, contextual problems and to recognize the social, political, economic and institutional constraints that affect the formulation and implementation of public policy. The student must be able to learn about public issues quickly, to cope with information overload, to communicate what he learns to others, and to work effectively in a group. The student is required to gather and use data and information from a variety of sources, to filter them in meaningful ways, and to learn to present material clearly and concisely. The case studies, workshops, and projects provide the opportunity to develop skills needed by effective analysts and planners.

3. *Electives:* These courses, taught both within the Program and available from other departments within the University, provide the student during his or her second year with the opportunity to develop detailed knowledge in a particular area in which he or she expects to concentrate, or to broaden his or her perspective and sensitivity to the social and behavioral elements of public policy.

A wide variety of courses and seminars related to the urban and policy sciences is offered through other departments at Stony Brook. Of particular interest to UPS students would be advanced courses in the Department of Economics and courses in advanced quantitative technique in the Department of Applied Mathematics, urban politics and administration in the Department of Political Science, organization theory and social change in the Department of Sociology, and social psychology in the Department of Psychology. All UPS students are encouraged to take a number of elective courses outside of the program.

4. *Internship:* No combination of courses, seminars, projects or workshops can completely bridge the gap between the academic environment and the professional world that the student enters upon graduation. Practical experience can be gained, however, through an arrangement where the student works as a paid staff member on a specific problem for a governmental or community organization. This experience is provided through the requirement that all UPS students satisfactorily complete an intern program during the summer months between the first and second year of study. Arrangements for the internship are made by the UPS faculty. An attempt is made to match as closely as possible student interests and abilities with the specific requirements of the governmental agency or community organization. Documentation of the project is required for evaluation by both the program and the client. Some examples of recent intern projects include: an air pollution model developed for the IBM scientific center, a study of alternative schools for the New Jersey Department of Education, a feasibility study of ocean disposal of solid wastes for the New York City Environmental Protection Administration, a survey and evaluation of day-care centers in New York for the Central Staff of the State Assembly, and an examination of milk pricing in New Jersey for the National Child Nutrition Project.

5. *Research:* In addition to working on organized research projects that are defined by the UPS faculty, the second year student may undertake an independent research project that reflects his or her knowledge of a selected area of policy concentration. This project may be of an applied or theoretical nature.

Requirements for the M.S. Degree

The program of study for each student must be approved on an individual basis by the educational director of the Program for Urban and Policy Sciences.

Students must satisfy the following requirements for graduation:

A. Four semesters (usually two years) of full-time study in the program;

B. Successful completion of a total of 48 credits of formal graduate course requirements—24 credits from the core curriculum, workshop, case studies, and projects, 6 from advanced quantitative methods; 18 credits of electives and seminars on public policy issues; and

C. Successful completion of a summer internship, including the preparation and submission of an acceptable summary document.

Students must maintain satisfactory progress throughout their course of study. If a student receives an "incomplete" for work, he or she must complete the requirements before enrollment in the subsequent semester or be restricted to a reduced course load.

Admission

The Program for Urban and Policy Sciences is designed for students who are highly motivated and capable of applying what they learn toward the solution of public sector problems. Each student will be asked to forward with his or her application a statement of his or her career objectives and the way he or she expects to realize these objectives through the program. A personal interview with the educational director is encouraged.

In addition, students must satisfy the following admissions requirements:

A. A baccalaureate degree with a minimum grade point average of 3.0. In exceptional cases, students not meeting this requirement may be admitted on a provisional basis;

B. Successful completion of course work in mathematics and/or statistics;

C. Submission of GRE scores;

D. Three letters of recommendation: one of which, if possible, should be from a professional working in a public agency, community organization, or private organization who is capable of evaluating the applicant's motivation and potential for public sector work and at least one of which should be from a college faculty member, counselor, or administrator; and

E. Finally, acceptance by both the Program for Urban and Policy Sciences and the Graduate School.

Although not required, examples of an applicant's creative work will be considered. These might include previous or professional project reports or published articles.

Applications for the M.S. Program should be made by April 1, although earlier submissions are encouraged. Applications are reviewed between January and April for the following fall semester. Final decisions con-

cerning financial aid will be made not later than the April 1 deadline for applications.

