StonyBrook

1971-72
Graduate Bulletin

STATE UNIVERSITY OF NEW YORK AT STONY BROOK

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STATE UNIVERSITY OF NEW YORK AT STONY BROOK

VOLUME IX

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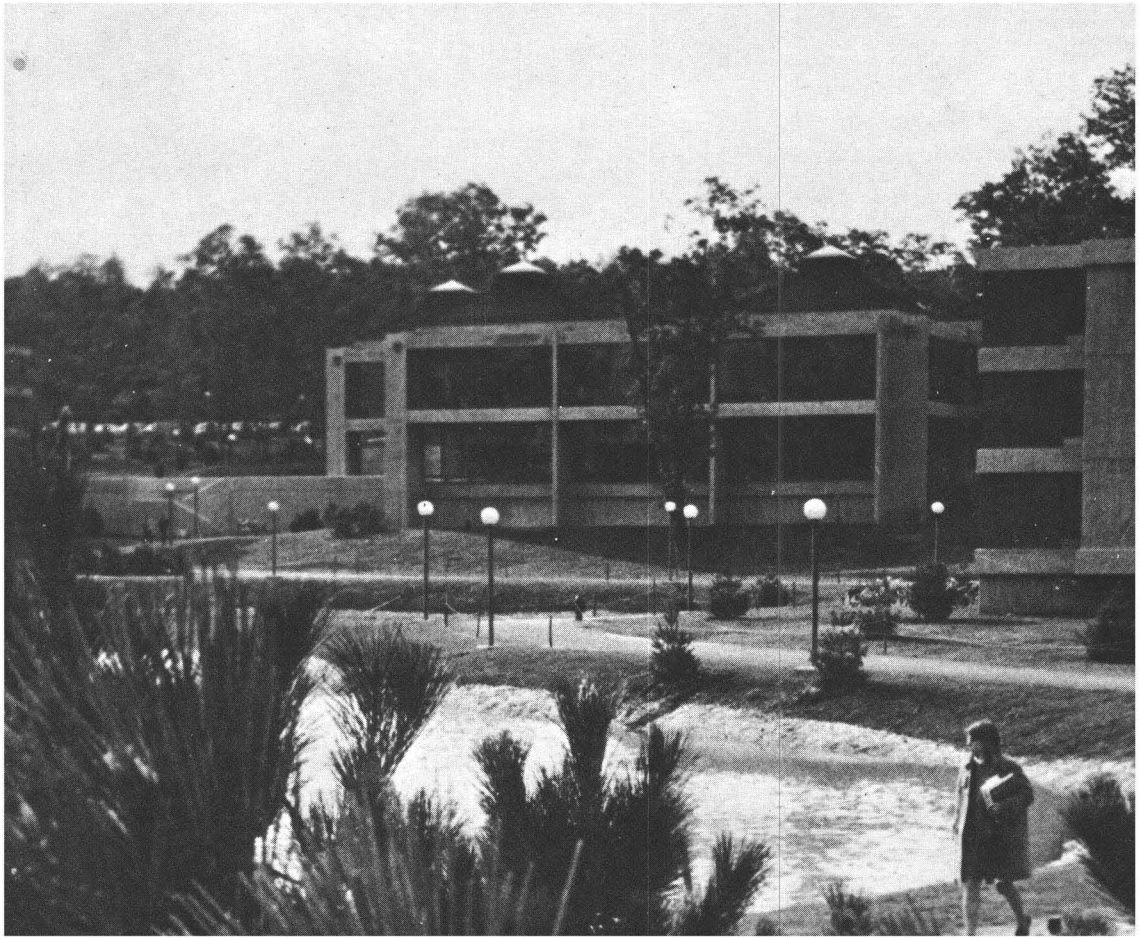
State University of New York
at Stony Brook

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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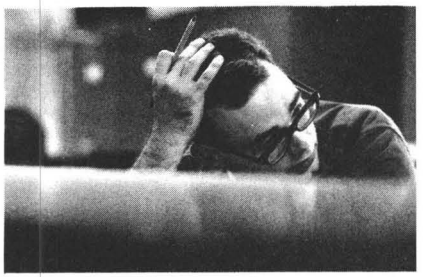
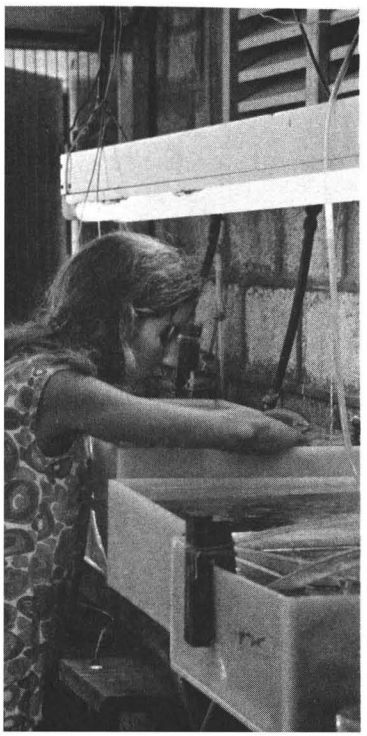


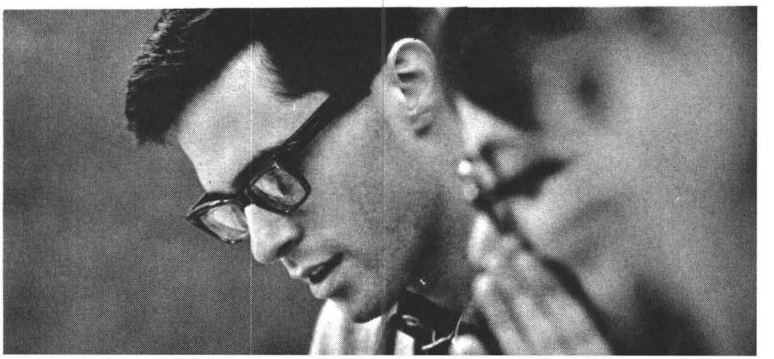
ACADEMIC CALENDAR
1971-72

Fall Semester 1971

August 30, Monday	All Residence Halls Open
August 30, Monday	Foreign Students Expected to Arrive Before Noon (Transportation Will Be Provided From Kennedy International Airport on Monday Only)
August 30-September 7, Monday-Tuesday	Foreign Student Orientation
August 31-September 1, Tuesday-Wednesday	Graduate Student Registration
September 1-4, Wednesday-Saturday	Orientation and Registration—Undergraduates
September 6, Monday	Labor Day Recess
September 7, Tuesday	Classes Begin
September 20, Monday	Last Day to Add a Course—Undergraduates
September 20, Monday	End of Late Registration Period—All Students
September 20-21, Monday-Tuesday	Rosh Hashanah Recess (No classes from 5 p.m. Sun., Sept. 19 to 5 p.m. Tues., Sept. 21)
September 29, Wednesday	Yom Kippur Recess (No classes from 5 p.m. Tues., Sept. 28 to 5 p.m. Wed., Sept. 29)
October 4, Monday	Last Day for Graduates to Add or Drop a Course
October 29, Friday	Advisory Grades Due

November 1, Monday	Last Day for Removal of Incompletes from Spring Semester and Summer Session for All Students
November 8-12, Monday-Friday	Advance Registration for Spring Semester for Graduates and Undergraduates (except CED Students)
November 24, Wednesday	Thanksgiving Recess Begins at Close of Classes
November 29, Monday	Classes Resume
December 17, Friday	Last Day of Classes
December 20, Monday	Final Examinations Begin
December 24, Friday	Final Examinations End—Fall Semester Ends
December 27, Monday	Final Grades Due in Registrar's Office—12 Noon
January 7, Friday	Last Day for Graduates to Submit Theses and Dissertations for January Graduation



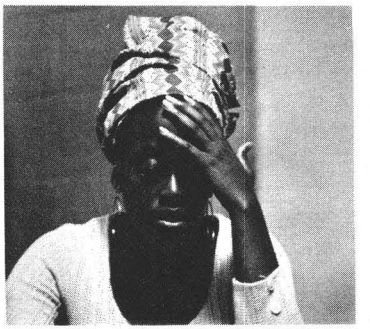


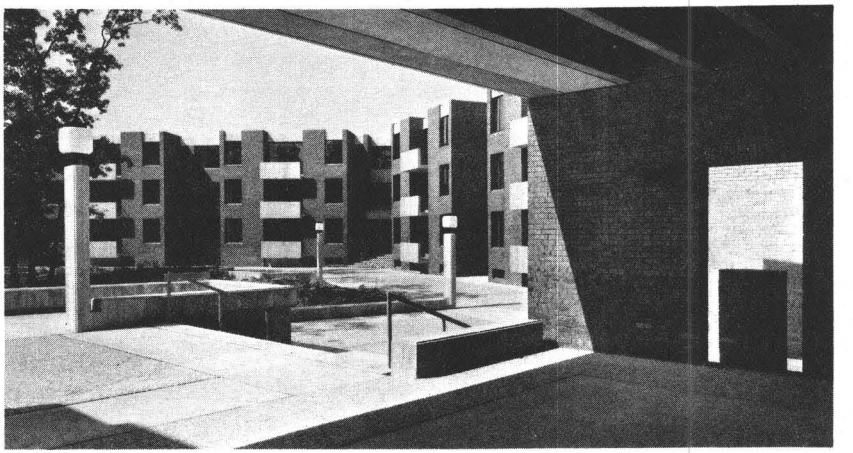
Spring Semester 1972

January 13-14, Thursday-Friday	Final Registration for Graduates
January 13-16, Thursday-Sunday	Orientation and Final Registration for Undergraduates
January 17, Monday	Classes Begin
January 28, Friday	Last Day to Add a Course—Undergraduates
January 28, Friday	End of Late Registration Period—All Students
February 11, Friday	Last Day for Graduates to Add or Drop a Course
March 3, Friday	Advisory Grades Due
March 15, Wednesday	Last Day for Removal of Incompletes from Fall Semester for All Students
March 25, Saturday	Spring Recess Begins at Close of Classes
April 3, Monday	Classes Resume
April 10-14, Monday-Friday	Advance Registration for Fall Semester and Summer Session for Graduates and Undergraduates (except CED Students)
April 21, Friday	Last Day for Graduates to Submit Theses and Dissertations for May Graduation
May 5, Friday	Last Day of Classes
May 6-9, Saturday-Tuesday	Reading and Review Days
May 10, Wednesday	Final Examinations Begin
May 19, Friday	Final Examinations End—Spring Semester Ends
May 23, Tuesday	Final Grades Due in Registrar's Office—12 Noon
May 28, Sunday	Commencement

Summer Session 1972

July 3, Monday	Final Registration
July 5, Wednesday	Classes Begin
August 11, Friday	Classes End—Summer Session Ends
August 18, Friday	Last Day for Graduates to Submit Theses and Dissertations for August Graduation





GENERAL INFORMATION

Introduction

The State University of New York at Stony Brook is one of four coeducational 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 Mr. Ward Melville. There are now 61 buildings on the campus and additional land has been acquired, more than doubling the original campus acreage.

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

The 1100-acre campus has a central plaza and library surrounded by various academic buildings (the Administration Building, the Humanities Building, the Earth and Space Sciences Building, and the Biological Sciences, Physics, and Chemistry Buildings). Construction has begun on a new Biological Sciences Building which will form a corner of the rim of the campus plaza, along with the Lecture Center and the Instructional Resources Center. The Stony Brook Union and the Gymnasium are located in a second rim of buildings surrounding

the central area. A new graduate chemistry building and math-physics complex are being built on this second rim not far from the existing engineering quadrangle, with its three academic buildings and the Computing Center.

Beyond the central plaza are 26 residential colleges, each providing residence accommodations for 200 to 400 students. These are located on the fringes of the campus in a series of quads separated from one another by wooded areas.

The Ashley Schiff Memorial Preserve, a 14-acre ecological preserve, located behind the site of the Biological Sciences Building separates the new South Campus from the central plaza area of the University. Eleven single-story buildings were constructed on the South Campus last year to serve as an additional 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. The 200-acre permanent site of the Health Sciences Center is now being developed on the East Campus across Nicolls Road from the main campus. It will provide a permanent location for the six schools of the Health Sciences Center, a University hospital, and a Veterans Administration Hospital.

Students and Programs

Graduate study is offered in three of the six schools in the Health Sciences Center, in the Center for Continuing Education, and in 19 academic departments, 17 of which offer the Ph.D. degree, and two interdisciplinary programs that offer masters degrees. At the undergraduate level, there are 25 academic departments as well as seven interdisciplinary programs.

During the academic year 1970-71, 3500 of the total Stony Brook enrollment of 12,500 were graduate students. Of the 3500 graduate students, 1900 were in Continuing Education (CED), an evening masters degree program designed primarily for working professionals. Of the remaining 1600 graduate students, close to 1200 were full-time doctoral candidates and 100 were full-time masters candidates. The remainder were enrolled in part-time masters and doctoral programs.

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 Engineers' Council for Professional Development. The Department of Chemistry is accredited by the American Chemical Society.

Summer Session Programs

During Stony Brook's six-week Summer Session, graduate and undergraduate courses are offered by the College of Arts and Sciences, College of Engineering, and Center for Continuing Education. Besides courses listed in the summer session catalogue, research courses for masters and doctoral degree candidates are offered by graduate departments. Graduate students are encouraged to remain on campus during the summer to continue study and research under faculty guidance. Some summer research traineeships are available through the Graduate School. Students in good standing at Stony Brook and other colleges or universities are eligible to attend the Summer Session.

Organization of the Graduate School

Under the direction of the Office of the Vice President for Academic Affairs, 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 Council chairman is the Dean of the Graduate School. Members include the Director of Libraries, seven members elected by the Faculty Senate, two members appointed by the Dean from Senate members not holding full-time administrative appointments, the president of the Graduate Student Council, and one representative elected by the Graduate Student Council.

The nine members chosen from and by the Senate serve three-year terms. Seven of the nine must come from the College of Arts and Sciences, two from the College of Engineering; and not more than one member may come from any academic department. 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.

Graduate Student Council

The Graduate Student Council was established by a vote of the graduate students in 1967. The Council's constitution empowers it "to act as a formal representative of the graduate students; to investigate areas of mutual concern to the graduate student body and the other members of the University community; and to encourage and coordinate interdepartmental graduate student activity."

As the formal representatives of the graduate student body, members of the Council sit on University committees which suggest and establish policies affecting the entire University community. These committees include the Council on Student Affairs, Stony Brook Union Policy Committee, Curriculum Committee, and Faculty-Student Association. The Council also appoints representatives to other University committees, including the Graduate Council, the Faculty Senate Executive Committee, Parking Committee, Special Committee on Traffic, Computing Center Committee, Operations and Safety Committee, Bookstore Committee, Teaching Policy Committee, and Instructional Resources Committee.

Student Services

Health and psychological services, financial aid and part-time employment, general and vocational counselling, international student advisement, and operation of the Stony Brook Union are administered through the Office of the Vice President for Student Affairs. Students are encouraged to seek advice and assistance through its subsidiary offices.

Psychological Services

A staff of trained psychologists and counselors experienced in helping students with personal, social, educational, and vocational problems is available through Psychological Services.

International Student Office

The International Student Office is located on the third floor of the Administration Building. It assists students 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.

University Health Service

The University Health Service, located in the Infirmary, is primarily concerned with student health needs; it serves faculty and staff on an emergency basis only. At least one physician is present during regular weekday hours and on Saturday mornings. At all other times, a physician is on call and a registered nurse is available at the Health Service Office. All students must file a health form and doctor's certificate with the Health Office before they can register for graduate studies.

Stony Brook Union

The Stony Brook Union provides facilities which include a cafeteria-ballroom, formal dining room and lounge, bookstore, little theatre, post office, meeting and conference rooms, barber shop, recreation area, radio station, craft shops, photography darkroom, student activities offices, lounges, bowling alleys, and billiards room to serve the university community.

Campus Activities

National and international leaders in government, science, education, and the arts visit Stony Brook regularly for lectures and seminars. A series of professional music concerts brings groups and soloists to the campus. Continuing art exhibitions feature the works of students and professionals. The Committee on Cinematographic Arts presents a series of foreign and domestic films annually. The films are shown twice nightly on Friday, Saturday, and Sunday.

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.

Libraries

The Frank C. Melville, Jr. Memorial Library is in the midst of expansion which will quadruple its square footage and permit an increase in its holdings from the present 500,000 volumes to more than 1,000,000 by 1975.

Besides its general and special collections, the library has some 60,000 volumes in specialized Chemistry, Earth and Space Sciences, Engineering, and Physics-Mathematics departmental libraries. An additional 55,000 volumes are held by a separate library for the Health Sciences.

The main library's resources also include about 750,000 pieces of microtext in reels and flat sheets. The present physical expansion of the library will result in a great increase in the number and variety of special study and research areas in the building.

Special Centers and Institutes

Center for Continuing Education

The Center for Continuing Education (CED) is one of Stony Brook's fastest growing units. The Center offers a part-time study program leading to a terminal Masters of Arts in Liberal Studies degree. Detailed information concerning admission and degree requirements can be found on page 93.

Instructional Resources Center

The Instructional Resources Center (IRC) is charged with development of more effective and efficient instructional procedures through close cooperation with faculty members of the various departments. IRC operations include one of the most extensive Computer-Assisted Instruction programs in the country. Thirty-two terminals, consisting of TV display screens, typewriter keyboards, and light-sensing pencils are connected with an IBM 1500 computer. The program aids students in physics, political science, statistics, data processing, French, and German.

A new 44,000-square-foot IRC building is under construction. Television and radio studios, moving picture and other film-making facilities, audio-visual equipment, and offices will be located in the two-story structure.

Center for Curriculum Development

The Center for Curriculum Development employs a professional staff charged specifically with developing new kinds of courses in areas of elementary and secondary education. Teachers enrolled in continuing education courses are invited to test some of the innovations and, in turn, to provide feedback on their effectiveness.

Institute for Research in Learning and Instruction

The Institute for Research in Learning and Instruction seeks to stimulate, support, and extend fundamental research in instruction. The human learning process, basic instruction processes, college-level instruction, and economic factors in innovative college instruction are specific research areas of concern to the Institute.

Center for Contemporary Arts and Letters

This newly developing campus resource is dedicated to deepening the understanding of 20th century arts and letters. It is not intended to be involved directly in instruction but rather to serve as a repository for the works of such artists and to sponsor appropriate activities that would serve to disseminate such contributions to the University community.

Computing Center

The Computing Center is located in the Engineering Quadrangle. The IBM 360-67 computer complex provides concurrent batch processing for student and faculty research work and for administrative data-processing. Short courses in programming are held periodically for all users.

Economic Research Bureau

The Economic Research Bureau conducts research, service, and training activities in applied economic analysis. Its recent work has included studies of economic problems facing Suffolk County youth, the feasibility of a regional corporate-profits tax, and the development of a planning model to guide the expansion of secondary education on Long Island. It serves as a link between the needs and resources of the academic community and those of the public and private sectors. Its work involves students, faculty members, visiting scholars, and consultants.

Institute for Colonial Studies

The Institute for Colonial Studies, founded in 1967, is concerned with comparative research into the institutions, customs, and history of colonies, especially those of the Western Hemisphere before 1800. The Institute has a library of source material—books, manuscripts, and microfilms—from the archives of the governments of Mexico and Spain and from the various states and counties of colonial America. A special section of the library is devoted to microfilms of documents from colonial Long Island. The Institute works closely with the Department of History at Stony Brook.

Institute for Theoretical Physics

Organized in the summer of 1966, the Institute for Theoretical Physics now has 20 faculty members carrying out research in various aspects of theoretical physics. Main topics of investigation presently include the structure of atomic nuclei and sub-nuclei particles. Other research activities include work with accelerator design, liquid gas, and magnetic substances.

Marine Sciences Research Center

The Marine Sciences Research Center, offering research facilities for faculty members and students from all State University of New York campuses, serves as a focal point for marine studies involving many different disciplines. The Center's proximity to Long Island Sound and its complex of wetlands provides an ideal setting for integrated studies of an impacted environment and environmental management.

Flax Pond, a tidal salt marsh acquired jointly by the State University and the State Conservation Department, is used by the Marine Sciences Research Center for shallow-water controlled experiments. Dock facilities for the Center's 40-foot research vessel are within ten minutes of the campus. In cooperation with the National Sea Grant Program, two-week ocean cruises are taken several times yearly on a 140-foot oceanographic vessel. The Center also cooperates with the University of the West Indies in running a laboratory at Discovery Bay, Jamaica, W.I.; and, along with Cornell University and the University of New Hampshire, it offers a marine sciences summer program at Isles of Shoals, off the Maine coast.

With the Division of Biological Sciences, the Center offers M.A. and Ph.D. degrees in marine biology. It also offers full- and part-time students an evening program leading to a multi-disciplinary M.S. degree in marine environmental studies.

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, changes in registration may be accomplished by completing the request form available from the Registrar and obtaining the approval of the Dean of the Graduate School, providing the proposed change does not alter the student's status as defined under "Student Status." *After the fourth week of classes, no course may be added or dropped.* In case it becomes 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 adjustment of these regulations to his case. Such petitions must be approved by both the chairman and the graduate program director of the department. In rare instances of this kind the grade of WP (withdrawn passing) or WF (withdrawn failing) will be assigned for each course dropped.

Summer Registration

Students who will be supported on faculty research grants or assistantships, traineeships, and fellowships during the summer must be registered for six credits in Summer Session. A list of courses which are approved for the summer is available at the Registrar's Office.

Registration for Maintaining Matriculation

Students must complete the appropriate forms obtained from the Registrar and register for at least a one-credit course in thesis or dissertation research *each semester* 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 a 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. 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.

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 registered 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 pro-

viding 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 credits from another institution toward his degree. The department has the responsibility of deciding on the applicability of these credits to their specific program. A candidate for the doctoral degree may transfer those 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.

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 15 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 his 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."

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 unsatisfactory 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). Indicated 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.

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 overall average falls below B (3.0) at any time after the completion of his first two semesters of graduate work. Additional minimum grade requirements may be imposed by individual departments.

Withdrawal from the University

Official Voluntary Withdrawal. A student finding it necessary to withdraw from the University must request permission to withdraw in writing and direct the request to the department chairman. If the department chairman favors such withdrawal, he then recommends approval of the request and forwards it to the Dean of the Graduate School. Once approval has been granted, 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 follow the procedure outlined in the "Official Voluntary Withdrawal" section above.

FINANCIAL AND RESIDENTIAL INFORMATION

Tuition and fee costs are based on the schedule printed below.

Charge or Fee	First Semester	Second Semester	Year
Tuition			
Full-time graduate student			
(N.Y. State Resident)	$400.00	$400.00	$ 800.00
(Out-of-State Resident)	$500.00	$500.00	$1,000.00
Special graduate student			
(Part-time, 11 credits or less)			
(N.Y. State Resident per semester credit hour)	$ 27.00	$ 27.00	
(Out-of-State Resident per semester credit hour)	$ 33.50	$ 33.50	
Professional Schools (Medicine, Dentistry)			
(N.Y. State Resident)			$1,200.00
(Out-of-State Resident)			$1,500.00
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[a]			
Individual (Basic)	$ 46.00		$ 46.00
Individual (Comprehensive)	$ 55.00		$ 55.00
Student and Spouse	$100.00		$ 100.00
Family Plan	$150.00		$ 150.00

[a] The University requires that all full-time students be covered by health insurance. A student may obtain coverage at registration, or submit proof of coverage at that time. The plans mentioned here are available through the insurance company. All plans and charges are subject to change without further notice.

	First Semester	Second Semester	Year
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		
Graduation Fee[b]	$ 15.00		
Late Registration Fee[c]	$ 15.00		
Transcript Fee[d]	$ 1.00 each		

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 deferred.

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. Private scholarship paid directly to the University
5. National Defense Student Loans

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

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.

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[b] Payable at the beginning of the semester in which the degree requirements will be fulfilled.
[c] Paid by students registering after the close of the official registration held in the Gymnasium.
[d] A student who obtains a degree may receive two transcripts without charge only if his account with the University is clear.
* This fee is optional for graduate students.

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

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.

Residence Charges

Room and board charges for students living on the Stony Brook campus are approximately $1161 per academic year, of which $565 represents the rent for one person sharing a double occupancy room; these charges are payable on a semester basis. A $25 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. Board is $596 per year.

The above fees and charges are subject to change without notice.

Refund Schedule

Request for refund of tuition, room, or board must be made in writing to the Bursar's Office, Room 262, Administration Building.

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 or special student who is given permission to cancel registration shall be liable for payment of tuition in accordance with the following schedule. A withdrawal card which is obtainable at the Registrar's Office must be completed and returned to that office on the date the student withdraws.

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 within one year after the end of the term for which the tuition requested to be refunded was paid to State University. The first day of class session shall be considered the first day of the semester, quarter or other term and Saturday of the week in which this first class session occurs shall be deemed the end of the first week for refund purposes.

Note: It is interpreted that a student who does not attend any class sessions after Saturday of the *first week* and who notifies the college of intent to cancel registration on or before the *second Saturday* following the first day of classes shall be deemed to have cancelled his or her registration *during the first week.*

Exceptions

A. There will be no tuition or fee liability established for a student who withdraws to enter military service prior to the end of an academic term for those courses in which he does not receive academic credit. Proof must be submitted.

B. A student who is dismissed for academic or disciplinary reasons prior to the end of an academic term will be liable for all tuition and fees due for that term.

Room Refunds

Once a student has registered and occupied a room, no refund will be granted for payment made for that quarter.

Board Refunds

Students who elect to participate in the board plan must pay for board as stated in the instructions. Payments are refundable on a percentage basis to those students who withdraw from the University after official notification has been

received by the Bursar's Office. No refunds are made to students who leave the campus on weekends, nor are refunds made to any student who, for any other reason, misses meals.

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 ($3800-4000) for the academic year.

Federal Awards

NDEA Graduate Fellowships

National Defense Education Act Graduate Fellowships/Title IV in the liberal arts and sciences and engineering are available for full-time study toward the doctorate. These fellowships carry stipends of $2400, $2600, and $2800 for the first, second, and third years of post-baccalaureate study respectively, plus tuition and fees each year. An allowance of $500 per year is provided for each dependent. To be eligible for an award, a candidate must be a citizen or national of the United States. Fellowships are granted for a 12-month period, although a nine-month tenure may be approved. All applicants to NDEA-approved departments are considered for these awards upon recommendation of their departments.

National Science Foundation Graduate Traineeships

National Science Foundation Graduate Traineeships are available to doctoral students in the mathematical, physical, biological and engineering sciences; anthropology, economics, psychology, and in interdisciplinary areas which are composed of overlapping fields in two or more sciences. The traineeships carry stipends of $2400, $2600, and $2800 for the first, intermediate, and terminal years of full-time study, plus tuition and fees each year, and an allowance of $500 per dependent per year. Stipends in the first year of graduate residence may be augmented by not more than $1000 for a tenure of a full calendar year or $750 for a tenure of nine months. Traineeships are granted for a 12-month

period, although a nine-month tenure may be approved under certain circumstances. Candidates for the award must be citizens or nationals of the United States. All applicants to eligible departments are considered for these awards.

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.

New York State Awards

For further information on the awards listed below, write: Regents Examination and Scholarship Center, State Education Department, 800 North Pearl Street, Albany, New York, 12204.

Herbert H. Lehman Graduate Fellowships

Herbert H. Lehman Graduate Fellowships are offered for full-time study in the social sciences. They offer a stipend of $4000 for the first year of graduate study, and $5000 for succeeding years. They may be held for a maximum of four years. The candidate must have been a legal resident of the United States for one year prior to the effective date of the award and must be a United States citizen or have made application for such citizenship. The holder of a Lehman Fellowship must enter full-time resident study in September of the year in which he receives the award, in a program leading to a graduate degree in an approved college or university in New York State. Closing date for applications is December 1.

Regents College Teaching Fellowships and Doctoral Fellowships

College Teaching Fellowships for beginning and advanced graduate study are available for full-time study in a doctoral program in a university in the United States. These fellowships carry stipends of $500 to $2500 per year, depending on financial ability. Candidates must be legal residents of New York State and citizens of the United States. Fellowships for full-time doctoral study in the arts, sciences or engineering in a college or university in New York State offer the same stipends as the College Teaching Fellowships. Closing date for applications is December 1.

Regents War Service Scholarships for Veterans

These scholarships, for full- or part-time study at any approved college, nursing school, business school, trade or technical school in New York State, carry stipends of up to $350 per year toward tuition and fees for a maximum of four years. Candidates must be legal residents of New York State who served in the armed forces after January 1, 1963, and were legal residents of New York State at the time of entry into military service. Closing date for applications is July 31.

Scholar Incentive Awards

Students with a minimum legal residency in New York State of one year prior to the beginning of the award and who are studying full-time are eligible for the Scholar Incentive Award. The award carries stipends of $100 to $600 per year depending upon financial need. Closing date for applications is December 1.

University Awards

Graduate traineeships are awarded on a competitive basis by the Graduate School on recommendation of the department. Traineeships carry stipends of $2800 and tuition exemption for the first academic year. For advanced students the stipend is $2900 for the second, and $3000 for subsequent years.

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. Inquiries concerning either financial aid or loan programs should be directed to the Financial Aid Officer in the Student Affairs Office.

The University has made available to foreign students a limited number of tuition scholarships. Applications for tuition scholarships may be obtained from the International Student Office located in the Administration Building.

Organization of American States Fellowships

Students from the member states of the Organization of American States who wish to pursue graduate studies may apply, upon seeking admission to the University, for a fellowship grant under the terms of the Program of Fellowships and Professorships of the Organization of American States. Requests for O.A.S. fellowship applications should be directed to: Technical Secretary, O.A.S. Fellowship and Professorship Program, Pan American Union, Washington, D.C. The deadline for receipt of application for this program is January 31 for those wishing to start their studies in the fall, and July 3 for those who wish to enter the University in the spring semester.

ADMISSION REQUIREMENTS

Scholastic Requirements

Applicants may be admitted to the Graduate School to pursue the M.A., M.S., M.M., or Ph.D. degree. 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, 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.

Student Status

Students regularly admitted to the Graduate School will register as full-time students and will register for 12 or more credit hours per semester. Responsibility for certifying the full-time status of graduate students rests with the department chairmen, who must be satisfied that the student is fully committed to the academic program leading to a graduate degree. A graduate traineeship is considered part of the academic program; therefore, a graduate trainee on a regular appointment will be a full-time student. Registration for 12 or more credit hours includes credit for supervised teaching and research.

Part-Time and Special Student Status

Admission of part-time students into advanced degree programs depends, in addition to applicants' qualifications, 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. Adherence to this criterion is the safeguard by which the Graduate School assures graduate students, part-time no less than full-time, that their preparation will be of appropriate academic calibre. Special and part-time students may enroll for no more than eight hours and no more than two courses per semester. Foreign students may not be part-time or special students. The Immigration and Naturalization Service prohibits any student on a student visa from another country from taking less than a full-time course load.

Graduate Record Examinations

Although a satisfactory score on the Graduate Record Examination is not a criterion of admission to the Graduate School, several departments do require the scores for admission and others use the examination in support of departmental selection procedures. 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.

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.

While individual departments may have certain course requirements, the Graduate School does not specify a minimum number of courses to be completed for each degree. Instead, the granting of the degree is based on the completion of residence, examination, thesis, 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. A student, well prepared upon admission, should normally be able to complete the course work for the masters degree in about one calendar year of full-time study, and for the Ph.D. Preliminary (candidacy) Examination in about two years of full-time study.

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 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. Research and thesis, or the passing of a comprehensive examination or both.
4. 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.
5. 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, 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 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 Graduate Council.

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. 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 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.

6. 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. 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.

Special Ph.D. Degree Program

A student who desires to undertake an area of study which bridges two or more departments not regularly associated may do so through the Special Ph.D. Degree Program. This program is not open to incoming graduate students. Interested students should consult with the advisors relevant to their special programs and develop plans of study, i.e., a series of courses, research, examinations, and procedures to be followed for the degree together with the assent of a proposed examining committee. The programs must be directed toward academic specialties which do not duplicate or otherwise parallel existing programs or proposed Stony Brook graduate programs. The student and his dissertation advisors submit the plan of study and the composition of the proposed examining committee to the Special Degree Program Committee, a standing committee of the Graduate School chaired by the Dean. The Special Degree Program Committee, if it approves the plan of study, then formally appoints an examining committee of appropriate faculty. The student is also expected to fulfill the general requirements for the Ph.D. degree, as stated in the previous section, and is responsible for the requirements in the plan of study in lieu of specific departmental requirements.

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 pages 93-95. Additional information is available from the Center, located in the Administration 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: June, August and January. 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 for each semester prior to and including the semester in which the degree is awarded.

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.

Degree Programs and Courses

Courses numbered 201 to 499 are for advanced undergraduates; detailed descriptions of these courses are given in the *Undergraduate Bulletin* (which may be obtained by writing to the Admissions Office, State University of New York, Stony Brook, New York 11790). Graduate courses are numbered 501 and above.

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

INSTRUCTIONS FOR THE PREPARATION OF MASTERS THESES AND DOCTORAL DISSERTATIONS

Candidates should consult with their departments or, in the case of engineering, their college, to determine if there are additional requirements, beyond those set forth in these instructions, which they will also be expected to follow in the preparation of their theses or dissertations. The State University of New York at Stony Brook does not allow multiple authorship for a thesis or dissertation.

I. General Instructions

A. MASTERS THESIS. Each candidate will deposit with the Graduate School the first or ribbon copy of his or her thesis for the University Archives, the first carbon or duplicate copy for the University Thesis Collection, the second carbon or duplicate copy for the approving department, and, in the case of engineering, a third carbon or duplicate copy for the Dean of Engineering. A department or college, may, as it sees fit, require additional copies beyond those specified here.

The requirement that two copies be deposited with the library is to make the research they contain available for scholarly use. These library copies may be used by qualified readers subject to reasonable rules for the protection of authors' rights.

The costs of typing, reproduction and binding for required copies normally will be borne by the candidate. For purposes of uniformity, binding of the required copies will be done by the library for a stated fee (presently $4.50 per copy).

B. DOCTORAL DISSERTATIONS. Each candidate will deposit with the Graduate School the first or ribbon copy of his or her dissertation (the original, after microfilming, goes to the University Archives), the first carbon or duplicate copy for the University Thesis Collection, the second carbon or duplicate copy for the approving department, and,

in the case of engineering, a third carbon or duplicate copy for the Dean of Engineering. A department or college, may, as it sees fit, require additional copies beyond those specified here. The candidate must also submit an extra copy of the abstract page(s) and title page. The abstract will be published in *Dissertation Abstracts*. The microfilm fee of $30, required of all doctoral candidates submitting dissertations, will cover the cost of the microfilm copy and the publication and distribution of the abstract.

If the candidate wishes to copyright the dissertation, the Graduate School will advise of the procedure to be followed and the exact additional cost, which is approximately $12. Microfilming is considered to be a form of publication. Publication by microfilm, however, does not preclude the printing of the dissertation in whole or in part in a journal or monograph.

The costs of typing, reproduction, binding and microfilming for the required copies normally will be borne by the candidate. For purposes of uniformity, binding of the required copies will be done by the library for a stated fee (presently $4.50 per copy).

II. Typing Directions

The pages of all copies must be 8½ by 11 inches. The paper used for the original typewritten copy must be a bond of at least 16-pound substance. Paper for carbon copies should be at least of 13-pound substance and have a smooth finish. Xerox copies shall be reproduced on a standard grade of Xerox paper.

All pages must have a 1½ inch margin on the left side to facilitate binding, and a 1 inch margin on each of the other three sides.

Pica or elite type may be used, with the same type employed for all pages of the thesis or dissertation. The general text of the manuscript should be double-spaced, but tables, long quotations and footnotes should be single-spaced.

The typing must be of a high quality, using a black ribbon, and free from ink insertions, except for characters which do not appear on standard typewriters, such as accents, brackets, scientific or mathematical symbols, etc. These exceptions may be inked in with permanent black ink. Corrections must be made by typewriting; interlinear corrections or strikeovers are not acceptable.

III. Format

A. MAIN PARTS. The thesis or dissertation falls into three main parts outlined as follows:

1. *Preliminaries*
   a. Title page (see outline at end of these instructions).
   b. Thesis committee approval.
   c. Abstract of the thesis or dissertation, not to exceed 600 words in length, summarizing the research problem and the main results.
   d. Preface and acknowledgments.
   e. Table of contents, showing the principal divisions of the thesis or dissertation. These divisions must agree in wording and style with the divisions shown in the text.
   f. List of illustrations or figures (if necessary).
   g. List of tables (if necessary).

2. *Text.* This is the main body of the thesis or dissertation, consisting of well-defined divisions such as parts, chapters, sections.

3. *Reference Matter*
   a. Appendix.
   b. Notes (where applicable).
   c. Bibliography.

B. PAGINATION. Every page shall be assigned a number, even though on the thesis or dissertation title page and any half-title pages no numbers will appear. (A half-title page is a separate sheet within the main body of the text carrying the number and title of a major division such as a part.)

Page numbers must be typed within the prescribed margins, in the upper right hand corner, at least two spaces above the first line of text. Exceptions to this are: (1) numbers of the thesis or dissertation title page and any half-title pages which are omitted, as noted above; and (2) the numbers of chapter title pages, which will appear at the foot in the middle of the page.

Preliminary pages shall be assigned small Roman numbers (e.g., ii, iii, iv, etc.) beginning with the thesis or dissertation title page and continuing consecutively through the remainder of the preliminary pages. However, the first number to appear will be the small Roman number "ii" on the page immediately following the thesis or dissertation title page.

The remainder of the thesis or dissertation pages will be numbered consecutively with Arabic numerals (e.g., 1, 2, etc.) beginning with the first page of the text and continuing through (including any illustrations and tables) to the last page of the reference matter.

C. TEXT.

Notes. Note references will follow a consistent style throughout whether they appear at the foot of the pages of text or are grouped at the end. Notes shall be numbered consecutively by chapter or other main division of the text. Where the department prescribes a style of citation, it shall be used. If there is an accepted form of citation for the subject field, it may be used. In the absence of these, the writer should adopt one of the standard forms of style and follow it faithfully. Among these standard forms are: *The MLA Style Sheet,* compiled and published by the Modern Language Association, New York City; or Kate L. Turabian, *A Manual for Writers of Dissertations,* University of Chicago Press, Chicago.

Illustrations. All illustrations used in the thesis or dissertation must appear in all copies. Illustrations, such as drawings, photographs, diagrams, photostats, etc., may be inserted wherever necessary in the text. They should be numbered consecutively throughout (e.g., Plate 1, Plate 2, etc.; or Fig. 1, Fig. 2, etc.).

Illustrations must be prepared on paper comparable to that of the copy in which they will appear. All illustrations must be designed so that plate and caption can be placed within the prescribed page margins.

Folded illustrations may be inserted if necessary. The sheet must be folded in such a way that it can be bound in the thesis and easily unfolded.

All illustrations should be firmly mounted to prevent curling of the paper. Photo mounting corners, cellophane tape, or staples are not acceptable.

Lettering and lines which cannot be typewritten on illustrations should be inserted in permanent black ink.

Tables. Be sure tables can be read easily. They should be typed or drawn with permanent black ink. Tables larger than a half page should be placed on a separate sheet; half-page or shorter tables may be centered on the page with text above and below. Very large tables

may be folded in the same manner described above for large illustrations. All tables should be consecutively numbered throughout (e.g., Table 1, Table 2, Table 3, etc.).

Formulas. Mathematical and chemical formulas should be carefully made by typewriting, hand lettering, or both. Complex mathematical formulas of two or more lines should not be included in text lines, but should be placed in the proper position in the center of the page between lines of text. The lines in structural chemical formulas must be in permanent black ink.

D. REFERENCE MATTER.

Appendix. In some theses or dissertations it may be desirable to include certain materials (e.g., test forms, detailed apparatus descriptions, lengthy expansions of points treated in the text, etc.) which do not actually form a part of the text. Such materials should be made part of the thesis or dissertation as one or more appendices, designated by capital letters, and placed after the close of the main body of the text. The same marginal, pagination and citation requirements will be followed as for the text proper.

Notes. Where note references are grouped with the reference matter at the close of the thesis or dissertation, they will follow the same regulations as to margins and pagination as the text. Notes at the end will be organized by the same divisions as appear in the text, will be single-spaced with double spacing between entries, and will be consistent in style.

Bibliography. The bibliography should be arranged in a definite order single-spaced with double spacing between entries. All books, articles and other material used in preparing the thesis or dissertation should be listed in the bibliography. As in the case of the notes, any departmental style regulations will be followed. Where these are not specified, the bibliographical style will be consistent with the style forms adopted for the notes (see the references above to *The MLA Style Sheet* and *A Manual for Writers of Dissertations;* these also contain suggested bibliographical forms).

IV. Exceptions

Students should consult their advisors if they feel that the special nature of their theses materials requires some deviation from the rules prescribed above. If the proposed change is minor and consistent with the objectives of these rules,

approval of the advisor is sufficient. Major changes must be approved by both the advisor and the Graduate School.

[TITLE]
A thesis presented
by
[Full name, including middle name, of author]
to
The Graduate School
in partial fulfillment of the requirements
for the degree of
[Master of Science or of Arts; Doctor
of Philosophy]
in
[Name of program]
State University of New York at Stony Brook
[Month, year of submission]

THE ARTS AND HUMANITIES

ENGLISH
GERMANIC LANGUAGES AND LITERATURES
MUSIC
ROMANCE LANGUAGES AND LITERATURES (French)

ENGLISH

Professors: ALTIZER, DICKSON, ERDMAN, GOLDBERG, KAZIN, KRANIDAS, LEVIN, LUDWIG, RIBNER, [a]L. SIMPSON, STAMPFER, STEVENS, [a]THOMPSON, WEISINGER

Associate Professors: [a]ABRAMS, DOLAN (*Chairman*), FIESS, FRY, R. A. LEVINE (*Director, Graduate Studies*), MARESCA, R. MILLER, NEUMEYER, PEQUIGNEY, ROGERS, SEARS, ZIMBARDO

Assistant Professors: ANSHEN, BASHFORD, BENNETT (*Director, M.A. Programs*), BERGSON, CARPENTER, FORTUNA, HALL, HALPERIN, HUFFMAN, LINDEMAN, NELSON, NEWLIN, RASKIN, SCHREIBER, SHAW, WILSON

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

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 three 600-level seminars, (2) to prepare for the Preliminary Examination by reading independently and by taking 500-level courses where necessary, and (3) to teach for at least two semesters. After taking the Preliminary Examination, the student will complete the dissertation.

[a] On leave academic year 1971-72.

Fellowships and Traineeships

Applicants who will have earned only the bachelors degree or its equivalent prior to admission to graduate study at Stony Brook will be eligible for fellowship support and will not normally assume teaching responsibilities in the first year of graduate study. The department participates in the NDEA Title IV Fellowship Program.

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 $2800 for the academic year.

Tuition is waived for holders of fellowships and graduate traineeships.

Admission to the M.A. Program

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. 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.

The department invites interested applicants to visit the campus to discuss their qualifications and plans for graduate study with the director of graduate studies in English and with other members of the department.

Requirements for the M.A. Degree

A. Formal course requirements: A student preparing for the degree of Master of Arts is required to take eight one-semester courses, normally amounting to 24 credit hours. These courses will include one graduate course in the literature of a *period,* one graduate course devoted to one or two authors, EGL 590 Masters Paper Direction, and five additional courses, at least four of which are to be in the English Department. Of these five additional courses, one may be

a graduate or advanced undergraduate (200-level) course in a field related to English. No more than two 200-level courses will be counted toward the degree. Graduate students admitted to 200-level courses in English shall be required by the instructor to do additional reading and to submit at least two papers, one of which shall be a research paper. EGL 597 may not be counted toward the eight-course requirement.

Before a masters degree is granted, the student 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.

Only one course numbered 599, Independent Studies, will be permitted to count toward the total of eight 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.

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. M.A. Paper: In addition to taking eight courses, the student must also write a substantial (25-35 page) scholarly or critical study of an approved topic, normally as part of the work in EGL 590.

Only one course numbered 590, Masters Paper Direction, will be permitted to count toward the total of eight courses required for the degree of Master of Arts in English. EGL 590 cannot be elected during the student's first semester of work toward the masters degree. A synopsis or outline of the proposed paper 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 write his paper.

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 590. The student can satisfactorily complete EGL 590 only by finishing an acceptable paper. If the student does not complete the paper during the semester in which he is enrolled in EGL 590, or before the end of the period in which an "Incomplete" must be made up, he or she will receive "No Credit" for the course.