Application forms may be obtained by writing to:

Educational Director, Program for Urban and Policy Sciences,
State University of New York at Stony Brook,
Stony Brook, New York 11790.

Courses

Courses marked with an asterisk* are usually taken in the first year.

Analytic and Quantitative Techniques

UPS 510* Data Analysis and Statistics

A one semester introduction to probability, statistics and data analysis. Topics include exploratory data analysis and statistics, uses and abuses of data, probability distributions, moments, sampling distributions, point estimation, interval estimation, hypothesis testing and regression and correlation analysis. Computer applications and illustrative examples are an integral part of the course.

Fall, 3 credits

UPS 513* Quantitative Methods for Public Systems Analysis

Modeling concepts related to public service systems. This first course in quantitative methods discusses optimization theory. Topics include network analysis, linear programming, the transportation problem, integer programming, heuristic programming and vehicle routing and scheduling. Examples include procedures for routing and scheduling school buses and street sweepers, political redistricting, facility location and manpower scheduling.

Spring, 3 credits

UPS 517/518 Advanced Quantitative Methods for Public Systems Analysis I and II

Advanced topics not covered in UPS 513 and UPS 510. Topics include experimental design, sampling techniques, non-parametric statistics, cluster and factor analysis, queuing analysis, markov analysis, analysis of emergency services, and industrial logistics. Application to examples in the public sector are given and computerized implementations demonstrated.

Fall and spring, 3 credits each semester

Economic Processes

ECO 545 Foundation of Urban Economics

Analysis of the nature and functioning of urban areas. The theoretical foundations of urban economics are developed: theories of the consumer and housing producer in economic space, land rent and use, urban structure, and the size distribution and growth of urban areas are developed. Emphasis is placed on methodology and hypotheses generated by the theories. The hypotheses are then related to empirical observations.

Fall, 3 credits

ECO 570* Price and Welfare Theory

Provides a concentrated introduction to price theory and welfare economics. Deals with the theory of consumer behavior, production theory, competitive and monopolistic markets, with special emphasis on the underlying assumptions. Surveys welfare theory, emphasizing social welfare functions, externalities, public goods, natural monopolies, consumers' surplus, and cost-benefit analysis. At the end of the course, some classic examples of urban economics will be analyzed in the light of this body of theory.

Fall, 3 credits

ECO 581 Economic Aspects of Public Policy I

Selected problems of current interest, such as the economics of health, education, environmental protection, cities, community finance, poverty, etc. These

will be studied to determine whether they arise from failure of the market mechanism, from inadequate public sector financing or from improper understanding of non-market economic processes.

Spring, 3 credits

UPS 575* Economic and Political Organization in the Public Sector

Discussion of both theoretical concepts and applied analyses of the economic/political organization of the local public sector. Topics include organization of government in metropolitan areas; economic behavior of public and private agencies; implications of competition and monopoly for the dynamic behavior of organizations; and organizational analysis of specific services such as fire protection, education, transportation, and criminal justice.

Spring, 3 credits

Policy Analysis and Decision Making

UPS 531* Political and Administrative Decision Making

Exploration of approaches to the study of decision making by individuals, groups and organizations, logical analysis of individual decision making under certainty and risk, game theory, collective choice, and political decision making behavior, as well as case studies of decision making in bureaucratic and political contexts.

Fall, 3 credits

UPS 535* Public Policy Analysis and Evaluation

Techniques for the analysis and evaluation of public issues including macro-economic analysis, public finance, cost-benefit analysis, modeling and simulation, public program evaluation, and experimental design.

Spring, 3 credits

UPS 551 Planning and Policy Sciences Seminar

A review and critique of historical and developing concepts and styles of planning with emphasis on theories and techniques. Discussions center on planning defined as a future-oriented, goal-directed, decision process. Topics include definitions of plans, planning and planners; the roles of beliefs, images, values anticipations, and the appreciative system in planning; knowledge, information, action, change, feedback, and evaluation in planning systems; freedom of information and public participation in planning; conflict and change; requirements for the change-over to long-range planning; resistance to planning; organizational restructuring; knowing and designing the future.