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

E. Foreign language proficiency: The student must demonstrate as early as possible ability to read texts of moderate difficulty in one approved foreign language.

F. Credit for work done elsewhere: A maximum of six hours of credit for 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. A sample of recent critical or scholarly writing may be required.

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

The department invites interested applicants to visit the campus to discuss their qualifications and plans for graduate study with the director of graduate studies in English and with other members of the 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 *required* to take only three 600-level seminars in English and American Literature and Language. The student must take at least one course at either the 600- or 500-level, during each of the first three semesters of the first two years of study toward the Ph.D. degree, that is, in the two years immediately following the M.A. or its equivalent. Students who intend to work for the doctoral degree are urged to take EGL 500 Methods of Literary Scholarship during their first semester at Stony Brook. Students who wish to terminate their graduate study with the M.A. degree may elect EGL 500.

The student's doctoral committee may recommend and the graduate committee may require that the student pursue studies through the more formal guidance of courses taken in addition to the required seminars.

It is recommended that 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 three grades in the three 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 linguis-

tics or the history and structure of the English language. These requirements can be met by courses taken while the student was an undergraduate.

B. Residence requirements: Every student is normally expected to make a three-year commitment to study toward the doctorate. Part-time study during any of these years is not normally permitted. Every student will be considered in full-time residence during any semester in which he or she: (1) is taking at least one 500-level course or 600-level seminar or is, in the opinion of the doctoral committee, properly preparing for the Ph.D. Preliminary 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 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 or she assists, advice from senior members of the department who visit classes, participation in staff meetings of large courses, and seminars in which he or she and fellow students are joined by senior members of the staff.

During those semesters in which he or she is teaching, the student is required to be enrolled in EGL 697 and/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 preliminary 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.

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.

The passing of the reading and/or comprehension examination at the M.A. level shall *not* be sufficient evidence that the student has met this option.

E. Preliminary Examination: Before the end of his fourth semester in full-time residence after he has received the M.A., the student will be required to take and pass a series of examinations testing knowledge and critical understanding of the literature of four fields in English literary history.

The student will choose four fields from the following list:

I Beginnings to 1550
II 1550-1660
III 1660-1780
IV 1780-1890
V American Literature: Beginnings to 1870
VI British Literature: 1890-Present and
American Literature: 1870-Present
VII Language and Linguistics*
VIII A single genre, from its beginnings in English literature throughout its development.

* The student who elects to be examined in the area of Language and Linguistics will ordinarily also choose to be examined in Field I, "Beginnings to 1550."

The candidate, in consultation with his or her doctoral committee, shall define a cohesive area of special competence on which he or she shall be orally examined. This field may be one of the fields above, but in any case it shall be of comparable scope to the outlined fields. The candidate, in consultation with the doctoral committee, shall prepare reading lists for preliminary examinations in his or her minor fields and shall submit them to that committee for approval no later than the end of the third semester of doctoral work. The examinations shall take place at some time, at the option of the candidate, before the end of the fourth semester of doctoral work, except that the examination in the major field may be taken before the end of the first month of the fifth semester of the candidate's residence. The candidate shall have the option of taking all of the examinations at the same time or of staggering them at reasonable intervals.

The Preliminary Examination will normally consist of a two-hour oral examination in the field of the dissertation and three three-hour written examinations, one on each of the other three fields. The student who fails one or more of these examinations may be granted re-examination at the discretion of the Graduate Program Committee of the department.

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.

The student is advised to seek a dissertation director from among the three professorial ranks of the department as soon as he has passed the Preliminary Examination or even earlier. The student must prepare a statement setting out the scope and method of the dissertation and submit it to his or her director and doctoral committee 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 choice of a second and third reader of the dissertation.

The three 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 or her program on the basis of the individual's wishes and needs and in the light of total preparation, both undergraduate and graduate.

As soon as the student is admitted to the Ph.D. program he or she is asked to recommend to the graduate program committee the names of four or five professors he would like to serve on his or her doctoral committee. The student may include the name of the advisor originally assigned. The Graduate Program Committee will then ask three of the student's nominees to serve as the doctoral committee throughout the period of the student's work toward the degree. The Graduate Program Committee will also name one of the three members of the doctoral committee to serve as its chairman. The student's advisor or the chairman of the doctoral committee must sign the student's course card during registration. On occasion the advisor or doctoral committee may recommend that the student take more or fewer courses than he or she wishes to.

B. Extensions of time limits: Extensions of time (beyond two years for the M.A. degree and three years for the Ph.D. degree) 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 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

Advanced undergraduate English courses, numbered from 200-399, will sometimes be part of a beginning graduate student's program. (See restrictions under Requirements for the M.A. degree above.) A list of these courses can be found in the English section of the *Undergraduate Bulletin.*

Graduate courses in the 500 series are open to all graduate students. Courses in the 600 series are open only to students admitted to study for the Ph.D. degree. 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 three 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 548 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 597 Practicum in Methods of Research

Variable and repetitive credit

EGL 599 Independent Studies

3 credits

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 or 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

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

GERMANIC LANGUAGES AND LITERATURES

Professors: GREEN, HAMBURGER, KARST, KOTT
Associate Professors: RUPLIN, SJOBERG (*Director of Graduate Studies*)
Assistant Professors: BERR, R. BROWN, ELLING, HORL, O'NEIL, REGAN, RUPLIN, RUSSELL (*Executive Officer*), STENGEL

Fellowships and Traineeships

Applicants who have earned only the bachelors degree or its equivalent prior to study at Stony Brook will be eligible for fellowship support and will not normally assume teaching responsibilities in the first year of graduate study. The department participates in the NDEA Title IV Fellowship Program.

Applicants who will have either earned the degrees 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 $2800 for the academic year.

Tuition is waived for holders of fellowships and graduate traineeships.

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 individual case will be treated on its 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 German 321 and perhaps German 322 in addition to the other course requirements listed below.

Other courses taken at Stony Brook (such as German 300 courses or relevant courses taken in other departments) may be used to substitute for certain courses of the minimum requirements listed below if they are approved in advance by the department.

Requirements for the M.A. Degree

A. Formal course requirements	Credit Hours
1. Two proseminars chosen from the 540-546 series, or, for students wishing to specialize in Germanic philology and linguistics, GER 570, and one such seminar	6

2.	GER 547 Special Author Studies	3
	GER 548 Special Period Studies	3
3.	One seminar from the 549-555 series	3
4.	GER 556 Bibliography and Methodology	3
	GER 557 History of the German Language	3
	GER 558 Middle High German	3
		24

B. Performance: Average of B or better for all courses listed under A.
C. Departmental 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 degrees. Part-time study may be permitted at the discretion of the department.
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 Exami-

nation 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

Advancement to Candidacy for the Ph.D. in Germanic Philology and Linguistics

A. Course requirements: After completion of, or exemption from, the courses listed under the masters degree, the following courses must be taken:

	Credit Hours
1. One seminar from the 549-555 series not previously taken	3
2. Two seminars from the 603-609 series or one of these and GER 570 if the latter not previously taken	6
3. GER 562 Gothic and Indo-European	3
GER 563 Old High German or EGL 510 Old English	3
GER 564 Old Saxon or Old Norse	3
GER 565 Middle High German Literature	3
GER 603 Medieval Literature	3
	24

B. Language requirement: Candidates for the Ph.D. in Germanic philology will be required to demonstrate proficiency in at least one Germanic language other than English and German.

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 for the most part 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 two years for the M.A. degree and three 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 must get the course instructor's approval, as well as that of the director of graduate studies.

Courses

Certain advanced undergraduate courses can sometimes be part of a beginning graduate student's program. Students should consult their tutors for details.

The specific topic 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 toward the end of the semester prior to that in which it is to be offered.

Graduate Seminar and Tutorial Offerings

Candidates should understand that these seminars are given general titles. The specific topic to be dealt with in each seminar will differ from semester to

semester and will depend upon the special interests of the professor giving the seminar. A candidate may take, so far as the requirements allow, the same seminar more than once if the alternation of subjects within that seminar benefit 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 conferences; 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.

Required of all teaching assistants
3 credits

A. Proseminars. M.A. candidates choose one.

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

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.

MUSIC

Professors: AREL, LAYTON (*Chairman*), NEMIROFF, [a]ROSEN
Associate Professors: BONVALOT, LESSARD, LEWIN
Assistant Professors: EKWUEME, FULLER, WINKLER
Instructors: R. KRAMER, LAWTON, STARR
Director of Choral Music: G. SMITH
Director of the University Band: KARASICK
Performing Artists in Residence: ADDISON, ANDERSON, BARON, BREHM, CANIN, DES ROCHES, DUPOUY, EDDY, FROELICH, GLAZER, GREENHOUSE, G. KALISH, KREISELMAN, ROSEMAN, WEISBERG, ZUKOFSKY

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).

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 results of the Graduate Record Examination.

All new students will be examined in the following areas during the week before the beginning of classes:

1. Ear training.
2. Basic keyboard skills.

[a] On leave fall semester 1971.

3. The harmonization of a chorale in four voices.
4. The setting of two voices in counterpoint to a cantus firmus (in either modal or tonal style, according to candidate's choice).
5. The analysis of representative examples of 18th and 19th century music.
6. The history of music (*musicology students only*).
7. Familiarity with important styles and works from all periods of Western music (*composition students only*).
8. 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.

If the results of the examinations reveal that a student's undergraduate preparation is deficient, he will be required to take one or more undergraduate courses in these areas.

Requirements for the M.A. Degree in Musicology

A. Courses: Twenty-four credit hours, chosen in consultation with the student's advisor, of which up to six may be in advanced undergraduate courses. At least two semester courses (graduate or undergraduate) outside the area of musicology must be a part of the student's program. If a course in a field other than music is taken to fulfill this requirement, prior approval by the department's Graduate Studies Committee must be obtained.

B. Foreign languages: A reading knowledge of French and German. This requirement should be satisfied by the beginning of the second year 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 his course work.

Requirements for the M.A. Degree in Composition

A. Courses: Twenty-four credit hours, chosen in consultation with the student's advisor, of which up to six may be in advanced undergrad-

uate courses. At least two semester courses (graduate or undergraduate) outside the area of composition and theory must be a part of the student's program. If a course in a field other than music is taken to fulfill this requirement, prior approval by the department's Graduate Studies Committee must be obtained.

B. Foreign language: A reading knowledge of one approved foreign language.

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 should be submitted to the department at least one month prior to the scheduled dates of the Comprehensive Examinations.

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.

Requirements for the M.Mus. Degree

A. Courses: Twenty-four credits, chosen in consultation with the student's advisor, of which no more than 12 may be in individual study of an instrument or voice. Of the remaining 12 credits, up to six may be in advanced undergraduate courses. At least two semester courses (graduate or undergraduate) outside the area of performance must be a part of the student's program. If a course in a field other

than music is taken to fulfill this requirement, prior approval by the department's Graduate Studies Committee must be obtained.

B. A public recital.

Courses

Advanced undergraduate music courses, numbered from 201-399, will often be part of a beginning graduate student's program. A list of these courses can be found in the music section of the *Undergraduate Bulletin.*

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 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 514 Sound Generation on a Digital Computer

Techniques and problems of programming, compositional possibilities. Exercises with the computer. Knowledge of FORTRAN programming equivalent to ESG 162 and compositional experience at an advanced level are required. MUS 513 is recommended but not required. Enrollment limited by machine time available.

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 533 Seminar in Music Theory: 20th Century Problems

This course will examine the problems involved in formulating theoretical constructs pertinent to post-tonal musical idioms (*c.* Debussy to the present.) Important theoretical writings will be studied, in themselves and also as examplars of the general problems. The interdependence of theoretical, analytical, and critical/aesthetic approaches will be discussed in this context.

Students' research topics may be historical/bibliographical, or they may involve original theoretical work. For entrance into the course, students will be required to have attained a level of sophistication about music theory equivalent to that afforded by the successful completion of the seminar in tonal theory.

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 each

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 571 Advanced Instruction in Instrument or Voice

Individual guidance in technique and repertory, with 30 practice hours required each week.

6 credits

MUS 573 Advanced Ensemble

Chamber ensembles such as the string quartet, wind quintet, solo vocal ensemble, piano duo, and other special mixed ensembles, each meet one hour per week under the direction of a member of the performance faculty for the study and preparation of works from the repertories of the respective groups, with particular attention given to the music of the 20th century. The work of the course is normally directed toward the performance of the compositions studied.

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 important solo and ensemble works of the present century for a particular instrument or voice. The special techniques and performance problems of the music of this period.

2 credits

MUS 587 Baroque Music for Flute

A study of the Baroque repertory for flute (including major works by Bach, Handel and Telemann) based on the instruction methods of the period, principally Hotteterre and Quantz. Actual playing of the Baroque flute will be part of this course.

A study of Baroque articulation, embellishment and ornamentation will be made based on the examples of J. S. Bach, Quantz, and Telemann.

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 member of the faculty.

Variable credit

ROMANCE LANGUAGES AND LITERATURES

FRENCH

Professors: BIEBER, BRUGMANS, [a]HAAC, LAIDLAW
Associate Professors: [b]ALLENTUCH, F. BROWN, MILLS
Assistant Professors: BLUM, PETREY, RIZZUTO, WILKINS

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. It is recommended that the student present 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.

[a] On leave spring semester 1972.
[b] Not in residence academic year 1971-72.

Requirements for the M.A. Degree

The Master of Arts degree in French requires at least one year (two semesters) of residence, including a minimum of 24 hours of course work. The 24 hours in course work must include a course in the history of the French language and five graduate courses covering different periods in French literature. Six hours may be taken in approved undergraduate courses with permission of the student's advisor. After the completion of course work, the candidate must pass a comprehensive examination, both written and oral. A masters essay, written under the supervision of a member of the French graduate faculty, must be presented for approval to the departmental Graduate Committee.

Courses

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 Spring semester 1972: *Les Chroniqueurs.*
This course may be repeated for credit when topic changes.

Spring, 3 credits

FRN 530 Studies in Poetry from the Pleiade to Baudelaire

French lyrical poetry of the Pléiade to the Baroque and Classical age; the Romantic and Parnassian schools. Poetic theory will be studied in the works of major authors such as Ronsard, Hugo, Vigny, and Leconte de Lisle.

Spring, 3 credits

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 *ecrivains mondains,* with special emphasis on La Rochefoucauld, Mme de Lafayette, and Mme de Sévigné.

Spring, 3 credits

FRN 541 Studies in the Enlightenment

A broad study of the background of the Enlightenment in France and of its development throughout the 18th century with emphasis on its impact on the Revolution of 1789.

Fall, 3 credits

FRN 542 Studies in 18th Century French Theater

Extensive reading and research stressing literary technique, themes and major trends (in French and other literatures) leading to new forms and "genres."

Spring, 3 credits

FRN 551 Studies in Romanticism

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

Fall, 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 590 Masters Essay Research

Variable and repetitive credit

FRN 599 Practicum in Teaching

Variable and repetitive credit

THE BEHAVIORAL SCIENCES
PSYCHOLOGY
SOCIOLOGY

PSYCHOLOGY

Professors: BRAMEL, GARCIA, KALISH (*Chairman*), [a,i]KRASNER, M. LEVINE, [c]MERLIS, [h]F. PALMER, [b]ROSS, SINGER, STAMM, WYERS

Associate Professors: DAVISON, D'ZURILLA, GEER, GOLDFRIED, KAYE, LIEBERT, [d]MORRISON, [g]POMERANZ, RACHLIN, VALINS

Assistant Professors: BRANSFORD, CALHOUN, [e]DOLL, EMMERICH, FEHMI, FRIEND, JOHNSON, KESTENBAUM, F. LEVINE, NEALE, SCHVANEVELDT, M. SMITH, S. STERNGLANZ, TWEEDY, WEINTRAUB, WHITEHURST, [f]WINKLER, YOUNG

Clinical Associates: MCCONNELL, MERBAUM

Admission to Graduate Study

Undergraduate requirements for admission shall normally include:

A. A baccalaureate degree in psychology.
B. An average of 3.0 in all undergraduate course work.

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[a] Director of Clinical Training.
[b] Acting Director of Clinical Training.
[c] Visiting Clinical Professor.
[d] Associate in Instructional Resources.
[e] Member, Institute for Research in Learning.
[f] Visiting Assistant Professor.
[g] Director of Psychological Services.
[h] Provost for Educational Research and Development.
[i] Not in residence academic year 1971-72.

C. Letters of recommendation from three instructors or academic advisors.
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 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 for 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 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.

Comparative-Physiological Psychology

The comparative-physiological program prepares a student with general background in cortical function, ethology, neuroanatomy, synaptic and sensory processes. This program may also be combined with the psychobiology program.

Psychobiology

The psychobiology program is an interdisciplinary program offered jointly with the Biology Department and focusing upon behavioral physiology, physiological psychology, and animal behavior.

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 research training, both in laboratory studies in complex human functioning 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

Advanced Undergraduate Courses

PSY 503 (322) Advanced Statistics
PSY 504 (372) Tests and Measurements
PSY 505, 506 (381, 382) Mathematical Psychology
PSY 514 (362) Sensation-Perception
PSY 552 (352) History and Systems
PSY 565 (341) Nervous System
PSY 566 (343) Synaptic Processes
PSY 567 (340) Physiological Psychology
PSY 610, 620 (391, 392) Seminars in Special Topics

Graduate 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.

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, 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 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

A continuation of PSY 511 which stresses the application of learning theories and principles.

Spring, 3 credits

PSY 515, 516 Research Practicum in Experimental Psychology

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

Fall and Spring, 3 credits each semester

PSY 517, 518 Clinical Research

Survey of faculty research interest during the fall semester. Special problems in clinical research (e.g., quasi-experimental design) during the spring semester.

Fall and Spring, 1 credit each semester

PSY 519, 520 Introductory Practicum in Clinical Procedures

An introduction to the working of the clinical psychologist by observation of trained clinicians in real life settings.

Fall and Spring, 1 credit each semester

PSY 521 The Development of Behavior

A consideration of contemporary theories and research in the area of personality, deviant behavior, and the social labeling process. Emphasis will be on the developmental point of view in understanding behavior.

Fall, 3 credits

PSY 522 Behavior Deviation

Theories, data, and research methods involved in the study of deviant behavior will be covered. Emphasis will be on experimental approaches to psychopathology.

Fall, 3 credits

PSY 527 Assessment of Behavior I

Techniques of psychological measurement and assessment as they relate both to theoretical formulations and to specific clinical problems involving assessment.

Spring, 3 credits

PSY 528 Assessment of Behavior II

Study of newly developed assessment procedures, particularly as they relate to current techniques of behavior modification. This course will be taught in conjunction with PSY 532 Practicum.

Fall, 3 credits

PSY 532 Practicum in Assessment

Supervised experience in the utilization of various assessment procedures.

Fall, 1 credit

PSY 535 Theories and Applications of Psychotherapy and Behavior Modification

Thorough delineation of the leading schools of psychotherapy. Emphasis on therapeutic techniques derived from modern learning theory and social psychological theory. Study of the relationship of theories of psychotherapy to models of deviant behavior and to assessment procedures. PSY 545 will be accompanying Practicum.

Spring, 3 credits

PSY 536 Special Techniques in Behavior Modification

Presentation and discussion of materials on special techniques of modifying human behavior such as behavior therapy, hypnosis, family therapy, non-directive and other special techniques. Included are films, tape recordings, and demonstrations.

Fall, 3 credits

PSY 545 Behavior Change Practicum

Experience and training will be provided in the area of psychotherapy conceptualized as a method for inducing change in behavior. Emphasis will be placed on practice in modes of behavior change.

Spring, 1 credit

PSY 550, 551 Social Psychology

Theories, methods, and data relevant to human behavior and cognition in interpersonal contexts. Consideration will be given to such topics as belief and attitude change, aggression and altruism, development of the self concept.

Fall and Spring, 3 credits each semester

PSY 560 General Physiological Psychology

The physiological basis of behavior. Discussion of the neuronal basis of sensation, perception, motivation, learning, sleep, and problem solving. Consideration of brain pathology and behavior impairment.

Spring, 3 credits

PSY 561, 562 Physiological Methods

Basic bio-electric principles and techniques, stereotaxic techniques, lesioning methods, pharmacological methods, and histological techniques will be presented and practiced. Basic methods for bio-electric 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 Laboratory

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 Laboratory

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 581, 582 Comparative Physiological Colloquium

Colloquium presentations on current research problems by advanced students, staff, and visiting scientists. One hour of lecture and two of 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 600 Practicum in Teaching of Psychology

Variable and repetitive credit

PSY 603, 604 Practicum in Clinical Procedures

Third and fourth year students will be placed in settings designed to broaden their clinical experience.

Variable and repetitive credit each semester

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, social psychology, and computer applications in psychology.

Variable and repetitive credit each semester

PSY 696, 697 Readings

Variable and repetitive credit each semester

PSY 698 Research

Variable and repetitive credit

PSY 699 Doctoral Research

Variable and repetitive credit

SOCIOLOGY

Professors: L. Coser, R. Coser, Dogan (*Visiting*), Gagnon, Lang, Perrow, Selvin, E. Weinstein (*Chairman*)

Associate Professors: Collver, S. Cole, Feldman, Goode, Goodman, Polsky, Street, Suttles

Assistant Professors: Berger, Bryson, [a]Farberman, Harrison, Herrick, Hudson, Phillips, M. Schwartz, Tuchman, Weitman

Lecturer: Tanur

Admission to Graduate Study

Requirements for admission will normally include:

A. An average of 3.00 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 D 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 two years of full-time study including at least two consecutive semesters. Full-time study entails 12 or

[a] On leave academic year 1971-72.

more 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 361* and 505) and three courses in methods of research (SOC 501, 502 and 503). Apart from this, there is no minimum number of courses a student must take beyond meeting the residence requirements.

C. Comprehensive examination: The adequacy of every student's general preparation will be evaluated by means of a written comprehensive examination.

This examination, to be taken between the beginning of the third and the beginning of the fourth 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. 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, 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.

E. 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 courses in other departments determined in consultation with the student's advisor and approved by the Graduate Committee.

* This course may be waived if the student offers evidence that he has passed an equivalent course.

F. 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.

G. 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.

H. 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 begins graduate work.

Courses

During the spring of 1971, the following information will be made available about each course for the academic year, 1971-72: (a) the semester in which the course is to be given; and (b) the professor who will teach it.

Advanced Undergraduate Courses

SOC 341 Historical Sociology

Sociological theories and methods applied to the study of historical phenomena, such as revolutions, migration, and industrialization. Prerequisites: SOC 103 *and* permission of instructor.

3 credits

SOC 351 Sociology of Literature

Literature as a symbolic expression of social structure: the relations between literary movements and other forms of social activity. Prerequisites: SOC 103 *and* permission of instructor.

3 credits

SOC 358 War and Military Institutions

The role of violence in social affairs; military organizations; civil-military relations.
Prerequisites: SOC 103 *and* senior standing.

3 credits

SOC 361 Historical Development of Contemporary Sociology

Main currents in the development of theories and empirical studies of society, culture, and personality.
Prerequisite: SOC 103 or permission of instructor.

3 credits

SOC 362 Introduction to Sociological Theory

A systematic treatment of the dominant general orientations in sociology including structural functional analysis and symbolic interactionism.
Prerequisite: SOC 103.

3 credits

SOC 363 Sociology Today

Recent advances in research, theory, and method in the field of sociology.
Prerequisites: SOC 361, 362 or permission of instructor.

3 credits

Graduate Courses

SOC 501 Sociological Analysis

Problems in the analysis and interpretation of data.
Prerequisite: One course in statistics or permission of instructor.

3 credits

SOC 502 Advanced Statistics

A second course in statistical methods most frequently used by sociologists.
Prerequisite: One course in statistics.

3 credits

SOC 503 Research Design

Decisions in the design of research, including choice of population, techniques of sampling, and methods of gathering and processing data.
Prerequisite: SOC 501.

3 credits

SOC 505 Modern Social Theories

The main types of theories current in the mid-20th century, including structural functional analysis, conflict theories, exchange theories, the perspectives of "ethnomethodology," and "general systems theory."

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 521 Social Interaction

The study of interaction in formal and informal settings. The reciprocal influence among group structure, norms, and inter-

active 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 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 549 Social Change

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

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 698 Research for Ph.D.

Credit to be arranged

THE BIOLOGICAL SCIENCES

BIOCHEMISTRY
CELLULAR AND COMPARATIVE BIOLOGY
ECOLOGY AND EVOLUTION

DIVISION OF BIOLOGICAL SCIENCES

Acting Provost: RAYMOND F. JONES
Executive Officer: ALBERT D. CARLSON

DEPARTMENT OF BIOCHEMISTRY

Professors: [a]CIRILLO, M. SIMPSON (*Chairman*)
Associate Professors: [b]FREUNDLICH, MOOS, RILEY
Assistant Professors: ARNHEIM, DUDOCK, [f]GESTELAND, LEICHTLING, S. SIMON, R. STERNGLANZ

[a] On leave academic year 1971-72.
[b] Research Career Development Award, U.S.P.H.S.
[c] Member, Marine Sciences Research Center.
[d] Director, Marine Sciences Research Center.
[e] Other scientists who may supervise graduate research in biological sciences.
[f] Joint appointment with Cold Spring Harbor Laboratory for Quantitative Biology, Cold Spring Harbor, New York.

DEPARTMENT OF CELLULAR AND COMPARATIVE BIOLOGY

Distinguished Professor: [a]GLASS
Professors: [f]CAIRNS, E. CARLSON, [a]ERK, JONES
Associate Professors: BATTLEY, A. CARLSON, [a]EDMUNDS, LYMAN, MERRIAM, TUNIK, WALCOTT (*Acting Chairman*)
Assistant Professors: EMLEN, FOWLER, HOY, KATZ, KERNAGHAN, KRIKORIAN, TENG
Lecturers: M. BAYLOR, FOGG

DEPARTMENT OF ECOLOGY AND EVOLUTION

Professors: [c]E. BAYLOR, [c]MCHUGH, SANDERS (*Adjunct*), SLOBODKIN (*Chairman*), SOKAL, [d]SQUIRES, [c]WILLIAMS
Associate Professors: ROHLF, SMOLKER
Assistant Professors: J. FARRIS, FUTUYMA, HECHTEL, [b]KOEHN, [c]WURSTER
(*Professors in Health Sciences:* V. FARRIS, LEFEVRE, PELLEGRINO, UPTON)[e]

Graduate Programs in the Biological Sciences

Graduate studies in the Division of Biological Sciences are centered around five independent programs, each under the direction of a program chairman and an executive committee. Currently the programs are: Developmental Biology, Ecology and Evolution, Marine Biology, Molecular and Cellular Biology and Psychobiology. With the exception of the Molecular and Cellular Biology Program which accepts only students seeking a Ph.D. degree, the programs accept students for both the M.A. and Ph.D. degrees.

[a] On leave academic year 1971-72.
[b] Research Career Development Award, U.S.P.H.S.
[c] Member, Marine Sciences Research Center.
[d] Director, Marine Sciences Research Center.
[e] Other scientists who may supervise graduate research in biological sciences.
[f] Joint appointment with Cold Spring Harbor Laboratory for Quantitative Biology, Cold Spring Harbor, New York.

The graduate programs within the Division of Biological Sciences transcend individual departments within the division and thus contain faculty both from the division and from other departments of the University. For example, while the Molecular and Cellular Biology Program derives its faculty primarily from the Biochemistry Department of the division, members of the Chemistry Department also participate. Likewise the Psychobiology Program is staffed by faculty drawn from both the Biology and Psychology Departments. The programs are briefly described below.

Developmental Biology

The Developmental Biology Program provides training and research opportunities in the physiological and genetic basis of growth, differentiation and morphogenesis of biological systems. Staff members in the program are engaged in research in developmental biology in microorganisms, lower and higher plants, insects and vertebrates. The viewpoint is essentially experimental with emphasis upon regulation of developmental processes at the cellular and organismic levels.

Ecology and Evolution

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 men 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

The Division of Biological Sciences in association with the Marine Sciences Research Center offers a graduate program leading to the M.A. and Ph.D. degrees in marine biology. Study of marine organisms and ecosystems is supervised by a faculty with widely diverse interests; opportunities for research and field studies on the Stony Brook campus and at several off-campus marine facilities

are provided. For further information, contact: Director of Graduate Studies, Marine Sciences Research Center, State University of New York, Stony Brook, N. Y. 11790.

Molecular and Cellular Biology

The Molecular and Cellular 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, 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 the Departments of Biology and Chemistry, and from the Health Sciences Center.

Psychobiology

The Psychobiology Program is an interdisciplinary program offered by faculty members of biology, psychology, and other departments. 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 behavioral physiology, physiological psychology, ethology, behavioral ecology, and animal behavior. Detailed information about admission to the program and degree requirements is available from: Dr. A. Carlson in the Biology Department and Dr. John Garcia in the Psychology Department.

Admission to Graduate Study

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 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.

Requirements for the M.A. Degree

A. Residence: One year.

B. Qualification to candidacy.

C. Formal course requirements: Successful completion of an approved course of study of at least 24 semester credits.

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

E. 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.

F. 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. The language requirement must be completed before permission will be given to take the Preliminary Examination.

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.

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.

Courses

Advanced Undergraduate Courses

Certain advanced undergraduate courses (300 level) may be taken for graduate credit. Students should consult their advisors about the suitability of such courses in their program of studies.

Graduate Courses

BIO 501 General Biochemistry

A survey of the structure and function of the major chemical constituents of the cell including carbohydrates, lipids, nucleic acids, and proteins. Emphasis will be placed on the physicochemical methods used to elucidate three dimensional structure, mechanisms of enzyme action, including kinetics and active site analysis, metabolic pathways, and the molecular biology of nucleic acids and protein biosynthesis.

Fall, 4 credits

BIO 502 Physical Biochemistry

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

Spring, 3 credits

BIO 503 Protein and Nucleic Acid Biosynthesis

The material in this course constitutes the essence of molecular biology. Nucleic acid structure is considered in detail and replication and transcription both *in vivo* and on the enzymatic level are taken up. The machinery of protein synthesis, including amino acid activation, transfer RNA, ribosomes, the genetic code, and peptide chain initiation, elongation and termination, is also covered.

Fall, 3 credits

BIO 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

BIO 506 Membranes and Transport

Molecular and ion transport mechanisms will be studied in microorganisms, higher cells, and 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. Not offered 1971-72.

BIO 507 Molecular Genetics

The molecular bases of recombination, mutation, replication, and gene expression are studied. The genetics of microorganisms is presented, and the experimental support for molecular models of basic genetic phenomena is examined.

Spring, 3 credits

BIO 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

BIO 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. The projects undertaken are of a research nature rather than being laboratory exercises and generally are part of the ongoing research problem being pursued by the faculty member.

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

BIO 512 Cellular 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

BIO 513 Mechanism of Enzyme Action

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, 2 credits

BIO 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 motile processes, the ultrastructure of the relevant cellular organelles, the biochemical and physicochemical properties of the active proteins, and a critical review of current theories.

Spring, 2 credits

BIO 516 Physiology and Biochemistry of Microorganisms

Discussion of physiology and biochemistry of microbial processes, such as nitrogen and hydrogen fixation, sulfur metabolism photosynthesis, cell wall synthesis, membrane functions, motility, and physiological adaptation.

Spring, 3 credits

BIO 520 Molecular Biology of Viruses

This course covers the principal aspects of the replication of bacterial and animal viruses with emphasis on genetics and biochemistry. Current research problems in the field will be stressed.

Spring, 3 credits

BIO 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

BIO 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. Not offered 1971-72.

BIO 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

BIO 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

BIO 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

BIO 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

BIO 536 Physiology and Development of Lower Plants

A consideration of the major problems and current research dealing with the physiology and biochemistry of growth and development in bacteria, algae, fungi, slime molds, and bryophytes. Emphasis will be placed on those aspects of enzyme regulation and control of protein synthesis that relate to growth and differentiation in these organisms.

Spring, 3 credits

BIO 540 Projects in Tropical Marine Biology

Intensive series of lectures on biology, physiology, and ecology of a coral reef and its immediate environs, concentrating on two or three specific problems. Each student will propose a detailed plan to investigate an aspect of these problems. Biochemical and biophysical approaches will be stressed. Each student will carry out his proposed experiments during a ten-day stay at the Discovery Bay Marine Laboratory.

Spring, 4 credits

BIO 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

BIO 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

BIO 546 The Physiological Basis of Animal Behavior

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

Spring, 3 credits

BIO 550 Practicum in Ecology

Students are involved in research projects supervised by staff members in their research laboratories on a rotational basis.

Fall and Spring, 2 credits

BIO 551 Principles of Ecology

This course examines the interactions of organisms with their biological, chemical, and physical environments. The physical nature of the primitive environment, origin of life, fundamentals of organismal interaction, ecology of the intertidal zone, and transition from an aquatic to a terrestrial environment will be considered. The development of theoretical concepts of community structure and their biological implications will be emphasized.

Fall, 4 credits

BIO 552 Multivariate Analysis in Biology

An introduction to multivariate statistical analysis for biologists with emphasis on the use of computers.

Spring, 3 credits. Not offered 1971-72.

BIO 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

BIO 554 Population Genetics

This course examines the historical development and current concepts of population genetics. Among the subjects covered are mutation, genetic fixation and drift, polyploidy, effects of population size, hybridization, selection, ecotype formation, and speciation. Descriptive and experimental studies of several plant and animal populations are discussed in detail.

Spring, 3 credits

BIO 570 Population and Community Ecology

A course which uses both cultured and naturally distributed organisms to examine the control and interactions of populations. Emphasis is placed on the development of theoretical concepts and biological implications through the use of physical, stochastic, and biological models. Topics include mortality, fertility, growth of populations, competition, predator-prey interaction, and community analysis.

Spring, 4 credits

BIO 574 Systematics

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

Spring, 2 credits. Not offered 1971-72.

BIO 575 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

BIO 583-598 Special Seminars

Topics to be arranged.

BIO 599 Research

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

Fall and Spring, credit to be arranged

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 chairman.

Fall and Spring, 3 credits

BIO 601, 602 Colloquium in Molecular and Cellular 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 and Cellular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and Spring, no credits

BIO 603, 604 Student Seminar in Molecular and Cellular 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 and Cellular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and Spring, no credits

BIO 605, 606 Molecular and Cellular 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 and Cellular Biology Program and attendance is mandatory. Visitors are welcome.

Fall and Spring, no credits

BIO 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

BIO 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

BIO 681-698 Advanced Seminars

Topics to be arranged.

BIO 699 Research

Original investigation undertaken as part of Ph.D. program under supervision of research committee.

Fall and Spring, credit to be arranged

THE CENTER FOR CONTINUING EDUCATION

CENTER FOR CONTINUING EDUCATION

Director: JOHN H. GAGNON
Associate Director: DIANE MARESCA

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 M.A./L.S. 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 a minimum of six credits in graduate courses with a grade point average of 3.0 (B) or better.

C. Acceptance by the Center for Continuing Education.

Students who do not meet these requirements may be admitted as non-matriculated students and enrolled in non-seminar courses.

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 a grade point average of 3.0 (B) or better in any graduate (including CED non-seminar courses) or upper division undergraduate courses at Stony Brook.

B. A minimum of six credits in graduate courses taken elsewhere with a grade point average of 3.0 (B) or better.

Requirements for the M.A./L.S. Degree

A. Formal course requirements: At least 30 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.

   No more than six credit hours in advanced undergraduate courses at the 200-400 level may be counted towards the M.A./L.S. degree.

   Any credit hours used to fulfill the matriculation requirement may not be used toward the M.A./L.S. degree.

B. Time limit: All requirements for the M.A./L.S. degree must be completed within seven years of admission to the program.

C. Work load: No student may register for more than eight credit 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 program are expected to maintain a grade point average of 3.0 (B) or better. Only one course with a grade of 2.0 (C) will be counted towards the degree. Matriculated students who accumulate as many as four courses with grades of 2.0 (C) will automatically lose their matriculated status. Readmission to the matriculated status will require the approval of the CED Academic Standing Committee. Any student who accumulates as many as six courses with grades of 2.0 (C) will not be permitted to register for further study.

Transfer Credits

A maximum of six graduate credits taken at accredited institutions may be transferred toward the M.A./L.S. degree. These credits must be less than ten years old at the time the student is admitted. If these hours are used to qualify for matriculation they may not be used toward the M.A./L.S. degree. 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 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 M.A./L.S. 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 294, Administration Building
State University of New York at Stony Brook
Stony Brook, New York 11790
Telephone: (516) 246-5936

Application deadline for the fall semester is July 15; for the spring semester, November 30; and for the summer session, March 31.

THE ENGINEERING SCIENCES

APPLIED MATHEMATICS AND STATISTICS
COMPUTER SCIENCE
ELECTRICAL SCIENCES
MATERIALS SCIENCE
MECHANICS
URBAN SCIENCE AND ENGINEERING

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 and one interdisciplinary program offering departmental and interdepartmental graduate programs, 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 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. There are two options for the M.S. degree in the College of Engineering: either the satisfactory completion of a minimum of 24 credits or a minimum of 18 credits and a thesis in the student's area of specialization. In some departments the choice of the option is not up to the student. At the discretion of the department, a student may be required to take either one or the other of the above options.

B. Up to six credits of the minimum course requirements may be for appropriate undergraduate courses, at the discretion of the student's advisor. All of the other credits must be for graduate courses exclusive of credits for Research or Practicum in Teaching. The faculties of individual graduate programs may impose additional course requirements. 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. Also, the faculties of the various programs may require that certain courses be taken by the candidates.

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 to 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.

APPLIED MATHEMATICS AND STATISTICS

For detailed description of admission requirements and degree programs, see pages 127-132.

COMPUTER SCIENCE

For detailed description of admission requirements and degree programs, see pages 133-138.

ELECTRICAL SCIENCES

Professors: CHANG, MARSOCCI (*Acting Chairman*), STROKE
Associate Professors: C. CHEN, DOLLARD, D. SMITH, THOMAS, TUAN
Assistant Professors: BARRY, CARROLL, HARRISON, RAPPAPORT

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

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

Introduction to stochastic processes in communication, control, and other signal processing systems. The concept of entropy of physical systems and of communication channels. Correlation functions, spectral densities, and their transmission properties. Wiener theorem. Simulation of stochastic processes and communication channels. Basic detection theory. Introduction and analysis of modulation systems including AM, FM, PPM, FSK, and time frequency multiplexing.

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 applications 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, tunnelling effects, application to the design of superconducting devices.

3 credits

ESE 513 Introduction to Electronic Processes in Solids

The fundamentals of the electronic energy-band structure of solids; a description of the direct and the reciprocal lattice, Bragg scattering. The one electron model, the nearly free electron, interaction with lattice waves. Brillouin zones, the Fermi surface, electron dynamics.

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. Introduction to integrated circuit devices.
Prerequisite: ESE 511.

3 credits

ESE 515 Quantum Electronics I

A detailed treatment of the physics of microwave and optical masers. Topics include: introduction to laser concepts; review of fundamental concepts of quantum theory, mathematical formulation; classical radiation theory; resonance phenomena in two-level systems, Bloch 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 Integated 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, theory of the p-n junction and the transistor. Thin film and integrated electronic structures, basis of the methods of fabrication, the physical mechanisms and the electrical characterizations of the field effect transistors (FET), metal-oxide semiconductor transistor (MOS, transistors), diodes, capacitors, and resistors. Elements of network synthesis techniques for distributed networks; RC structures, gyrators, negative impedance converters, design techniques for linear and for digital circuit structures; temperature effects, fundamental limitation of integrated electronic components and circuits; the operational amplifier, the digital gate, examples of logic circuit forms. 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. Boundry value problems; Green's function, guided waves, travelling wave and changed 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 anisotropic 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 excitation 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 waves, 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 523 Antenna Theory

This course gives a systematical analysis of circuit and field properties of radiating and receiving antennas. Both physical concepts and mathematical techniques are emphasized. The following topics are included: basic concepts of antenna theory, cylindrical antennas, Hallen's integral equation, current distribution by iteration, by Fourier series methods, Fourier transform technique applied to an infinitely long antenna, antenna admittance, impedance and fields, coupled antennas, linear arrays, wave theory and array theory approach to a long linear array, theory of receiving antennas, loop antennas, antennas in a dissipative medium, aperture antennas, horn and reflector antennas.

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 dimensionality, 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. MSA 507 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 for 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 535 Information Theory and Coding

Concepts of information and entropy. Information sources and extensions. Markov sources. Properties of noiseless codes and the inequalities of information theory. Encoding of information sources. Shannon's theorems. Information channels and capacity. Exchange of reliability for rate. Reliable signalling through unreliable channels. Error correcting codes.
Prerequisite: ESE 340 or knowledge of basic probability theory.

3 credits

ESE 537 Noise and Random Processes

Stationarity, correlation and power spectrum. Narrowband processes and zero crossings. Linear mean square estimation. Stationary and non-stationary normal processes. Markov processes and Poisson processes. Recursive filtering. Applications to communications, information theory and systems.
Prerequisite: ESE 340 or equivalent or permission of instructor.

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 the 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 realization. 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 Feedback Control Systems I

Analysis and synthesis of continuous and discrete systems, Nyquist and Bode plots, root locus method, multiple loop systems, synthesis through pole-zero configurations, compensation of continuous and sampled systems.

3 credits

ESE 542 Feedback Control Systems II

Stability analysis and design of linear time-invariant multivariable systems. Dynamical equation descriptions of non-linear systems. Analysis and design of non-linear system by graphical method, perturbation method, describing function method, Lyapunov's direct method, and Popov's frequency domain method (including circle criterion). Functional analysis methods are introduced.

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

A study in multiprocessor computer systems including pipeline concept and its realization, parallel processing, modular computer sharing, and high speed arithmetic units.

3 credits

ESE 550 Combinational Switching Theory

Definition of classes of combinational functions and their complexity; generalized consensus theory for two level synthesis; testing and synthesis of linearly separable functions. Adaptive logic and applications to pattern recognition; multilevel synthesis by functional decomposition; linear programming and factoring methods; Faulk diagnosis.

3 credits

ESE 551 Sequential Machines

The course deals with the analysis and synthesis of sequential machines from an engineering viewpoint. Areas covered include the representation and minimization of sequential machines, and the principal results on decomposition. Emphasis is placed on special form synthesis, in terms of linear machines, feedback shift registers and feedback threshold gate networks.
Prerequisite: ESE 550.

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 599 Research

Variable and repetitive credit

ESE 610 Seminar in Solid State Electronics

A course designed primarily for the student who is, or expects to be, involved in solid state research. The subject matter presented is designed in any given semester to support the research interests of the staff and the students involved.

3 credits

ESE 620 Seminar in Electromagnetic Theory

Current research problems in electromagnetic wave propagation and antennas.

3 credits

ESE 630 Seminar in Communications Theory

3 credits

ESE 640 Seminar on Systems Theory

Recent and current research work in systems theory.

3 credits

ESE 650 Seminar in Computer Science

Current research topics in logical design, machine learning, and self-organization.

3 credits

ESE 698 Practicum in Teaching

3 credits, repetitive

ESE 699 Research

Variable and repetitive credit

MATERIALS SCIENCE

Professors: JONA, S. LEVINE, NATHANS, SEIGLE, THOMSON (*Chairman*)
Associate Professors: CARLETON, HERMAN, JACH, MOSS, SIEGEL, F. WANG
Assistant Professor: BILELLO

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 solid 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 technology. Current research interests of the faculty include studies of point defects in metals, dislocation structure, radiation effects, polymers, biomedical materials, magnetic properties of solids, thermodynamics of solids, phase transformations, order-disorder phenomena, mechanisms of solid state sintering, surface structure, X-ray and neutron diffraction, and the structure and properties of amorphous materials.

In addition to the College of Engineering requirements for the M.S. and Ph.D. degrees, a student is admitted to either the M.S. or Ph.D. programs in materials science only after satisfactorily passing a graduate program Qualifying Examination. The Qualifying Examination is given at the beginning of each semester and is a comprehensive examination covering undergraduate work in materials science, physics, chemistry, and applied mathematics. The Qualifying Examination is taken by a student during the first week of the second semester in which the student is enrolled as a full-time student (excluding special students) in the Materials Science Department. However, well-prepared students are encouraged to take the examination in their first semester (a second attempt is then allowed, if required). An M.S. degree is not a prerequisite to admission to the Ph.D. degree program in materials science. The normal period of residence expected of students in the department is two consecutive semesters of full-time study for the M.S. degree and for the Ph. D. degree. Exceptions to this rule will be considered upon petition to the graduate program chairman.