Spring 1975, 3 credits

UPS 555 Urban Techno-Policy Seminars

Policy analyses of specified urban problems for the purpose of identifying points of institutional and technological intervention. Policy analysis areas include technology assessment, cost-benefit analyses, systems regulation, environmental impact, and/or socio-psychological studies of human adaptation to technology. Problem areas for investigation include energy, criminal justice, land-use planning, wastes management, and telecommunications.

3 credits, repetitive

Practica in Policy Analysis and Public Management

UPS 541/542* Workshop in Urban and Policy Sciences

An opportunity to participate in the formulation and solution of problems encompassing economic-political-social constraints. It is intended to supplement the theoretical courses in the program as well as integrate the facts and techniques that the student has learned. It provides the student with an opportunity to put his knowledge and initiative to a practical test. The course is organized into a number of case studies of varying duration. During the beginning portion of the course the class participates in a number of short studies aimed at expanding its awareness of the many operating skills and communications skills necessary to deal with problems of an unstructured nature. The class also defines and generates a number of alternative solutions to one or more public pol-

icy issues. The class is expected to collect its own data and design an implementation and evaluation plan. They are also expected to use consultants from the faculty, industry, public or government as the need arises.

Fall and spring, 3 credits each semester

UPS 590 Professional Development

Topical problems of professional practice in the public realm such as the art of advice-giving, the role of the professional policy analyst and planner, organizational development and behavior, and professional ethics.

Spring, 1 credit

UPS 591 Special Topics in Urban and Policy Sciences

Designed to accommodate innovative subject matter on an experimental basis and provide the opportunity of offering courses taught by visiting faculty. Topics may include the creative use of law in shaping public policy, public management, and others. May be repeated for credit.

3 credits, repetitive

UPS 595 Individual Directed Research in Urban and Policy Sciences

Designed to accommodate independent research projects, with faculty guidance. May be repeated for credit.

Fall and spring, 1 to 3 credits

UPS 596 Small Group Studies in Urban and Policy Sciences

Designed to accommodate ad hoc small group student research projects on an experimental basis. Projects are designed by UPS faculty and students. Topics are announced at the beginning of each semester. May be repeated for credit.

Fall and spring, 1 to 3 credits

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This list contains faculty of the Ph.D. programs in Basic Health Sciences, which are coordinated with the Graduate School. Faculty of graduate professional programs in the Health Sciences Center are listed in the *HSC Bulletin.*

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[a] On leave academic year 1974–75

[b] On leave fall semester 1974

[c] On leave spring semester 1975

* An asterisk indicates faculty who are located primarily at affiliated hospitals and agencies off campus, including the following facilities designated as clinical campuses in partnership with the Health Sciences Center:
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STATE UNIVERSITY OF NEW YORK

General Statement

State University of New York, which celebrated its 25th anniversary in 1973, is unique in its organization and the breadth of its educational mission. It is the largest coordinated, centrally managed multi-level system of public higher education in the nation.

In a recent report to the University's Trustees, Chancellor Ernest L. Boyer said, "The State University welcomes not only the future architects, business executives, engineers, surgeons, and literary critics, but also future dairy farmers and medical technicians, accountants and social workers, foresters and automobile mechanics. And, through work in film, electronics, pollution control, data processing, police science, urban studies and similar fields, the University seeks to educate persons for tomorrow's roles as well as those of today."

Since its founding in 1948, the State University has grown from 29 State-supported but unaffiliated campuses into an organized system of higher education comprising 72 institutions which enrolled 234,000 full-time and 127,000 part-time students in academic 1973–74.

Specifically, the University encompasses four university centers (two of which, Buffalo and Stony Brook, include health science centers); two medical centers; 13 colleges of arts and science; a non-residential college; three specialized colleges; six agricultural and technical colleges; five statutory colleges; and 38 locally-sponsored community colleges. Together, they offer students a choice of more than 3,100 academic specializations, representing more than 1,500 different degree programs. Twelve of the campuses offer graduate study at the doctoral level, 22 at the masters level.