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. This course is equivalent to ESM 302.

3 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, semiconductors, 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. This course is equivalent to ESM 304.

3 credits

ESM 509 Thermodynamics of Solids

The basic laws and thermodynamics 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 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 512 Strength and Plasticity of Solids

This course provides a broad 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; dislocation 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 515 Reactions in Solids I

This course provides a comprehensive treatment of solid state reactions and transformations. 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 516 Reactions in Solids II

Continuation of ESM 515. 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 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. This course is equivalent to ESM 325.

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 Modern Theory 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, semiconduc-

tors, and ionic crystals. Topics include dielectric and magnetic properties, electrical and thermal conductivity and the interpretation of resonance techniques. This course is equivalent to ESM 336.

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.

3 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 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 615 Electron Theory of Solids

Band theory of solids, Brillouin zones, Fermi surface in metals, alloys, and semiconductors, galvanomagnetic effects, optical properties, magnetism, lattice vibrations, and thermal properties of solids. Applications to magnetoresistance, 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; magneto-acoustic 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 materials 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 electro-optic and elasto-optic be-

havior 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, the 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

MECHANICS

Professors: BERLAD, BRADFIELD, CESS, IRVINE, R. S. L. LEE (*Chairman*), O'BRIEN, STELL, C. H. YANG
Associate Professors: CHIANG, S. HARRIS, TASI, L. WANG
Assistant Professors: CHEVRAY, VARANASI

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 heat transfer, thermodynamics, thermokinetic systems, 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, and experimental methods. In each area students are encouraged to participate in research.

Requirements for the M.S. and Ph.D. degrees are listed on pages 96-98. 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 boundry 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 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 boundry layers.

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 nonequilibrium 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 525 Wave Theory

A more detailed consideration of the theory and application of the wave equation than is given in the introductory physics course. In addition to an exposition of the general consequences of the wave equation, special consideration is given to applications in the areas of optics and acoustics, and, to a lesser extent, electromagnetic waves. Emphasis is directed toward establishing a close connection between the mathematical formulation and the associated physical ideas. This course is equivalent to ESC 311.

3 credits

ESC 526 Reactive Media

Lectures designed to provide the student with an introduction to the rate processes, flow and stability of reactive media. Fundamentals of theory and experiment for combustion, condensation, crystallization, and other phase transition and transport phe-

nomena. Energy transfer processes and molecular states. Onset and properties of laser action. Determination of thermokinetic rates from experiment. Applications to modern systems. This course is equivalent to ESC 322.

3 credits

ESC 527 Combustion

Lectures and laboratory work designed as an introduction to the fundamentals of combustion processes. Combustion theory. Experimental properties of the ignition, quenching, propagation, and stability of flames. Explosions and detonations. Combustion processes and air pollution. Radiative properties of flames. Dust explosions. Applications to modern systems. This course is equivalent to ESC 323.

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. This course is equivalent to ESC 342.

3 credits

ESC 529 Applied Aero- and Hydromechanics

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. This course is equivalent to ESC 361.

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 boundry layers, flow due to steadily moving bodies, jets, free shear layers, and wakes. This course is equivalent to ESC 375.

3 credits

ESC 531 Compressible Gas Dynamics

One-dimensional gas dynamics and wave propagation, shock waves in supersonic flow, Prandtl-Meyer expansion, and hodograph 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. This course is equivalent to ESC 379.

3 credits

ESC 532 Analysis of Structures

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. This course is equivalent to ESC 381.

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. This course is equivalent to ESC 391.

3 credits

ESC 534 Magnetofluid Dynamics

An integration of the concepts of fluid mechanics and electromagnetic theory. The in-

teractions 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. This course is equivalent to ESC 395.

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. This course is equivalent to ESC 392.

3 credits

ESC 536 Heat and Mass Transfer

The fundamental laws of momentum, heat, and mass transfer are discussed, and the corresponding transport coefficients are examined for gases using elementary kinetic theory. Principles of steady-state and transient heat conduction in solids are investigated. Analyses of laminar and turbulent boundry layer flows are treated, as well as condensation and boiling phenomena. Thermal radiation, including the analogy between molecular and photon transport, is discussed. Radiation heat transfer between surfaces is treated, as well as the derivation and application of the radiation flux equation for absorbing-emitting media. This course is equivalent to ESC 305.

3 credits

ESC 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. This course is equivalent to ESC 372.

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 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 561 Photoelasticity

Theory of two- and three-dimensional photoelasticity, frozen stress technique, oblique incidence method, scattered light photoelas-

ticity, 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 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 Time Dependent Phenomena in Two-Phase Flows

Introduction to regimes of two-phase internal and external flow with time dependent momentum, heat and mass transport; study of self-excited oscillations at the stagnation point of two-phase flows involving heat and mass transport; time dependent flows of thin liquid films in a gaseous atmosphere; shear

wave instabilities in laminar film boiling; instabilities of accelerated liquid interfaces; study of selected papers from the open literature.

3 credits

ESC 623 Homogeneous Turbulence

Probability functions and generalized Fourier transforms. Kinematics. Invariance theory. Isotropic turbulence. Statistical theories. Local isotropy. Scalar transport.

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 652 Viscoelasticity

Constitutive relations for linear viscoelastic media. Equations of motion. Uniqueness theorem. Reciprocity theorem. Quasi-static problems. Contact theory. Wave propagation in infinite and bounded media.

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 696 Special Problems in Mechanics

Conducted jointly by graduate students and one or more members of the faculty.

3 credits

ESC 698 Practicum in Teaching

3 credits, repetitive

ESC 699 Research

Variable and repetitive credit

URBAN SCIENCE AND ENGINEERING

For detailed description of admission requirements and degree programs, see pages 121-124.

THE ENVIRONMENTAL SCIENCES

EARTH AND SPACE SCIENCES
ECOLOGY AND EVOLUTION
MARINE ENVIRONMENTAL STUDIES
URBAN SCIENCE AND ENGINEERING

EARTH AND SPACE SCIENCES

For detailed description of admission requirements and degree programs, see pages 153-158.

ECOLOGY AND EVOLUTION

For detailed description of admission requirements and degree programs, see pages 84-92.

MARINE ENVIRONMENTAL STUDIES

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 offered by the closely interacting faculty of the Marine Sciences Research Center attempts to meet that challenge. Students with highly varied academic backgrounds from the natural, physical, and social sciences, and the humanities will be introduced to the concepts and procedures of other disciplines relevant to competent environmental management.

Requirements for Admission to the Program

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. An official undergraduate transcript and letters of reference from three previous instructors and/or employers in relevant professional fields must accompany applications for admission. The results of the Graduate Record Examination are desirable to help in the selection of candidates. 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 credits, of which not more than six credits may be MAR 580 Seminar and/or MAR 590 Research. Students must 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 511 Marine Instrumentation
4. MAR 580 Seminar

and *three* of the following:

1. MAR 514 Socio-Economic Aspects of the Coastal Zone
2. MAR 521 General Problems of the Marine Environment
3. MAR 522 Case Studies in Environmental Problems
4. MAR 552 Topics in Marine Legal-Political Arrangements
5. MAR 553 Fishery Ecology

C. Each student must submit evidence of field experience aboard a research vessel at sea.

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

Courses

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. This course is equivalent to MAR 301 and identical to CEB 570.

Fall, 3 credits

MAR 502 Biological Aspects of the Marine Environment

Detailed treatment of mutual dependence of the biological communities and physio-chemical aspects of the marine environment, with emphasis on coastal and estuarine areas. This course is equivalent to MAR 302 and identical to CEB 571.

Spring, 3 credits

MAR 511 Marine Instrumentation

The course covers shipboard computer data acquisition, buoy data systems, radiotelemetry data systems, optical oceanography, acoustical oceanography, fathometry, chemical oceanography, cruise planning, the logistics of ships, personnel, and equipment and long-range weather forecasting.

Fall, 2 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. This course is equivalent to BIO 340.

Spring, 2 credits

MAR 514 Socio-Economic Aspects of the Coastal Zone

Examination of social problems and their relationships to the marine environment. Multiple utilization of environmental resources, social costs of exploitation, and development of management rationale. Federal, state, and local policies in coastal zone management.

Fall, 3 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. This course is identical to CEB 572.

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, pesticides, food from the sea, eutrophication, and the various problems of Jamaica Bay or San Francisco Bay. This course is identical to CEB 573.

Spring, 2 credits

MAR 550 Topics in Marine Sciences

Fall or Spring, variable and repetitive credit

MAR 552 Topics in Marine Legal-Political Arrangements

An examination of the legal and political aspects of management, including problems related to fisheries, water quality, waste management, coastal and estuarine zone management, mineral resources of the sea, and weather modification.

Spring, 3 credits

MAR 553 Fishery Ecology

The objectives, history, and development of fishery research and management will be examined, illustrated with case histories of domestic and international fisheries.

Spring, 3 credits

MAR 580 Seminar

Fall and Spring, 1 credit, repetitive

MAR 590 Research

Fall and Spring, variable and repetitive credit

URBAN SCIENCE AND ENGINEERING

The Master of Science Program in Urban Science and Engineering is an interdisciplinary graduate program designed to provide quantitative training through case work and field experience for individuals interested in professional careers related to problems of the public sector. Training concepts covered are applied to such areas as pollution, waste disposal, and transportation. Also included are fire and police protection, housing, and health. The emphasis of the program of study is on the practical knowlege and skills useful for handling problems in the environment where they originate.

The program contains a core curriculum which allows the student to develop a high level of competence in engineering and economic analysis. Elective courses provide an understanding of the essential political and social factors relevant to all analyses of public problems. Unusual features of the program are the Case Studies and Summer Internship, which are designed to demonstrate to the student the importance and complexity of the implementation process.

Students entering the program are expected to have had a background of undergraduate work in engineering, economics, or the physical sciences. Students offering evidence of a potential for applying analytical skills to the public sector problems but lacking the proper prerequisites in mathematics, may extend their period of study or utilize their electives to acquire the required analytical skills.

Requirements for the M.S. Degree

A. Residence: Four semesters of full-time study plus a summer internship.
B. Formal course requirements: A total of 36 credits—21 from the core curriculum courses, nine from the list of elective courses or an appropriate substitution and six comprising Case Studies.
C. Satisfactory performance on a significant case study project and an acceptable summary report on the internship in the field.

Programs of study are to be approved individually by the urban science and engineering faculty. Should students in the Urban Science and Engineering Program subsequently decide to enter the regular program of any of the participating departments, they must reapply for admission in competition with new applicants to those departments.

The faculty in the program consists of members of the program and associate faculty from departments in the College of Engineering and the Economics and Political Science Departments. The faculty includes Professors Altman, Beltrami, Bodin, Carroll, and Nathans (Chairman). The associate faculty includes Professors Ames, Berlad, Blum, Cimbala, Dusansky, Friedland, Gross, Heller, James, Kristein, Meyers, Neinhaus, Nordell, Sakbani, Schoepfle, and Skolnick.

Program of Study*

A core curriculum allows the student to develop a high level of competence in engineering, economic analysis, applied mathematics, and political decision-making.

I. Analytical and Quantitative Methods
ECO 520 or MSA 551 Mathematical Statistics or Introduction to Applied Probability and Statistics I
ECO 521 Econometrics
ESU 513 (ECO 571) Quantitative Methods for Public Sector Analysis
MSC 583 Modeling and Simulation

* For detailed descriptions of courses listed, and additional information on the Urban Science and Engineering Program, write: Professor Robert Nathans, Urban Science and Engineering Program, State University of New York, Stony Brook, New York 11790.

II. Economic Processes
ECO 570 Price and Welfare Theory
ECO 542 Urban Economics

III. Political and Social Processes
ESU 531 Political and Administrative Decision-Making

IV. Systems Planning and Management
ESU 501, 502 Case Studies in Urban Science and Engineering I, II
ESU 549 Research Project in System Planning and Management

Electives: Listed below are examples of suggested courses:

MSA 545 Graph Theory and Its Applications
MSA 538 Methods of Operations Research II
MSC 584 Information Organization and Retrieval
ECO 514 Dynamic Economic Models
ECO 530 Public Finance
POL 254 The Politics of Government Planning
POL 256 The Problems of Urban Areas
POL 272 Advanced Topics in Quantitative Political Analysis
SOC 532 Complex Organizations
SOC 362 Introduction to Sociological Theory
PSY 209 Social Psychology

Case Studies: The role of the student in the Case Studies is expected to be an active one. The Case Studies provide the linkage between formal course work and real world situations. During the first year, actual problem situations are presented to the student by the faculty. Student participation grows as familiarity with the methods and approaches begins to develop.

At the beginning of the second year a single large project involving a small group of students working with several members of the faculty in the program is arranged. Problem conditions, taken from the research activities of faculty in the program, are presented to the student to structure and investigate; the student collects and assesses useful sources of information about them, and finally recommends reasonable courses of action. This project replaces the thesis normally associated with the M.S. degree.

Internship: Normally, a student in the program is expected to devote the intervening summer between the first and second year of study gaining field experience by working with local or state agencies, consulting firms or non-profit institutions in areas related to urban or environmental problems. These intern-

ships, which are arranged by the faculty in the Urban Science and Engineering Program and the Economic Research Bureau, are intended to aid the student in developing further confidence and ability to deal with problems in the field. This is particularly important for a student who enters the program with no previous work experience. Conditions of employment during the internship depend on the employer and the type of work carried out during the internship.

The critical examination of field work experience, in light of the formal training in analysis taken during the first year of study, is an important part of the internship program. The student is expected to summarize the field work in a case study to be submitted at the beginning of the second year. Faculty supervision for the internship and the preparation of this study are to be arranged for by the student after the first semester of study.

Research activities by members of the program currently involve a number of problem areas. These include: solid waste sources and flow; fire protection; housing maintenance and rehabilitation; patient flow in state mental institutions; noise pollution. Student participation in the ongoing research in these areas is encouraged.

THE HEALTH SCIENCES

ALLIED HEALTH PROFESSIONS
BASIC HEALTH SCIENCES
DENTAL MEDICINE
MEDICINE
NURSING
SOCIAL WELFARE

HEALTH SCIENCES CENTER

The Health Sciences Center encompasses six schools: Medicine, Dental Medicine, Basic Health Sciences, Nursing, Social Welfare, and Allied Health Professions; a University Hospital, and a Veterans' Administration Hospital; a Division of Laboratory Animal Medicine, a Division of Health Sciences Communications, and a projected 500,000 volume Health Sciences Library. The academic plan of the total Health Sciences Center has been developed in a way that will insure to students in all the schools opportunities to draw upon the expertise and resources of all parts of the Health Sciences Center and of the total campus.

Clinical resources, in addition to those planned at the campus itself, will include a number of "clinical campuses" being developed in cooperation with several outstanding patient care facilities on Long Island.

In the fall of 1970, the School of Nursing opened its undergraduate program while the School of Allied Health Professions began with an undergraduate program for cardiopulmonary/respiratory specialists. The School of Medicine and the School of Social Welfare will accept their first classes in September 1971, at which time the School of Allied Health Professions will expand its program offerings to include health services administration plus other programs still being developed. The first formal graduate training programs in Basic Health Sciences will be offered by the School of Basic Health Sciences in 1971 with the exception of the graduate program in biochemistry, which has been in operation for several years in the Division of Biological Sciences. The School of Dental Medicine is scheduled to admit students in September 1972.

The following table shows the opening dates of each school and the degrees to be conferred:

School	*Date of Opening*	*Degrees*
Allied Health Professions	1970	B.Sc.
Nursing	1970	A.B.
Social Welfare	1970	B.S.W., M.S.W., D.S.W.
Basic Health Sciences	1971	M.Sc.
Medicine	1971	M.D.
Dental Medicine	1972	D.D.S.

Students wishing information, or the Bulletin for the entire Health Sciences Center, should address their inquiries to the Dean of the appropriate School in the Health Sciences Center, State University of New York at Stony Brook, Stony Brook, New York 11790.

THE MATHEMATICAL SCIENCES

APPLIED MATHEMATICS AND STATISTICS
COMPUTER SCIENCE
MATHEMATICS

APPLIED MATHEMATICS AND STATISTICS

Professors: BELTRAMI, DICKER, DOLEZAL, GERST (*Chairman*), TEWARSON, ZEMANIAN
Associate Professors: Y. CHEN, KIM, LEIBOWITZ, SRIVASTAV, THAMPURAN
Assistant Professors: BODIN, GRAN, JOSEPH, LENT, TUCKER

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 applications 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, and the urban sciences.

Requirements for the M.S. and Ph.D. degrees are listed on pages 96-98.

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 96, 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. Corequisite: MSA 505.

3 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.

3 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.

3 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.

3 credits

MSA 505 Applied Algebra I

Matrix algebra. Normal operators and their spectra. Direct sums and reducibility. Canonical forms. Abstract groups and their matrix representation. Applications to physical symmetry. An introduction to tensor algebra.

3 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.

3 credits

MSA 507 Introduction to Probability and Stochastic Processes

Basic concepts of probability: sample spaces, probability measure, random variables. Elementary combinatorial problems, 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. Applications to biology, physics, and engineering according to interests of the class.

3 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.

3 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 Liénard's equations. Approximate solutions by the small-parameter method of Poincaré.
Prerequisite: MSA 501.

3 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. This course is equivalent to MSA 316.

3 credits

MSA 517 Ordinary Differential Equations

This course deals with the 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, Liénard, and Duffing equations; approximate solutions. This course is equivalent to MSA 317.

3 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.

3 credits

MSA 526 Numerical Analysis I

Simultaneous linear equations, matrix inversion, eigenvalues, linear programming, error analysis.

3 credits

MSA 527 Numerical Analysis II

Ordinary differential equations, integral equations, partial differential equations of elliptic, parabolic, and hyperbolic type.

3 credits

MSA 537 Methods of Operations Research I

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

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. Applications such as inventory theory or traffic theory according to the interest of the class.
Prerequisite: MSA 537.

3 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 immittances. 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.

3 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 nonplanar 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.

3 credits

MSA 550 Algebraic Coding Theory

Utilizing concepts and results from modern algebra and number ttheory 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.

3 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. This course is equivalent to MSA 251.

3 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. This course is equivalent to MSA 252.

3 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.

3 credits

MSA 557, 558 Elasticity I and II

This course is identical with ESC 541, 542.
3 credits each semester

MSA 563 Fluid Dynamics

The mathematical theory of inviscid fluid motions. Irrotational motion, flow nets, conformal mapping, Schwarz-Christoffel transformation. Applications to subterranean flow and surface waves, aerodynamics, hydrodynamic stability.
Prerequisite: MSA 502.

3 credits

MSA 565 Wave Propagation I

This course is identical with ESE 520.

3 credits

MSA 566 Wave Propagation II

This course is identical with ESE 521.
Prerequisite: MSA 565.

3 credits

MSA 599 Research

Variable and repetitive credit

MSA 605 Probability Theory and Applications

Measure-theoretic basis of probability. Fourier transforms. Generating functions. Sums of independent random variables. Limit theorems. Martingales. Markov processes and their connection with differential and integral equations, potentials. Applications to random walk and ruin problems, information theory and coding, statistical mechanics, problems of strategy and decision-making, queuing problems, extinction of populations.
Prerequisites: MSA 504 and MSA 552.

3 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.

3 credits

MSA 609 Markov Processes and Their Applications

Modern definition of a Markov process. Transition functions. Operators of transition functions. Diffusion processes. Brownian motion and generalized Brownian motion. Feller processes. Wiener processes. Transformations of Markov processes. Stochastic differential and integral equations. Applications to engineering, physics, astronomy, biology.
Prerequisite: MSA 605.

3 credits

MSA 611 Theory of Partial Differential Equations and Their Applications

Theorem of Cauchy and Kowalewsky; 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.

3 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.
Prerequisites: MSA 504 and MSA 505.

3 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.

3 credits

MSA 628 Functional Analysis

Metric and Banach spaces and their applications to applied problems. Completeness, contraction mappings, compactness and Arzela's theorem. Linear spaces and manifolds, norms, continuous linear functionals, dual spaces, Hahn-Banach theorem, reflexivity, weak convergence. Applications to linear systems are given.
Prerequisites: MSA 504 and MSA 505.

3 credits

MSA 635, 636 Realizability Theory in Banach Space 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-invariant Banach systems and convolution. Hilbert ports and passivity. The admittance and scattering formulisms. Representation theorems. Ooports. Synthesis of Hilbert ports.
Prerequisite: MSI 201 Advanced Calculus.
Corequisite: MSA 628 Functional Analysis.

3 credits each semester

MSA 651 Non-Linear Analysis and Optimization

The direct method of Liapunov for stability. Fixed point arguments and their use in establishing the convergence of iterative methods for non-linear operator equations. Frechet differentials. The Newton-Raphson method in function space and non-linear boundary value problems. The Courant penalty concept and constrained optimization. Gradient techniques and non-linear programming.
Prerequisite: MSA 505.

3 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

3 credits each semester, repetitive

MSA 698 Practicum in Teaching

3 credits, repetitive

MSA 699 Research

Variable and repetitive credit

COMPUTER SCIENCE

Professors: FINERMAN, GELERNTER, HELLER, KIEBURTZ (*Acting Chairman*), TYCKO
Associate Professors: BERNSTEIN, D. SMITH
Assistant Professor: AKKOYUNLU

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 college-level physics.
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.

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.

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:

1. M.S. without thesis (24 credits)
   a. Core courses (MSC 502, 521, 522, and 525).
   b. MSA 506 Finite Structures *or* MSC 541 Theoretical Foundations of Computing I.
   c. MSC 524 Laboratory in Computer Science, three credits extending over two semesters.
   d. Six credits of elective courses, chosen with advisor's approval.
2. M.S. with thesis (18 credits)
   a. Core courses (MSC 502, 521, 522, and 525).
   b. Six credits of elective courses, chosen with advisor's approval.

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 326 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 examinations 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 departmental 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 24 credits of course work with a B average or better and passing the Ph.D. Qualifying Examination.

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.

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 (12 credits)

1. MSA 506 Finite Structures
2. MSC 541 Theoretical Foundations of Computing I
3. ESE 318 Digital System Design
4. MSC 521 Data Structures

Spring Semester (12 credits)

1. MSA 514 Applied Algebra II
2. MSC 542 Theoretical Foundations of Computing II
3. MSC 502 Computer Organization *or*
   ESE 551 Switching Theory
4. MSC 522 Algorithmic Languages and Compilers I

Second Year

Fall Semester (12 credits)

1. MSC 543 Automata Theory I
2. MSC 641 Mathematical Theory of Computation
3. MSC 523 Algorithmic Languages and Compilers II
4. MSC 525 Systems Programming

Spring Semester (12 credits)

1. MSC 544 Automata Theory II
2. MSC 530 Simulation and Modelling *or*
   MSC 630 Seminar in Artificial Intelligence
3. MSC 532 Information Organization and Retrieval
4. MSC 620 Analysis of Computer Systems.

D. Preliminary Examination: The Preliminary Examination must be scheduled within two years from the time the student has passed his 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.

E. Dissertation: The most important requirement of the Ph.D. program 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 reputable scholarly journals.

F. Approval and defense of the 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 Organization

Design of computer subsystems such as memories, storage devices, control units, input-output facilities, arithmetic units. Microprogramming and overall system design problems. Description and simulation techniques. Features needed for multiprocessing and real-time systems. Other advanced topics and alternate organizations. This course is equivalent to MSC 302.
Prerequisites: MSC 102 and ESE 318 or equivalent.

3 credits

MSC 521 Data Structures

Representation and organization of information as data inside and outside the computer. Basic concepts and formal descriptions 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.

3 credits

MSC 522, 523 Algorithmic Languages and Compilers I and II

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.

3 credits each semester

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.

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.

3 credits

MSC 530 Simulation and Modelling

Statistical aspects of systems modelling. Syntax and usage of General Purpose Systems Simulator (GPSS). Mathematical-analytic tools of systems modelling. Analog computer as a modelling guide. Construction of GPSS working models in engineering, biology, and the social sciences. Simulation using the FORTRAN language in physics, chemistry, and engineering.

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.

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.

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.

3 credits

MSC 543 Automata Theory I

Finite-state machines and regular expressions, context-free languages and push-down automata, Turing machines and the halting problem, complexity of computation.
Prerequisite: MSA 514.

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 permutation-reset machines.
Prerequisite: MSA 514.

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.

3 credits

MSC 630 Seminar in Artificial Intelligence

A survey of the research area of artificial intelligence, with special emphasis given to the study of heuristic problem-solving systems. Other topics that may be considered are pattern recognition, game-playing programs, theorem proving, and machine simulation of cognitive processes. The course will be conducted through the study of the classical (circa 1960) and current literature of artificial intelligence.
Prerequisite: MSC 525.

3 credits

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.

3 credits

MSC 698 Practicum in Teaching

3 credits, repetitive

MSC 699 Research

Variable and repetitive credit

MATHEMATICS

Professors: ADLER, AX, BARCUS, CHARLAP (*Director of Graduate Studies*), DOSS, DOUGLAS, GROMOLL, KUGA, LISTER, PINCUS, RAPAPORT, SAH, SIMONS (*Acting Director, Division of Mathematical Science*), SZUSZ
Associate Professors: CHEEGER, EBIN, FARKAS, W. FOX, FRIED, KRA (*Acting Chairman*), MEYER, OSHER, PHILLIPS, SCHANUEL, THORPE, ZAUSTINSKY
Assistant Professors: FRANK, HELTON, HOWE, KUMPEL, RALLIS, ROITBERG
Research Instructors: AKIBA, BAK, KIREMIDJIAN
Lecturer: AUCHMUTY

Admission to Graduate Study

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

A. A baccalaureate degree with preparation substantially equivalent to that required of mathematics majors at Stony Brook.
B. Three letters of recommendation from members of the mathematics faculty under whom the applicant has taken courses.

Requirement A may be waived for exceptionally qualified undergraduates.

Departmental recommendation for admission will be based upon signs of exceptional ability in mathematics as indicated by these letters and the student's grades.

In certain cases a student whose background in mathematics contains deficiencies may be admitted on a provisional basis. Upon admission, the student will be informed of the requirements which must be satisfied in order to be admitted to full standing.

Requirements for the M.A. Degree

A. One year of residence, with registration in a program of departmentally approved courses.

B. Passing of the Masters Comprehensive Examination.

Masters Comprehensive Examination

The examination will cover the syllabi for the four graduate courses: Algebra I, Real Analysis I, Complex Analysis I, and Algebraic Topology I. The examination will be given near the end of each semester. No student will be permitted to take the examination more than twice except under very special circumstances.

Requirements for the Ph.D.

A. Demonstration of proficiency in two languages chosen from French, German, and Russian.

B. Passing of the Masters Comprehensive Examination.

C. Passing of the Ph.D. Oral Qualifying Examination.

D. Advancement to candidacy: The department's recommendation to the Graduate School for advancement to candidacy to the Ph.D. will be based primarily on the satisfactory completion of requirements A, B, and C above.

E. Dissertation and the passing of the Dissertation Examination.

Ph.D. Oral Qualifying Examination

The examination will be administered by a committee of three faculty members. The chairman of this committee and one additional member will be selected by the student, subject to the approval of the Committee on Graduate Studies, while the third member will be selected by the Committee on Graduate Studies The material covered on the examination will be chosen by the chairman of the examination committee and the student at the beginning of the preparation period, subject to the approval of the other members of the examination committee and the Committee on Graduate Studies.

The level of the examination will be such that its successful completion should signify that the student is ready to begin work on his dissertation.

A student may assemble the examination committee and begin preparation for the oral examination if Ph.D. requirement B has been fulfilled. Normally this examination may not be taken more than twice.

Time Limitations

Except for students who enter with inadequate preparation, all students must take the Masters Comprehensive Examination by the end of their first academic year of study. Students are urged to take the Oral Qualifying Examination as

soon as possible and, in any case, not later than two years after passing the Masters Comprehensive Examination.

Courses

Not all of the courses listed will be offered every year, but any course will be given if there is sufficient interest.

MSM 502 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 503 Algebra II

The structure and use of algebras including tensor and exterior algebras, semi-simple algebras, theorems of Wedderburn and Brauer.

4 credits

MSM 504 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 505 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 506, 507 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 508, 509 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 512 Real Analysis I

Measures and associated integrals particularly Lebesgue measure and the Lebesgue integral, the Riesz representation theorem, linear functionals on L_p, absolute continuity, functions of bounded variation, product measures, Lebesgue decomposition theorem, derivative of measure.

4 credits

MSM 513 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

MSM 514, 515 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 516, 517 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 518, 519 Harmonic Analysis

The classical theory of trigonometric series, almost 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 522 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 function including Taylor and Laurent series expansions. Geometric properties of holomorphic functions. Moebius transformations. Riemann's mapping theorem.

4 credits

MSM 523 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 524, 525 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 532 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 533 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 534 Differential Topology

Manifolds, imbedding and immersion theorem, vector bundles, characteristic classes. Further topics such as cobordism, Morse theory.

4 credits

MSM 540, 541 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 542, 543 Introduction to 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 546, 547 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 548, 549 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, σ-process, Kodaira imbedding theorem, Hirzebruch-Riemann-Roch theorem, deformations of complex structure.

4 credits each semester

MSM 552, 553 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 598 Independent Study

Variable and repetitive credit

MSM 600 Practicum in Teaching

Variable and repetitive credit

MSM 602, 603 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 612, 613 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 622, 623 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 multiply connected regions.

4 credits each semester

MSM 632, 633 Topics in 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 644 Characteristic Classes

DeRahm's theorem, Gauss-Bonnet theorem, Weil-homomorphisms, characteristic classes of homogeneous spaces, vector fields foliations, and characteristic numbers.

4 credits

MSM 645 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 646, 647 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 648 Minimal Varieties

Classical examples and connection with complex variables, geometic measure theory, currents, Bernstein theorem and counter examples, recent work on minimal varieties in constant curvature manifolds.

4 credits

MSM 652, 653 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 699 Thesis Research

Variable and repetitive credit

CHEMISTRY

Professors: ALEXANDER (*Chairman*), BONNER, CHU, FRIEDMAN, HAIM, HIROTA, KOSOWER, LAUTERBUR, LE NOBLE, OKAYA, PORTER, RAMIREZ, SUJISHI
Associate Professors: GOLDFARB, SCHNEIDER, WEISER, WHITTEN, WISHNIA
Assistant Professors: F. FOWLER, D. HANSON, JESAITIS, JOHNSON, KERBER, KRANTZ, KWEI, LLOYD, MUROV, SCHWARTZ, SPRINGER, STIEFEL
Director of Chemical Laboratories and Lecturer: CROFT

Admission to Graduate Study

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

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 course work, and 3.00 (B) in all courses in the sciences and in 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.

Qualifying Examination

Before classes begin in the fall semester a series of three qualifying examinations in the fields of physical, inorganic, and organic chemistry will be administered to

all incoming graduate students. These examinations will be based upon final examinations given in the undergraduate program of the State University at Stony Brook. The examinations will also be given between the fall and spring semesters and at the end of the spring semester. Any of the three parts not passed must be repeated. The purpose of the qualifying examinations is to aid in the advising of incoming graduate students concerning their first year programs and to insure that the students are qualified for candidacy for an advanced degree.

Seminars

All first year graduate students will register for the chemistry seminar series CHE 531 (0 credit) and 532 (1 credit). The first semester series (CHE 531) is a preresearch seminar in which the faculty members of the Department of Chemistry will present talks on their research programs. The objective of these seminars is to provide information which will allow the student to make an intelligent selection of a research advisor. During the second semester (CHE 532) each student shall present a topic of his own selection.

In addition to the above, all graduate students are expected to attend the department's regularly scheduled colloquia. These colloquia are presented by outstanding chemists invited from outside the University.

Research Advisor

During the second semester, no later than April 15, each first year student shall request a faculty member to become his research advisor and shall then apply to the chairman of the Department of Chemistry for final approval. Each student shall register for one or two credits of research for the second semester with the expectation that he will initiate his research work upon selection and approval of the research advisor.

The research advisor becomes the academic advisor for the student, and his subsequent program of study must meet with the approval of the research advisor.

With the permission of the chairmen of the Department of Chemistry and of Earth and Space Sciences, research may also be conducted in the area of earth and space science.

Courses of Study

Students will be advised concerning courses of study appropriate to their backgrounds. The objective of the course of study in the first year is the development of breadth in chemistry. Six formal courses (selected as indicated below) or their equivalent are required of all graduate students. Qualification to can-

didacy is based on achievement in these first year courses as described under degree requirements.

Quantum Chemistry I	(CHE 521)	3 credits
Chemical Thermodynamics	(CHE 523)	3 credits
—and two of the following:		
Organic Chemistry	(CHE 501, 502 or 503)	3 credits each
Inorganic Chemistry I	(CHE 511)	3 credits
Biochemistry	(BIO 501)	4 credits
—and at least two of the following:		
Organic Chemistry[a]	(CHE 501, 502, 503)	3 credits
Inorganic Chemistry	(CHE 511, 512)	3 credits
Quantum Chemistry II	(CHE 522)	3 credits
Chemical Kinetics	(CHE 526)	3 credits each
Statistical Mechanics	(CHE 528)	3 credits
Nuclear Chemistry	(CHE 529)	3 credits
Physical Chemistry of Macromolecules	(CHE 530)	3 credits
Biochemistry	(BIO 501)	3 credits

Students entering with advanced standing and desiring placement out of any first year course must obtain the approval of the faculty member in charge of the course and of the chairman. Such approvals must be filed in the department office.

Qualification to Candidacy

The qualifications of each first year graduate student will be reviewed by the faculty of the Department of Chemistry at the end of the spring semester. Students will be qualified to candidacy for a graduate degree upon successful completion of the Qualifying Examinations and the required graduate courses. Successful completion of the courses involves achievement of the grade point average indicated below.

Requirements for the M.S. Degree

A. Residence: One year minimum.

B. Qualifying Examinations.

C. Language: Students must demonstrate reading proficiency in German, French, or Russian.

[a] Any one of the organic chemistry courses (501, 502 or 503) or their equivalent is required for all students. A student whose major area is organic chemistry is required to take all three of these courses during his first year.

D. Formal course requirement: Successful completion (3.0 average[a] or above) of an approved course of study comprising at least 24 graduate credits.

E. Thesis: Upon acceptance of an M.S. thesis by a reading committee, the student is admitted to oral defense of his thesis. After satisfactory defense of the thesis before the committee, the chairman of the department recommends acceptance of the thesis to the Dean of the Graduate School.

Requirements for the Ph.D. Degree

A. Residence: Two years minimum.

B. Qualifying Examinations.

C. Language: Students must demonstrate reading proficiency in German, French, or Russian.

D. Formal course requirement: Successful completion (3.5 average[a]) of an approved course of study.

E. Cumulative examination and proposition: Cumulative examinations and propositions are intended to provide a means by which the student's depth of knowledge can be enhanced as well as demonstrated.

The cumulative examination will be offered at eight stated dates each year in the four major areas of physical, inorganic and organic chemistry, and chemical biology. A student is expected to pass at least two examinations within the first two semesters after qualification to candidacy, and a total of four examinations within the three semesters following qualification. Each student will present and defend a proposition, not directly related to his thesis problem, during the four semester period following qualification. The proposition will consist of the presentation of a written research proposal which the student will defend orally before a faculty committee after completion of the cumulative examination requirement.

F. Dissertion: Upon acceptance of a Ph.D. dissertation by a reading committee, the student is admitted to oral defense of his dissertation. After satisfactory defense of the dissertation before the committee, the chairman of the department recommends acceptance of the dissertation to the Dean of the Graduate School.

[a] Based on the system A = 4.5, A− = 4.0, B = 3.5, B− = 3.0, C = 2.0, F = 0 for chemistry graduate courses.

Doctoral Program in Chemical Physics

The doctoral program in chemical physics is intended to meet the needs of students whose interests lie in areas of both chemistry and physics. A graduate student who is admitted to either the Chemistry or Physics Department may elect the chemical physics course program, with the consent of his department chairman. A chemistry student may elect this program if he wishes to obtain more extensive training in physics than is normally required by chemistry departments. A physics student may elect the program if he wishes to obtain more extensive exposure to chemical systems than is normally obtained in physics departments. The mechanics of the program (admission, qualification, etc.) will be administered by the usual departmental procedures in either the Chemistry or Physics Department. Thus the program is a course option for graduate students in chemistry or in physics[a]; each student must satisfy the requirements of his own department, except as modified below.

ADMISSION TO THE PROGRAM

A graduate student who has been admitted to the Chemistry Department may seek the consent of the chairman to enter the chemical physics program. The student should have a strong background in physics in the areas appropriate to his interest. A student who does not have such a background may be advised to take undergraduate courses (PHY 201 or 341, etc.) before entering the program.

QUALIFICATION

Students in the chemical physics program will take the same qualifying examinations and meet the same performance standards in required courses as other students in the Chemistry Department. The student's qualification evaluation will be based on at least six courses from the following list:

CHE 523 Chemical Thermodynamics

PHY 343 Mathematical Physics

Two courses from among CHE 521, 522 Quantum Chemistry I, II, PHY 511,512 Quantum Mechanics I, II

CHE 528 or PHY 540 Statistical Mechanics

PHY 501 and 502 Classical Physics I, II

One course in chemistry from among CHE 501, 502, 503, 511 and 512.

[a] A student who is admitted to physics should consult the physics section of this catalog.

COURSE OF STUDY

The course of study will include a total of eight courses, completing the list above, and in addition, CHE 532 and three credits chosen from among the 500 and 600 level chemistry and physics courses, but excluding practicum, seminar and research courses.

RESEARCH

Selection of a research advisor will be made during the second semester of the first year as described in the chemistry program. The selection of the research advisor may be made in the Physics Department, subject to the approval of the department chairmen.

CUMULATIVE EXAMINATIONS

These examinations will usually be the chemistry cumulative examinations; however, a hybrid set of examinations may be recommended by an interdepartmental committee.

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 510 Practicum in Teaching

Practice instruction in chemistry at the undergraduate level, carried out under faculty orientation and supervision. A minimum of two semesters of registration for CHE 510 is required of all candidates for graduate degrees in chemistry, unless explicitly waived by the chairman.

Variable and repetitive credit

CHE 511 Inorganic Chemistry I

A course in modern physical-inorganic chemistry with emphasis in bonding and structural principles. Valence-bond theory, valence-shell electron-pair repulsion theory, molecular-orbital theory, crystal and ligand-field theories are discussed and applied to inorganic systems.

Fall, 3 credits

CHE 512 Inorganic Chemistry II

A course in modern physical-inorganic chemistry in which fundamental structural, ther-

modynamic, spectroscopic, and kinetic principles are applied to inorganic systems.

Spring, 3 credits

CHE 521 Quantum Chemistry I

Elementary quantum and statistical mechanics will be applied to problems of chemical interest, including chemical bonding and molecular structure. The interpretation of ultraviolet, visible, infrared and radio-frequency spectroscopic data will be emphasized.

Fall, 3 credits

CHE 522 Quantum Chemistry II

An introduction to matrix methods in quantum mechanics, and the behavior of systems in the presence of electric and magnetic fields. The application of symmetry properties and group theory will be made to atomic and molecular 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 equilibrium 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 and Spring, 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. This course is identical to ESC 524.

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, 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 531 Seminar

Fall, no credit

CHE 532 Seminar

Spring, 1 credit

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 mechanism of biochemical transformations from the point of view of physical organic chemistry.

Spring, 2 credits

CHE 623 Molecular Spectroscopy

A detailed description of the theory and practice of rotational, vibrational, and electronic absorption spectroscopy. Topics to be covered will include energy levels, force fields and selection rules for polyatomic molecules. Emphasis will be on the application of spectroscopic data to molecular structure and other problems of chemical interest.

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, feed-back control as applied to chemical instrumentation. Students will design, simulate, and/or perform actual experiments with the computer.

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

EARTH AND SPACE SCIENCES

Professors: CARTER, LINDSLEY, A. PALMER, SCHAEFFER (*Chairman*), [a]STROMGREN
Associate Professors: BENCE, BRETSKY, [b]H. Y. CHIU, DODD, G. HANSON, HARDORP, OWEN, PAPIKE, PREWITT, SHU, STROM
Assistant Professors: GEBEL, GEBELEIN, KNACKE, LEVINTON, M. SIMON
Lecturer: BUDDENHAGEN

The Earth and Space Sciences department offers degree programs in astronomy-astrophysics-planetology, geochemistry-mineralogy-petrology-cosmochemistry, and environmental paleobiology-sedimentary geology.

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: Successful completion with a B average of an approved course of study consisting of either 18 academic credits and a thesis or two approved research papers; or 24 credits without a thesis.

[a] Distinguished Professor of Astronomy, Royal Danish Observatory, Copenhagen; adjunct at Stony Brook.

[b] NASA/Goddard Space Studies Institute, part-time at Stony Brook.

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 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

Advanced Undergraduate Courses

ESS 301 Optical Mineralogy

ESS 302 Environmental Geology

ESS 306 Petrology

ESS 309 Structural Geology

ESS 312 Stratigraphy

ESS 317 Marine Ecology

Graduate Courses

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.

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, alternate years. Not offered 1971-72.

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, alternate years. Offered 1971-72.

ESS 515 Depositional Models in Stratigraphy

The evolution of persistent depositional models (i.e., deltas, barrier islands, etc.) is studied by comparing well-documented examples of present-day and ancient models. Investigation involving extensive use of the literature, field investigations, and laboratory work. Two-hour lecture and four-hour laboratory per week, plus at least two mandatory weekend field trips.
Prerequisite: Permission of instructor.

Spring, 3 credits, alternate years. Offered 1971-72.

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; autecology of selected fossil invertebrate groups; and spatial distribution.

Spring, 3 credits, alternate years. Not offered 1971-72.

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.

Spring, 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.

Fall, 3 credits

ESS 526 Mineral Equilibria

After a brief introduction, carbonate systems, oxidation potential, and pH relations, complex ions and applications to geological processes are discussed. Two one-hour lectures and one four-hour laboratory per week.

Spring, 3 credits

ESS 531 X-ray Mineralogy

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 and II

A number of laboratory experiments designed to illustrate modern astronomical techniques and to familiarize the student with the use of telescopes and the electronic instrumentation attached to astronomical telescopes. A survey of the methods of observational measurements and the reduction of data. Three one-hour lectures and two four-hour laboratories per week.

Fall and Spring, 4 credits each semester

ESS 553 Stellar Interiors and Stellar Evolution

Physics of stellar interiors; equation of state, nuclear reactions, stellar opacity sources, mechanism of energy transfer; discussion of recent work on stellar evolution.

Fall, 3 credits

ESS 554 Physics of Stellar Atmospheres

Transfer of energy in stellar atmospheres; the thermodynamics of stellar atmospheres; mechanisms of line formation; determination of stellar temperatures, gravities, and chemical compositions.

Spring, 3 credits

ESS 556 Cosmology

Introduction to the study of the universe at large. The observational evidence for the expansion, the distance scale and the time scale of creation for the universe. Development of the theories of special and general relativity and discussion of the observational and experimental tests of Einstein's theory of gravitation. Comparison of Newtonian and relativistic cosmologies, the "big-bang" and steady-state theories. The problem of the formation of galaxies, the distance scale for quasars, the curvature of space, and the 3°K thermal radiation.

Spring, 3 credits

ESS 563 Sediments and Sedimentary Processes

A study of sedimentary processes and products. Marine environments (platform, continental shelf, deep ocean) terrestrial environments (fluvial), and transitional environments (deltaic) will be examined in terms of sediment production and provenance, transport, deposition and structures produced. Identification and understanding of sediment grain properties and of sedimentary structures will be emphasized. Field trips will examine recent and ancient depositional settings. Three one-hour lectures and one three-hour laboratory per week.

Fall, 4 credits

ESS 564 Marine Geology

Intensive study of modern theories of the ocean basins, their morphology, origin, and evolution. Topics included are a quantitative discussion of waves and tidal currents and their effect on beaches and coastal features. Geophysical studies of continental margins, ocean basins, and oceanic rises; survey of sediments and sediment transport in the coastal and deep ocean areas; sea floor spreading and continental drift. Three one-hour lectures and one three-hour laboratory per week.

Fall, 3 credits, alternate years. Not offered 1971-72.

ESS 581 Astrophysical Processes I

Introduction to transport processes of astrophysical importance; the conditions of thermal equilibrium for gases and radiation; the kinetic theory of gases and the theory of radiative transfer. Discussion of diffusion, convection, turbulence, and waves in neutral and ionized gases. Theory of thermal and nonthermal emission of electromagnetic radiation. Application of the theory to a variety of astronomical problems. Three one-hour lectures per week.