Advanced degree study encompasses a wide spectrum, including agriculture, business administration, criminal justice, dentistry, education, engineering, forestry, life and physical sciences, medicine, nursing, optometry, pharmacy and veterinary medicine.

Four-year programs emphasize the liberal arts and science and include such specializations as teacher education, business, forestry, physical education, maritime service, ceramics and the fine and performing arts.

The two-year colleges offer associate degree opportunities in arts and science and in technical areas such as agriculture, business, civil technology, data processing, police science, nursery education, nursing, medical laboratory technology and recreation supervision. The two-year colleges also provide transfer programs within the University for students wishing to continue study toward a baccalaureate degree.

Two of the University's state-wide programs which have played important roles in upgrading educational opportunity for disadvantaged students have been merged into single operations called Educational Opportunity Centers.

The ten centers now combine the efforts of the former Urban Centers, which provided opportunities for educationally deprived students to upgrade occupational skills and find gainful employment, with those of the former cooperative college centers, which identified students with college potential and prepared them for matriculation into public and private colleges in New York State.

Educational innovation has from the first been a University watchword.

With funding support from a private educational foundation, several University campuses are experimenting with programs to shorten substantially the traditional four-year period of baccalaureate study.

Empire State College, the 72nd and newest institution, is a non-residential college whose students earn degrees without being attached to a specific campus or attending traditional classes. Its coordinating center at Saratoga Springs reaches out to students through regional learning centers.

State University is governed by a Board of Trustees, appointed by the Governor, which determines the policies to be followed by the 34 State-supported campuses.

The 38 community colleges operating under the program of State University have their own local boards of trustees. The State contributes one-third to 40 per cent of their operating costs and one-half of their capital costs.

The State University motto is "Let Each Become All He Is Capable of Being."

CAMPUSES

UNIVERSITY CENTERS

State University at Albany
State University at Binghamton
State University at Buffalo
State University at Stony Brook

MEDICAL CENTERS

Downstate Medical Center at Brooklyn
Upstate Medical Center at Syracuse

COLLEGES OF ARTS AND SCIENCE

College at Brockport
College at Buffalo
College at Cortland
Empire State College
College at Fredonia
College at Geneseo
College at New Paltz
College at Old Westbury
College at Oneonta
College at Oswego
College at Plattsburgh
College at Potsdam
College at Purchase
College at Utica/Rome

SPECIALIZED COLLEGES

College of Environmental Science and Forestry at Syracuse
Maritime College at Fort Schuyler (Bronx)
College of Optometry at New York City

AGRICULTURAL AND TECHNICAL COLLEGES (Two-Year)

Alfred
Canton
Cobleskill
Delhi
Farmingdale
Morrisville

STATUTORY COLLEGES

College of Ceramics at Alfred University
College of Agriculture and Life Sciences at Cornell University
College of Human Ecology at Cornell University
College of Industrial and Labor Relations at Cornell University
Veterinary College at Cornell University

COMMUNITY COLLEGES

(Locally-sponsored, two-year colleges under the program of State University)

Adirondack Community College at Glens Falls
Auburn Community College at Auburn
Borough of Manhattan Community College
Bronx Community College
Broome Community College at Binghamton
Clinton Community College at Plattsburgh
Columbia-Green Community College at Athens
Community College of the Finger Lakes at Canandaigua
Corning Community College at Corning
Dutchess Community College at Poughkeepsie
Erie Community College at Buffalo
Fashion Institute of Technology at New York City
Fulton-Montgomery Community College at Johnstown
Genesee Community College at Batavia
Herkimer County Community College at Herkimer
Hostos Community College at South Bronx
Hudson Valley Community College at Troy
Jamestown Community College at Jamestown
Jefferson Community College at Watertown
Kingsborough Community College
LaGuardia Community College at Long Island City
Mohawk Valley Community College at Utica
Monroe Community College at Rochester
Nassau Community College at Garden City
New York City Community College

Niagara County Community College at Sanborn
North Country Community College at Saranac Lake
Onondaga Community College at Syracuse
Orange County Community College at Middletown
Queensborough Community College
Rockland Community College at Suffern
Schenectady County Community College at Schenectady
Staten Island Community College
Suffolk County Community College at Selden
Sullivan County Community College at South Fallsburg
Tompkins-Cortland Community College at Groton
Ulster County Community College at Stone Ridge
Westchester Community College at Valhalla

TRANSPORTATION TO STONY BROOK

By Air

Stony Brook is located ten miles from Long Island-MacArthur Airport and 50 miles from Kennedy International and LaGuardia Airports.