Fall, 3 credits

ESS 582 Astrophysical Processes II

Introduction to high-energy processes occurring in the interstellar medium and stellar interiors. The origin of cosmic rays, the mechanism of synchrotron radiation, thermonuclear reactions, and neutrino processes. Application to the study of highly evolved stars, supernovae remnants, radio galaxies and quasars. Two one and one-half hour lectures per week.

Spring, 3 credits

ESS 583 Physics of the Interstellar Medium

A study of processes in statistical equilibrium applied to the determination of the excitation, ionization, and heating of the interstellar medium and the outer layers of the sun. Spectroscopy, recombination theory, and gas dynamics will be discussed. The scattering and polarization properties of interstellar grains and the problem of their origin and composition. Three one-hour lectures per week.

Spring, 3 credits, alternate years. Not offered 1971-72.

ESS 584 Galactic Structure

Introduction to the kinematics and dynamics of the interstellar medium and of stellar systems. The interaction between stars and the

interstellar medium; the problems of star formation, mass ejection, radiative ionization and interstellar turbulence. The coupling of the interstellar medium with magnetic fields. Galactic rotation and the large-scale structure of our own galaxy as deduced from radio surveys of the emission and absorption of the 21 cm. hydrogen line. The dynamics of star clusters and galaxies. Application to the study of the distribution of stars in velocities and in space and to the study of the large-scale structure of regular galaxies.

Spring, 3 credits, alternate years. Offered 1971-72.

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 Topic in Astronomy-Astrophysics

ESS 602 Topics in Environmental Sciences

ESS 603 Topics in Petrology

ESS 604 Topics in Geo-Cosmochemistry

ESS 605 Topics in Sedimentary Geology-Paleontology

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

PHYSICS

Professors: ARIMA, BALAZS, [c]G. BROWN, [b]CHIU, [ac]COURANT, [c]DRESDEN, EISENBUD, FEINGOLD (*Director of Graduate Program*), FINOCCHIARO, D. FOX, [c]M. GOLDHABER (*Adjunct*), M. GOOD, LAMBE, [c]B. LEE, L. LEE JR., MUETHER, NATHANS, POND, SILSBEE, STRASSENBURG, SWARTZ, TOLL, [c]WEISBERGER, WILCOX, [d]C. N. YANG (*Einstein Professor*)

Associate Professors: O. AMES (*Chairman*), BLIEDEN, DEZAFRA, FOSSAN, [c]FREEDMAN, GRANNIS, A. JACKSON, KAHN (*Director of Undergraduate Program*), KAO, KIRZ, KUO, LEE-FRANZINI, MOULD, PAUL, STROM

Assistant Professors: J. COLE, FOSTER, [c]A. GOLDHABER, GRAF, [c]HWA, [c]MCCOY, MCGRATH, [c]NIEH, PALDY, [c]J. SMITH, SPROUSE, [c]J. WANG

[a] Physicist, Brookhaven National Laboratory, on part-time appointment at Stony Brook.
[b] Member, NASA Goddard, on part-time appointment at Stony Brook.
[c] Member, Institute for Theoretical Physics.
[d] Director of Institute for Theoretical Physics.

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 entrance, the student will be informed of the requirements he must satisfy for the termination of the provisional status.

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 courses approved by the advisor.

B. Satisfactory performance in a program of studies approved by the Graduate Committee. Normally, such a program would consist of six semester courses at the 500 level, including Classical Physics I, II, and Quantum Mechanics I, II.

C. Passing of the Master's 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.

A. Physics prerequisite: Students entering the program will be required to exhibit a proficiency in physics equivalent to that attained by

successful completion of the University's general degree program in physics (see the *Undergraduate Bulletin* for details). This proficiency will be demonstrated by satisfactory performance on a placement examination. Students who do not perform satisfactorily on this examination may be required to take additional courses before being permitted to enroll for physics courses which will be credited toward the degree.

B. 30 Credit-Hour Program
   1. Nine credit hours of physics selected from among:
      PHY 203 Optics
      PHY 205 Mechanics
      PHY 206 Kinetic Theory
      PHY 208 Quantum Physics
      300 series physics courses
      500 series physics courses
   2. Three credit hours of PHY 239 Methods of Teaching Physics.
   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 (1 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 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, or education 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. Demonstration of proficiency in one language (French, German, or Russian).

C. A grade of A or B in each of the following courses: Classical Physics I, II, Quantum Mechanics I, II, Statistical Mechanics. This requirement may be satisfied in any of the above three areas by satisfactory performance in a basic examination in the area in lieu of taking the specific courses. A student who does not receive an A or B in a course or related basic examination may, with permission, take the related basic examination the next time it is given.

D. Passing of the Preliminary Examination: A student who begins graduate study at Stony Brook with neither advanced standing nor deficiencies will normally take this examination in September, at the beginning of his third year. The examination consists of a written and an oral part. In the written part, each student is examined in two areas of his choice. At present the list of areas includes: elementary particle physics, nuclear physics, solid state physics, statistical mechanics, astrophysics and chemical physics. In special cases, a student may be given permission to choose an alternate area. The oral examination will consist of a student presentation (approximately 20 minutes) of a review of some topic of current research. In addition, the oral examination will include a discussion session on questions suggested by the presentation and possibly those of a more general nature. The oral examination is to be taken within four weeks of the written examination.

E. 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 requirements B, C, and D above.

F. Teaching experience at least equivalent to that obtained in a one-year appointment as a teaching assistant.

G. 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 of both chemistry and physics. A graduate student in either

the Chemistry or the Physics Department may, with the consent of his chairman, elect to participate in the program. A physics student may enter the program if he wishes to have a more extensive exposure to chemical systems than is normally obtained in physics departments. 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; details are included in the following sections.

ADMISSION TO THE PROGRAM

A graduate student who has been admitted to the Department of Physics may seek the consent of the chairman to enter the chemical physics course program. The student should have a background in chemistry in the areas appropriate to his interest. The student who does not have such a background may be advised to take certain undergraduate chemistry courses (such as CHE 201,2, 255,6, 305) before entering the program.

COURSES

Since the preliminary examination for students in the program will contain an advanced option in chemical physics, the student will normally be advised to take one or more appropriate courses in chemistry, such as CHE 511, 523, 528, 529, 603, 623, 624, 625.

PRELIMINARY EXAMINATIONS

The student will take the physics examinations, as required of all physics students. One of the two areas of the written examination will be chemical physics; the original proposition must also be on a topic in this area.

RESEARCH

A research advisor will be selected after the student has been admitted to candidacy for the Ph.D. The selection of this advisor may be made in the Department of Chemistry, subject to the approval of the department chairmen.

Courses

PHY 501, 502 Classical Physics I, II

Classical mechanics (not more than one-half semester): Lagrangian and Hamiltonian formulations, variational principles, Hamilton-Jacobi theory, mechanics of fields. Electromagnetism: special relativity, fields and radiation due to charged particles with prescribed motion, motion of charged particles in prescribed fields, electric and magnetic properties of materials, spin resonance, superconductivity, plasmas, radiation by charge distributions, scattering of electromagnetic waves.

3 credits each semester

PHY 503, 504 Methods of Mathematical Physics I, II

A selection of mathematical techniques useful for physicists. Types will be selected from the following: linear vector forces, matrices, Green's functions, complex analysis, differential equations, special functions, boundary value problems, integral transforms, integral equations, probability. This course is identical to PHY 343, 344 and should be taken only by entering graduate students who have a deficiency in this area.

3 credits each semester

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 exposure to physical foundations of quantum mechanics.

3 credits each semester

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 553 Astrophysics I, Stellar Interiors

Introduction to the study of stellar interiors. hydrostatic equilibrium. Analytical solutions (polytropics), stellar energy sources and stellar gravity sources. Main sequence stars, stellar evolution red giants, white dwarfs, pulsating stars, subnova and element synthesis.

3 credits

PHY 554 Astrophysics II, Stellar Atmospheres

Theory of radiative transfer. Continuous spectrum of stars; the formation of lines; characteristics of absorption and emission lines; theory of line broadening; principles in the analysis of stellar spectra and determination of the abundance of the elements. Introduction to nucleosynthesis theory.

3 credits

PHY 555 Solid State Physics I

Crystal structure symmetry and space groups, ionic crystals, lattice vibrations, band theory of metals and semiconductors, transport phenomena, imperfections, magnetic and dielectric phenomena, low temperature properties of solids.

3 credits

PHY 556 Solid State Physics II

Transport properties of solids; electron-proton and electron-electron interactions; optical, spectroscopic and photoelectric properties; dielectric and magnetic properties; superconductivity.

3 credits

PHY 557 Elementary Particle Physics I

Introduction to elementary particle characteristics and phenomena, symmetry and invariance principles, partial wave analysis and resonance phenomena, models for strong interaction, weak interactions, accelerator and detector development.

3 credits

PHY 558 Elementary Particle Physics II

Fundamental particle semantics, weak and strong interactions, high energy phenomena.

3 credits

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 credit

PHY 585 Special Study

Reading course in selected topics.

Each semester, variable and repetitive credit

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 1971-72 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

THE SOCIAL SCIENCES

ANTHROPOLOGY
ECONOMICS
HISTORY

ANTHROPOLOGY

Professors: ARMILLAS, P. BROWN, CARRASCO, FARON (*Chairman*)
Associate Professor: STEVENSON
Assistant Professors: ARENS, HICKS, REGELSON, STARR, WEIGAND, WHEELER

Admission to Graduate Study

Applications for admission to graduate study in anthropology must be accompanied by an official transcript of undergraduate record and letters of recommendation from three previous instructors. The results of the Graduate Record Examination, though not mandatory, are desirable to help in the selection process for admission.

Additional Requirements for Admission

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 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.

With the approval of the Dean of the Graduate School and the Department of Anthropology, a student holding the M.A. degree from another accredited university may be admitted to the graduate program with advanced standing.

Requirements and Procedures for the Ph.D. in Social Anthropology

The anthropology program is designed to accomplish three aims:

1. To give the student a general knowledge of the subject matter through work in the major fields of social anthropology;
2. To acquaint the student with some of the specialized methods and problems of social anthropology through intensive independent work;
3. To equip the student for doing his or her own creative work in social anthropology.

A number of basic requirements are necessary to achieve these aims.

Departmental Requirements

Requirements are subject to review and revision. Students are bound by the rules and requirements under which they enter. A student must:

A. Achieve competence in the general theory of social and cultural anthropology and complete satisfactorily ANT 501, 502.

B. Acquire a general knowledge of world ethnography and a detailed knowledge of the ethnography of at least two areas of the world, such as Middle America and sub-Saharan Africa.

C. Achieve competence in at least two topical, theoretical fields, such as comparative religious systems, comparative political systems, or peasant cultures and societies.

D. Acquire a working knowledge of descriptive linguistics.

E. Demonstrate reading proficiency in the language or languages necessary for the fields of specialization as determined by the department.

F. Demonstrate the ability to use library materials in largely independent research.

G. Demonstrate an understanding of the use of quantitative methods in social sciences.

H. Pass a Qualifying Examination after the first two semesters of residence. Pass the written and oral Preliminary Examination before being permitted to do fieldwork under the sponsorhip of the department.

I. Complete a period of fieldwork.

J. Submit an acceptable dissertation within a period of five years after residence requirements (including the period of fieldwork) are completed.

Minimum residence: Four semesters of full-time study beyond the baccalaureate including at least two consecutive semesters.

Courses

All courses in the 500 range will be conducted as reading seminars and presuppose an undergraduate background in the subject matter. Students not having such background will be advised how they may correct the deficiency.

All courses in the 600 range will be conducted as guided independent research and presuppose a full year of advanced study.

ANT 501, 502 Core Seminar 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

A survey of the political and economic problems faced by undeveloped peoples as they become modern nations, and a 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 506 Problems in African Ethnology

Research and intensive examination of select problems in African ethnology of both current and enduring interest. Students will present the results of their own directed research on aspects of these problems in the form of oral reports in seminar and term papers. Specific problem areas for consideration will vary from year to year and will be announced at the beginning of the term.

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 513 China: The Social and Cultural Background

The development of Chinese culture from prehistoric times through the present is analyzed from the standpoint of anthropological theories of cultural evolution, diffusion, functionalism, and human ecology. Special attention is directed to critical formative and transitional periods. Distribution of physical types, languages, and ethnicities both within and without the Chinese development generated by sister disciplines are discussed with a sympathetic but critical point of view.

3 credits

ANT 515 Social Structure in Lowland South America

Modes of social and symbolic classification in selected tribal societies of lowland South America with particular reference to the Ge speaking peoples of Brazil. Varying theoretical interpretations of particular social structures will be discussed and evaluated within an ethnographic framework.

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 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 553 Political Anthropology

Description and analysis of political institutions among the simpler societes. 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. Political development in contemporary societies will also be considered.

3 credits

ANT 560 Readings in Descriptive Linguistics

Description and historical study of language; linguistic analysis; linguistic structures; language classification; language families of the world; language in its social and cultural setting.

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 Southeast Asia.

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

ECONOMICS

Professors: E. AMES (*Chairman*), HOFFMANN, LEKACHMAN, NEUBERGER, STEKLER
Associate Professors: JAMES, KALMAN, KANOVSKY, KRISTEIN, STALEY, VAN ROY, ZSCHOCK
Assistant Professors: DAWES, DUSANSKY, L. MILLER, NIENHAUS, NORDELL, SAKBANI, SATTINGER, SCHOEPFLE, WICHERS, ZWEIG

Admission to Graduate Study

For admission to graduate study in economics, 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 graduate 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 adequate training in mathematics prior to entry into the graduate economics program, 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 encourged; 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 departmental 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.

Requirements for the M.A. Degree

The graduate program in economics is basically a Ph.D. program, and students admitted to the program are expected to have the aptitude for and intention of obtaining the Ph.D. degree. For students who for various reasons must terminate their enrollment before obtaining the Ph.D., the M.A. will be awarded under the following conditions:

1. Twenty-four hours of resident graduate enrollment exclusive of Teaching Practicum or its equivalent.
2. Performance in class work satisfactory to a committee composed of their graduate professors.

3. Not more than three years time since first registration as a graduate student.

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.

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 503 Axiomatic Theory of Value

The axioms of consumer choice theory and production theory. Competitive equilibrium. Existence, uniqueness, optimality and stability of solutions to microeconomic models. Qualitative economics and dynamic systems.

3 credits

ECO 504 Operations Research and Economic Theory

Programming and decision rules viewed from the point of view of economic choice. Activity analysis in production and investment. Optimal allocation in a Leontief system. The emphasis in this course is on the application of operations research models to economic analysis.

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 506 Welfare Economics

Examination of the theory and methodology of modern welfare economics and its implications for applied analysis and public policy. Alternative proofs of the Pareto-optimality of competitive equilibrium; detailed consideration of the causes of market failure, including externalities; efficiency and equity under government planning; problems in the measurement of social welfare; intertemporal resource allocation and welfare maximization through time.

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 512 Monetary Theory

The development of monetary theory, including the quantity theory, liquidity preference, and assets approaches to money; empirical studies; and the development of monetary policy.

3 credits

ECO 513 Economic Forecasting

Analysis of topics in economic forecasting; applications of macroeconomic theory with emphasis on econometric approaches. A consideration of judgmental techniques and nonquantitative methods useful in predicting turning points and the level of aggregate economic activity.

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 529 Studies in Quantitative Methods

Variable and repetitive credit

ECO 530 Public Finance

Topics in the theory of public expenditure, taxation, and fiscal policy, such as effects of alternative tax and subsidy techniques on allocation, exchange, and welfare; theories of public goods—their production, exchange, and consumption; principles of cost-benefit analysis for governmental decisions; measurement of benefits and costs; theories and measurement of tax incidence; optimal tax policy and economic growth.

3 credits

ECO 531 Seminar in Public Finance

In-depth study of selected issues in public finance introduced in ECO 530, with emphasis on theoretical and econometric analysis. Students, individually or jointly, will undertake independent research projects.
Prerequisites: ECO 530 or the equivalent; ECO 521 or the equivalent (can be taken concurrently).

Spring, 3 credits

ECO 532 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 540 Economics of Education

Intensive analysis of the economic aspects of education; the use of mathematical models (e.g., linear and dynamic programming and activity analysis) to study the internal behavior of the educational system. Quality problems and educational performance of institutions and individuals. Intergenerational effects and education; education and future earnings. Analysis of alternate educational technologies. Institutional behavior and optimization. Externalities. Societal optimization under various assumptions about societal goals.

3 credits

ECO 541 Economics of Medicine

This course will consider the goals of a national health system and how these goals are met in the United States and elsewhere. Economic analysis will be used to investigate shortcomings and to suggest improvements, for example, in such areas as manpower shortages, administration and institutions, and appropriate forms of insurance. The course will outline areas where research is needed and give some idea of how that research might be accomplished.

3 credits

ECO 542 Urban Economics

3 credits

ECO 543 Law and Economics

The American system of law as it influences the allocation of resources, the pricing system and the distribution of income and wealth. Case studies, such as liabilities of oil companies for damage to beaches and real estate values, manufacturers' responsibilities for injuries to persons and property, and tax law, will be employed.

3 credits

ECO 544 Legal Aspects of Poverty

The relations among legislation, common law, and the distribution of income and wealth. Topics include: the protection of the law to small debtors and poor tenants, welfare legislation, laws of local government and the fiscal situation of large cities, legal remedies for housing segregation.

3 credits

ECO 549 Studies in Human Resources

Repetitive and variable credit

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 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

Economic interests and the determination of governmental economic policy; motivation and impact of specific governmental programs, and general theories of the state.

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 nonlinear 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 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 599 Research in Special Topics

Variable and repetitive credit

ECO 600 Advanced Microeconomic Theory I

The following topics will be developed in detail: preference structure on commodity spaces, choice functions, production sets, optimization, states of the economy, existence of competitive equilibrium, Pareto-optimality.
Prerequisites: ECO 501 and ECO 591, or the equivalent.

Fall, 3 credits

ECO 601 Advanced Microeconomic Theory II
The following topics will be developed in detail: static and dynamic stability theory, global stability, cooperative and non-cooperative n-person games, the core of an economy, Edgeworth market games, games with a continuum of players.
Prerequisite: ECO 600 or the equivalent.

Spring, 3 credits

ECO 693 Interdisciplinary Seminar on Mathematics in the Social Sciences

Invited speakers and discussion on the formulation, testing, and interrelations of various mathematical models.

2 credits, repetitive. Students enrolled in this seminar must concurrently enroll in ECO 599 for 1 credit.

ECO 698 Practicum in Teaching

Variable and repetitive credit

ECO 699 Thesis Research

Variable and repetitive credit

HISTORY

Professors: Angress, Chinchilla Aguilar, Lampard, Main, Semmel, Taylor, Trask (*Chairman*)
Associate Professors: Alin, Bottigheimer, Burner, Cleland, Kuisel, Lebovics, Lee, Pratt, [a]Rosenthal, Weinstein, Weltsch, Wildman, Williams
Assistant Professors: Cowan, Hamnett, Knight, Lam, R. M. Levine, Marcus, McCarthy, Rapp
Lecturer: Kavenagh

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.

[a] Not in residence academic year 1971-72.

C. Results of the Graduate Record Examination, though not mandatory, are desirable to help in the selection process for admission. Applicants are strongly urged to submit them.

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

Proficiency in at least one foreign language must be demonstrated before a candidate may be examined for any higher degree in history.

Ph.D. candidates are expected to be able to use whatever languages are necessary for significant research in the major field. The student and his advisor will decide what those additional languages are, with the approval of the Graduate Program Committee. Samples: Latin Americanists—usually both Spanish and Portuguese, and in some cases, French and/or German; Europeanists—the language of the country of study, plus French and/or German.

Those preparing for Ph.D. candidacy are expected, in addition, to demonstrate proficiency in a foreign language in course work, in either the major or a minor field. Before admission to a course in which a foreign language will be used, the student must satisfy the instructor by examination or otherwise that he or she is ready to do so.

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 3 units per semester of degree credit. Their teaching will be supervised and evaluated by the instructor in charge of the course in which they assist, who will submit a teaching report on each assistant's work.

Normally teaching assistants will perform research functions in their first year of graduate study, teach in their second and third, and assist with research

again when they reach the dissertation level. This sequence of functions is an intended pattern which will not fit every individual instance.

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 M.A. in history is awarded upon satisfactory completion of at least two semesters of advanced course work and upon demonstration in an oral examination of competence in a field of history. No masters thesis is required.

Advising

Upon registration, M.A. candidates shall be assigned advisors in their anticipated area of study (e.g., U.S., Europe, Latin America). The students shall work out with their advisors fields of examination, and schedules of appropriate courses.

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 be assumed by the examiners.

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 Russian 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 24 units of appropriate course work before taking the examination. These courses shall normally include:

1. One reading colloquium/research seminar sequence 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, advanced undergraduate courses and individual directed readings.
   Normally a candidate will take no more than 9 units of directed readings in preparing for the M.A.

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 a one-hour oral examination.

Time Schedule

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 Program Committee.

Doctor of Philosophy Degree

The Ph.D. is the highest professional degree in history. Students are advanced to Ph.D. candidacy by passing the Qualifying Examination, both written and oral, in which they demonstrate a command of a major field and two minor fields. After advancement to candidacy, students must demonstrate capacity for significant original work in history by preparing and defending a doctoral dissertation.

Advising

Students proceeding beyond the M.A. shall choose an advisor in their anticipated major area of study (e.g., Europe: intellectual).

With an advisor, each student shall work out a major field and two minor fields. A statement of these fields shall be submitted to the Graduate Program Committee for review. This process shall be completed by the first registration after the student has embarked on Ph.D. work. Once approved, the statement of fields shall govern the scope of the student's Qualifying Examination and preparation for it.

Guidelines for Fields

A field shall be a coherent and substantial area of historical study, not necessarily a traditional political or chronological unit, for which a significant literature exists and within which significant historical issues are explicable.

The *major field* shall enclose the student's expected research interest.

The two *minor fields* shall be chosen for the suggestiveness of the comparisons they evoke with the major field, or for preparation to teach. Except in cases of regional overspecialization, one minor field may be taken in a related discipline (economics, sociology, literature, etc.).

As of 1970-71, the Department of History offers major fields in which doctoral dissertations may be written in Modern Europe, United States, Latin America, and Expansion of Europe.