By Car

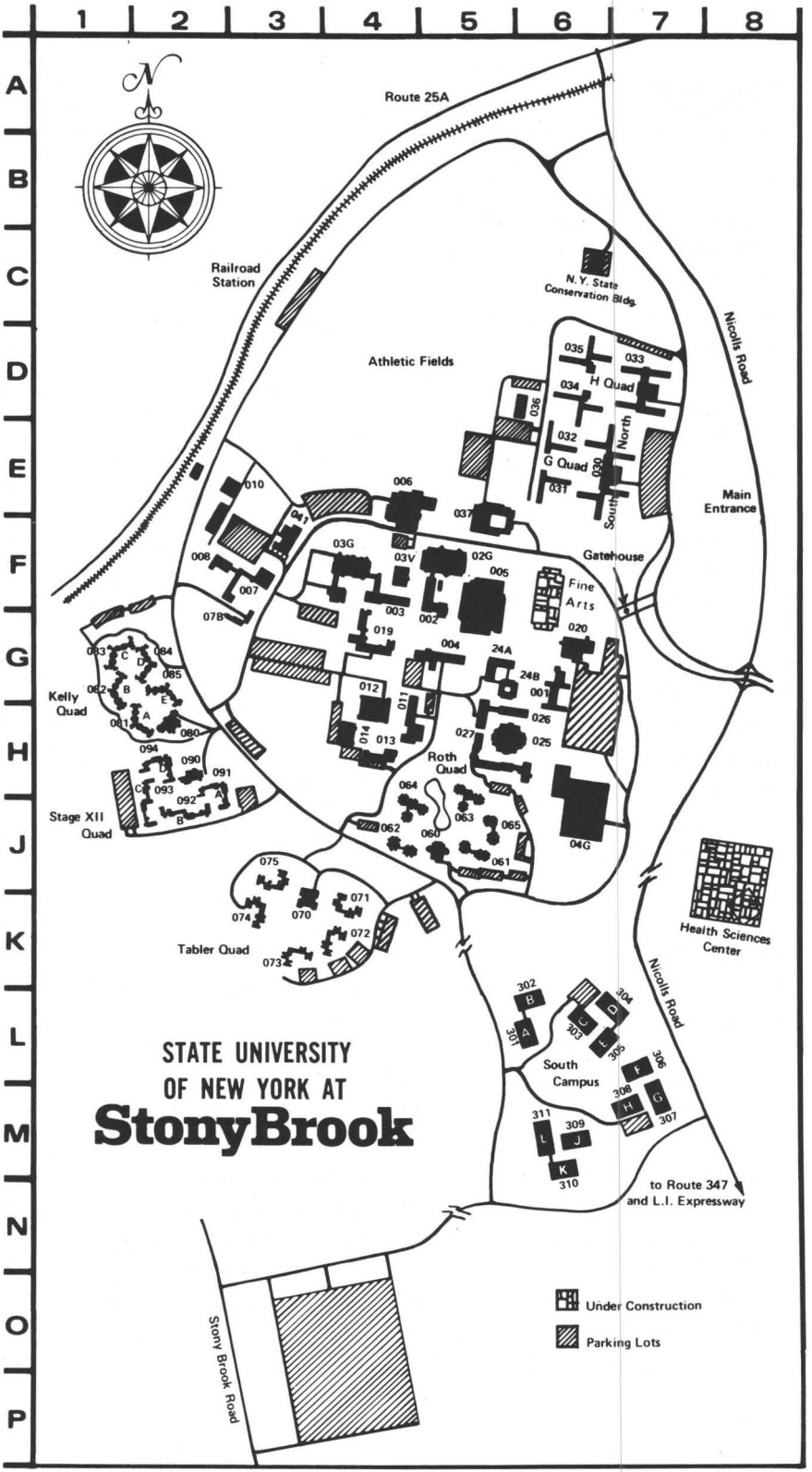
Take the Long Island Expressway (Route 495) east from the Queens-Midtown Tunnel in Manhattan. Leave Expressway at Exit 62 and follow Nicolls Road north for nine miles. Turn left at the main entrance to the University and stop at the gatehouse for a parking permit.

By Railroad

Take the Long Island Railroad's Port Jefferson line from Pennsylvania Station (Manhattan) or Flatbush Avenue Station (Brooklyn), or Jamaica Station. Change trains at Jamaica or Huntington, according to LIRR timetable. Get off at Stony Brook Station. Inquire for free campus bus.

CAMPUS GUIDE

Official Bldg. No.	Building Index	Map Location
020	Administration Building	G 6
032	Ammann College	E 6
033	Benedict College	D 7
04G	Biological Sciences Graduate Building	J 6
004	Biology Building	G 5
062	Cardozo College	J 4
002	Chemistry Building	F 5
02G	Chemistry Graduate Building	F 5
041	Commissary	F 3
014	Computing Center	H 4
072	Douglass Coilege	K 4
073	Dreiser College	K 3
019	Earth and Space Sciences Building	G 4
010	Electric Sub-Station	E 3
011	Engineering Building	H 4
013	Engineering Heavy Laboratory	H 4
012	Engineering Light Laboratory	G 4
030	G-Cafeteria	E 6
07B	Garage	G 2
	Gatehouse	F 7
065	Gershwin College	J 5
031	Gray College	E 6
006	Gymnasium	E 4
033	H-Cafeteria	D 7
071	Hand College	K 4
	Health Sciences Center	J 8
008	Heating Plant	F 2
063	Henry College	J 5
001	Humanities Building	G 6
036	Infirmary	D 5
026	Instructional Resources Center	H 6
030	(South) Irving College	E 6
034	James College	D 6
080	Kelly Cafeteria	H 2
081	Kelly A	H 1
082	Kelly B	G 1
083	Kelly C	G 1
084	Kelly D	G 2
085	Kelly E	G 2
027	Laboratory-Office Building	H 5
035	Langmuir College	D 6
025	Lecture Hall Center	H 6
005	Library, Frank Melville Jr. Memorial	F 5
064	Mount College	H 4
030	(North) O'Neill College	E 6
003	Physics Building	F 4
03G	Physics/Math Graduate Building	F 4
060	Roth Cafeteria	J 5
074	Sanger College	K 3
007	Service Building	F 3
24A	Social Sciences Laboratory	G 5
24B	Social Sciences Office	G 6
301	South Campus A	L 6
302	South Campus B	L 6
303	South Campus C	L 6
304	South Campus D	L 7
305	South Campus E	L 6
306	South Campus F	L 7
307	South Campus G	M 7
308	South Campus H	M 7
309	South Campus J	M 6
310	South Campus K	N 6
311	South Campus L	M 6
090	Stage XII Cafeteria	H 2
091	Stage XII A	H 2
092	Stage XII B	J 2
093	Stage XII C	J 2
094	Stage XII D	H 2
037	Stony Brook Union	E 5
070	Tabler Cafeteria	K 3
302	Theatre (South Campus B)	M 6
075	Toscanini College	J 3
03V	Van de Graaff Accelerator	F 4
007	Warehouse	G 2
061	Whitman College	J 5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Route 25A
Railroad Station
N.Y. State Conservation Bldg.
Athletic Fields
Nicolls Road
H Quad
G Quad
North
South
Main Entrance
Gatehouse
Fine Arts
Kelly Quad
Roth Quad
Stage XII Quad
Tabler Quad
Health Sciences Center
South Campus
STATE UNIVERSITY
OF NEW YORK AT
StonyBrook
to Route 347 and L.I. Expressway
Stony Brook Road
Under Construction
Parking Lots

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State University of New York at Stony Brook

Additional Information

For general information about graduate programs and/or application, please write or phone:

The Graduate School, State University of New York at Stony Brook
Stony Brook, N.Y. 11790, (516) 246-5945


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