Course Work

Although the Ph.D. is not acquired by an accumulation of courses, some formal course work is required in each field.

Major field: Two seminars, preferably a reading colloquium/research seminar sequence, beyond M.A. work. At this point, the student will normally begin to focus upon an anticipated dissertation area.

Minor fields: Normally at least one formal course (preferably a reading colloquium) in each field. Under special circumstances and with the approval of the Graduate Program Committee, M.A. work may be counted. A field in a related discipline will normally entail some formal course work.

Qualifying Examination

The two *minor fields* will be examined first, in writing. An examining committee of three persons is named for each field by the Dean of the Graduate School. Fields in related disciplines shall also be examined in writing, with at least one member of the History Department among the examiners.

The *major field* is examined orally. The oral examination committee is named by the Dean of the Graduate School. It shall include one examiner from outside the department as well as appropriate major field examiners.

Normally the written and oral parts of the Qualifying Examination may be retaken once, after a suitable elapse of time decided upon by the student and his advisor, subject to the approval of the Graduate Program Committee. If one minor field written examination is failed and the other received a grade of "Weak Pass," both minor field written examinations must be retaken.

Time Schedule

The Qualifying Examination may be taken at any time after the second semester beyond the M.A. It must be taken no later than four semesters after Ph.D. work has begun.

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 an advisor appointed by the departmental chairman. The student will select a dissertation topic from the sphere of special emphasis within the major field. At present, the department can offer dissertation fields only in United States, Modern European, Latin American history, and Expansion of Europe. The department anticipates adding Early Modern and Medieval Europe as dissertation fields as soon as additional faculty appointments in these fields are made.

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 #6 of the Graduate School Regulations.

Courses

To prepare students for examinations and research work in both major and minor fields, the Department of History offers the following six kinds of graduate courses. The department attempts to maintain a balanced offering in each major field every year. Students wishing to know the exact course offering for 1971-72 should request this information from the Department of History.

Research Seminars

The research seminar is the foundation of a graduate student's advanced training in history. It introduces the special problems and research methods in a

field. The instructor and the students define a problem, examine the historical literature and then undertake original or methodologically useful research on different aspects of the topic. The usual expectation is the student's writing a creditable article-length paper based on primary sources. These courses are numbered in the 600's.

Reading Colloquia

The reading colloquia support the work of research and prepare students for their general oral and written examinations. Here the prime concern is the mastery of the important secondary literature on a topic within a field. The normal requirement is a series of short papers or reports and an article-length bibliographical essay surveying a topic. These courses are numbered in the 500's.

Directed Reading

These courses are intended to allow students to close gaps in their knowledge, usually in preparing for their Ph.D. Qualifying Examinations, or to allow some exploration of a topic on which no regular course is offered. These courses are offered by permission of the instructor and can be taken for variable numbers of credits. The specific requirements are settled between students and instructors. Normally, a bibliographical essay comparable to that prepared for a reading colloquium is required. This paper, with letter grade and evaluation by the instructor, is placed in the student's graduate record file.

Research

HIS 699 may be taken for variable credit by students past their examinations who are writing their doctoral dissertations.

Undergraduate Courses

Upper division undergraduate courses, especially senior colloquia, may be taken by graduate students to fill gaps in their programs. These are often suitable alternatives to directed readings. Students should consult their advisors about the suitability of any individual undergraduate course.

Special Courses

A number of these are offered by the department or in conjunction with other departments to meet the needs of graduate students. Examples are: HIS 581 Supervised Teaching; GER 115 German for Historical Researchers; FRE 100 Reading Course in French, etc.

In addition, graduate students may take courses in other departments which have graduate programs. Students should consult their advisors as to the availability and suitability of such courses.

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 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 Reading for Ph.D. Candidates

Variable and repetitive credit

HIS 699 Research for Ph.D. Candidates

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LESTER G. FEHMI
Assistant Professor of Psychology
Ph.D., University of California at Los Angeles

ARNOLD M. FEINGOLD
Professor of Physics and Director, Physics Graduate Program
Ph.D., Princeton University

KENNETH A. FELDMAN
Associate Professor of Sociology
Ph.D., University of Michigan

EDWARD FIESS
Associate Professor of English
Ph.D., Yale University

AARON FINERMAN
Professor of Engineering
Sc.D., Massachusetts Institute of Technology

GUIDO FINOCCHIARO
Professor of Physics
Ph.D., Catania University, Italy

GEORGE G. FOGG
Lecturer in Biological Sciences
Ph.D., University of Oklahoma

DIANE FORTUNA
Assistant Professor of English
Ph.D., Johns Hopkins University

DAVID B. FOSSAN
Associate Professor of Physics
Ph.D., University of Wisconsin

MARGARET C. FOSTER
Assistant Professor of Physics
Ph.D., University of Wisconsin

FRANK W. FOWLER
Assistant Professor of Chemistry
Ph.D., University of Colorado

JAMES A. FOWLER
Assistant Professor of Biological Sciences and Assistant Dean, College of Arts and Sciences
Ph.D., Columbia University

DAVID FOX
Professor of Physics
Ph.D., University of California, Berkeley

WILLIAM C. FOX
Associate Professor of Mathematics
Ph.D., University of Michigan

DAVID FRANK
Assistant Professor of Mathematics
Ph.D., University of California, Berkeley

DANIEL Z. FREEDMAN
Associate Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., University of Wisconsin

MARTIN FREUNDLICH
Associate Professor of Biological Sciences
Ph.D.,University of Minnesota

MICHAEL FRIED
Associate Professor of Mathematics
Ph.D., University of Michigan

HAROLD FRIEDMAN
Professor of Chemistry
Ph.D., University of Chicago

RONALD FRIEND
Assistant Professor of Psychology
Ph.D., University of Toronto

RALPH FROELICH
Performing Artist in Residence
B.S., Juilliard School of Music

DONALD K. FRY
Associate Professor of English
Ph.D., University of California, Berkeley

SARAH FULLER
Assistant Professor of Music
Ph.D., University of California, Berkeley

DOUGLAS J. FUTUYMA
Assistant Professor of Biological Sciences
Ph.D., University of Michigan

JOHN GAGNON
Professor of Sociology
Ph.D., University of Chicago

JOHN GARCIA
Professor of Psychology
Ph.D., University of California, Berkeley

WILLIAM L. GEBEL
Assistant Professor of Astronomy
Ph.D. University of Wisconsin

CONRAD D. GEBELEIN
Assistant Professor of Sedimentology
Ph.D., Brown University

JAMES H. GEER
Associate Professor of Psychology
Ph.D., University of Pittsburgh

HERBERT L. GELERNTER
Professor of Engineering and Computing Center Associate
Ph.D., University of Rochester

IRVING GERST
Professor and Chairman, Department of Applied Mathematics and Statistics
Ph.D., Columbia University

RAYMOND F. GESTELAND
Assistant Professor of Biological Sciences (Joint Appointment with Cold Spring Harbor Laboratory for Quantitative Biology)
Ph.D., Harvard University

[a]BENTLEY GLASS
Distinguished Professor of Biological Sciences and Academic Vice President
Ph.D., University of Texas; Sc.D., Washington College, Western Reserve University; LL.D., Baylor University

DAVID GLAZER
Performing Artist in Residence
B.Ed., University of Wisconsin, Milwaukee

HOMER B. GOLDBERG
Professor of English
Ph.D., University of Chicago

THEODORE D. GOLDFARB
Associate Professor of Chemistry
Ph.D., University of California, Berkeley

MARVIN R. GOLDFRIED
Associate Professor of Psychology
Ph.D., State University of New York at Buffalo

ALFRED S. GOLDHABER
Assistant Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., Princeton University

MAURICE GOLDHABER
Adjunct Professor of Physics
Ph.D., Cambridge University

MYRON L. GOOD
Professor of Physics
Ph.D., Duke University

ERICH GOODE
Associate Professor of Sociology
Ph.D., Columbia University

NORMAN GOODMAN
Associate Professor of Sociology
Ph.D., New York University

ERLEND H. GRAF
Assistant Professor of Physics
Ph.D., Cornell University

PAUL D. GRANNIS
Associate Professor of Physics
Ph.D., University of California, Berkeley

DENNIS H. GREEN
Professor of German
Ph.D., University of Basel

BERNARD GREENHOUSE
Performing Artist in Residence
Diploma, Juilliard Graduate School

DETLEF GROMOLL
Professor of Mathematics
Ph.D., University of Bonn, Germany

M. GRANT GROSS
Professor of Oceanography
Ph.D., California Institute of Technology

[c]OSCAR A. HAAC
Professor of French
Ph.D., Yale University; Doctorat, University of Paris

ALBERT HAIM
Professor of Chemistry
Ph.D., University of Southern California

BEATRICE L. HALL
Assistant Professor of English
Ph.D., New York University

JOHN W. HALPERIN
Assistant Professor of English
Ph.D., Johns Hopkins University

MICHAEL HAMBURGER
Professor of German
M.A., Oxford University

BRIAN R. HAMNETT
Assistant Professor of History
Ph.D., University of Cambridge

DAVID HANSON
Assistant Professor of Chemistry
Ph.D., California Institute of Technology

GILBERT N. HANSON
Associate Professor of Geology
Ph.D., University of Minnesota

JOHANNES HARDORP
Associate Professor of Astronomy-Astrophysics
Ph.D., Hamburg University, Germany

STEWART M. HARRIS
Associate Professor of Engineering
Ph.D., Northwestern University

MICHAEL I. HARRISON
Assistant Professor of Sociology
M.A., University of Michigan

SHELLEY A. HARRISON
Assistant Professor of Engineering
Ph.D., Polytechnic Institute of Brooklyn

GEORGE J. HECHTEL
Assistant Professor of Biological Sciences
Ph.D., Yale University

JACK HELLER
Professor of Engineering
Ph.D., Polytechnic Institute of Brooklyn

JOHN W. HELTON
Assistant Professor of Mathematics
Ph.D., Stanford University

HERBERT HERMAN
Associate Professor of Engineering
Ph.D., Northwestern University

CLINTON HERRICK
Assistant Professor of Sociology
M.A., Emory University

DAVID HICKS
Assistant Professor of Anthropology
B. Litt., University of London

NOBORU HIROTA
Professor of Chemistry
Ph.D., Washington University

CHARLES HOFFMANN
Professor of Economics
Ph.D., Columbia University

SABINE HORL
Assistant Professor of German
Ph.D., University of Hamburg

ROGER HOWE
Assistant Professor of Mathematics
Ph.D., University of California, Berkeley

RONALD R. HOY
Assistant Professor of Biological Sciences
Ph.D., Stanford University

JAMES R. HUDSON
Assistant Professor of Sociology
Ph.D., University of Michigan

CLIFFORD C. HUFFMAN
Assistant Professor of English
Ph.D., Columbia University

RUDOLPH C. HWA
Assistant Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., in Physics, Brown University; Ph.D., University of Illinois

THOMAS F. IRVINE, JR.
Professor of Engineering and Dean, College of Engineering
Ph.D., University of Minnesota

JOSEPH JACH
Associate Professor of Engineering
Ph.D., Oxford University

ANDREW D. JACKSON, JR.
Associate Professor of Physics
Ph.D., Princeton University

ESTELLE JAMES
Associate Professor of Economics
Ph.D., Massachusetts Institute of Technology

RAYMOND JESAITIS
Assistant Professor of Chemistry
Ph.D., Cornell University

MARCIA K. JOHNSON
Assistant Professor of Psychology
Ph.D., University of California, Berkeley

PHILIP M. JOHNSON
Assistant Professor of Chemistry
Ph.D., Cornell University

FRANCO P. JONA
Professor of Engineering
Ph.D., Eidgenossische Technische Hochschule

RAYMOND F. JONES
Professor of Biological Sciences and Acting Provost, Division of Biological Sciences
Ph.D., Kings College, University of Durham (Newcastle Division), England

ROY D. JOSEPH
Assistant Professor of Applied Mathematics and Statistics
Ph.D., Case Institute of Technology

PETER B. KAHN
Associate Professor of Physics and Director of Physics Undergraduate Program
Ph.D., Northwestern University

GILBERT KALISH
Performing Artist in Residence
B.A., Columbia University

HARRY I. KALISH
Professor and Chairman, Department of Psychology
Ph.D., State University of Iowa

PETER J. KALMAN
Associate Professor of Economics
Ph.D., Purdue University

ELIYAHU KANOVSKY
Associate Professor of Economics
Ph.D., Columbia University

YI-HAN KAO
Associate Professor of Physics
Ph.D., Columbia University

SIMON KARASICK
Director of the University Band
B.Mus., Eastman School of Music

ROMAN KARST
Professor of German
Ll.M., Jagielonsky University, Poland

EUGENE KATZ
Assistant Professor of Biological Sciences
Ph.D., University of Cambridge

W. KEITH KAVENAGH
Lecturer in History
Ph.D., New York University

HERBERT L. KAYE
Associate Professor of Psychology
Ph.D., Brown University

ALFRED KAZIN
Distinguished Professor of English
Litt.D., Adelphi University

ROBERT C. KERBER
Assistant Professor of Chemistry
Ph.D., Purdue University

R. PETER KERNAGHAN
Assistant Professor of Biological Sciences
Ph.D., University of Connecticut

RICHARD KESTENBAUM
Assistant Professor of Psychology
Ph.D., New York University

RICHARD B. KIEBURTZ
Professor of Engineering
Ph.D., University of Washington

WOO JONG KIM
Associate Professor of Applied Mathematics and Statistics
Ph.D., Carnegie Institute of Technology; Ph.D., Carnegie-Mellon University

GARO KIREMIDJIAN
Research Instructor in Mathematics
Ph.D., Columbia University

JANOS KIRZ
Associate Professor of Physics
Ph.D., University of California, Berkeley

ROGER F. KNACKE
Assistant Professor of Astronomy
Ph.D., University of California, Berkeley

FRANKLIN W. C. KNIGHT
Assistant Professor of History
Ph.D., University of Wisconsin

RICHARD K. KOEHN
Assistant Professor of Biological Sciences
Ph.D., Arizona State University

LEE KOPPELMAN
Adjunct Professor, Marine Environmental Studies Program
M.S., Pratt Institute

EDWARD M. KOSOWER
Professor of Chemistry
Ph.D., University of California at Los Angeles

JAN KOTT
Professor of Comparative European Drama
Ph.D., Lodz University, Poland

IRWIN KRA
Associate Professor and Acting Chairman, Department of Mathematics
Ph.D., Columbia University

RICHARD A. KRAMER
Instructor in Music
M.F.A., Princeton University

THOMAS KRANIDAS
Professor of English
Ph.D., University of Washington

ALLEN KRANTZ
Assistant Professor of Chemistry
Ph.D., Yale University

[a]LEONARD KRASNER
Professor of Psychology and Director of Clinical Training
Ph.D., Columbia University

JACK KREISELMAN
Performing Artist in Residence
Manhattan School of Music; Pupil of Simeon Bellison and Simon Kovar

ABRAHAM D. KRIKORIAN
Assistant Professor of Biological Sciences
Ph.D., Cornell University

MARVIN KRISTEIN
Associate Professor of Economics
Ph.D., New School for Social Research

MICHIO KUGA
Professor of Mathematics
Ph.D., University of Tokyo

RICHARD F. KUISEL
Associate Professor of History
Ph.D., University of California, Berkeley

PAUL KUMPEL
Assistant Professor of Mathematics
Ph.D., Brown University

T. T. S. KUO
Associate Professor of Physics
Ph.D., University of Pittsburgh

GEORGE H. KWEI
Assistant Professor of Chemistry
Ph.D., University of California, Berkeley

G. NORMAN LAIDLAW
Professor of Romance Languages
Ph.D., Columbia University

TRUONG BUU LAM
Assistant Professor of History
Doctorat en Philosophie et Lettres, Histoire Moderne

EDWARD D. LAMBE
Professor of Physics and Director, Instructional Resources Center
Ph.D., Princeton University

ERIC E. LAMPARD
Professor of History
Ph.D., University of Wisconsin

KURT LANG
Professor of Sociology
Ph.D., University of Chicago

PAUL C. LAUTERBUR
Professor of Chemistry
Ph.D., University of Pittsburgh

DAVID LAWTON
Instructor in Music
B.A., University of California, Berkeley

BILLY JIM LAYTON
Professor and Chairman, Department of Music
Ph.D., Harvard University

HERMAN E. LEBOVICS
Associate Professor of History
Ph.D., Yale University

BENJAMIN W. LEE
Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., University of Pennsylvania

LINWOOD L. LEE, JR.
Professor of Physics and Director of the Nuclear Structure Laboratory
Ph.D., Yale University

RICHARD SHAO-LIN LEE
Professor of Engineering and Chairman, Department of Mechanics
Ph.D., Harvard University

ROBERT H. G. LEE
Associate Professor of History
Ph.D., Columbia University

JULIET LEE-FRANZINI
Associate Professor of Physics
Ph.D., Columbia University

MARTIN A. LEIBOWITZ
Associate Professor of Applied Mathematics and Statistics
Ph.D., Harvard University

BENJAMIN H. LEICHTLING
Assistant Professor of Biochemistry
Ph.D., Northwestern University

ROBERT LEKACHMAN
Professor of Economics
Ph.D., Columbia University

WILLIAM J. LE NOBLE
Professor of Chemistry
Ph.D., University of Chicago

JOHN LESSARD
Associate Professor of Music
Diploma, Ecole Normale, Longy School of Music

RICHARD L. LEVIN
Professor of English
Ph.D., University of Chicago

FREDRIC M. LEVINE
Assistant Professor of Psychology
Ph.D., Northwestern University

MARVIN LEVINE
Professor of Psychology
Ph.D., University of Wisconsin

RICHARD A. LEVINE
Associate Professor of English and Director, Graduate Studies in English
Ph.D., Indiana University

ROBERT M. LEVINE
Assistant Professor of History
Ph.D., Princeton University

SUMNER N. LEVINE
Professor of Engineering
Ph.D., University of Wisconsin

JEFFREY S. LEVINTON
Assistant Professor of Paleontology
Ph.D., Yale University

DAVID LEWIN
Associate Professor of Music
M.F.A., Princeton University

ROBERT M. LIEBERT
Associate Professor of Psychology
Ph.D., Stanford University

YEHUDY LINDEMAN
Assistant Professor of English
Ph.D., Harvard University

DONALD H. LINDSLEY
Professor of Petrology
Ph.D., Johns Hopkins University

WILLIAM G. LISTER
Professor of Mathematics
Ph.D., Yale University

DAVID A. LLOYD
Assistant Professor of Chemistry
Ph.D., University of California, Berkeley

JACK LUDWIG
Professor of English
Ph.D., University of California at Los Angeles

HARVARD LYMAN
Associate Professor of Biological Sciences
Ph.D., Brandeis University

JACKSON TURNER MAIN
Professor of History
Ph.D., University of Wisconsin

ROBERT D. MARCUS
Assistant Professor of History
Ph.D., Northwestern University

THOMAS E. MARESCA
Associate Professor of English
Ph.D., Johns Hopkins University

VELIO A. MARSOCCI
Professor of Engineering and Acting Chairman, Department of Electrical Sciences
Eng.Sc.D., New York University

JOHN MCCONNELL
Clinical Associate, Department of Psychology
Ph.D., University of Rochester

BARRY M. MCCOY
Assistant Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., Harvard University

ROBERT L. MCGRATH
Assistant Professor of Physics
Ph.D., University of Iowa

J. L. MCHUGH
Professor of Biological Sciences and Member of Marine Sciences Research Center
Ph.D., University of California

MICHAEL MERBAUM
Clinical Associate, Department of Psychology
Ph.D., University of North Carolina

SIDNEY MERLIS
Visiting Clinical Professor, Department of Psychology
M.D., Creighton Medical School

ROBERT W. MERRIAM
Associate Professor of Biological Sciences
Ph.D., University of Wisconsin

HAROLD J. METCALF
Assistant Professor of Physics
Ph.D., Brown University

WOLFGANG MEYER
Associate Professor of Mathematics
Ph.D., University of Bonn, Germany

H. CRANE MILLER
Professor of Marine Law
LJ B., University of Virginia

LEONARD S. MILLER
Assistant Professor of Economics
Ph.D., University of California, Berkeley

RUTH MILLER
Associate Professor of English
Ph.D., New York University

LEONARD R. MILLS
Associate Professor of French and Italian
Litt.D., University of Rome; Ph.D., Columbia University

CARL MOOS
Associate Professor of Biological Sciences
Ph.D., Columbia University

H. WILLIAM MORRISON
Associate Professor of Psychology and Associate in Instructional Resources
Ph.D., University of Michigan

SIMON C. MOSS
Associate Professor of Engineering
Ph.D., Massachusetts Institute of Technology

RICHARD A. MOULD
Associate Professor of Physics
Ph.D., Yale University

HERBERT R. MUETHER
Professor of Physics
Ph.D., Princeton University

STEVEN L. MUROV
Assistant Professor of Chemistry
Ph.D., University of Chicago

ROBERT NATHANS
Professor of Physics and Engineering, and Chairman, Department of Urban Science and Engineering
Ph.D., University of Pennsylvania

JOHN M. NEALE
Assistant Professor of Psychology
Ph.D., Vanderbilt University

GERALD B. NELSON
Assistant Professor of English
Ph.D., Columbia University

ISAAC NEMIROFF
Professor of Music
Cincinnati Conservatory of Music; Pupil of Stefan Wolpe

EGON NEUBERGER
Professor of Economics
Ph.D., Harvard University

PETER F. NEUMEYER
Associate Professor of English
Ph.D., University of California, Berkeley

PAUL A. NEWLIN
Assistant Professor of English
Ph.D., University of California at Los Angeles

H. T. NIEH
Assistant Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., Harvard University

DAVID M. NIENHAUS
Assistant Professor of Economics
Ph.D., Northwestern University

LAWRENCE P. NORDELL
Assistant Professor of Economics
Ph.D., University of California, Berkeley

EDWARD E. O'BRIEN
Professor of Engineering
Ph.D., Johns Hopkins University

YOSHI OKAYA
Professor of Chemistry
Ph.D., Osaka University

K. DANIEL O'LEARY
Associate Professor of Psychology
Ph.D., University of Illinois

DANIEL C. O'NEIL
Assistant Professor of German and Assistant Dean, College of Arts and Sciences
Ph.D., Cornell University

STANLEY J. OSHER
Associate Professor of Mathematics
Ph.D., New York University

TOBIAS C. OWEN
Associate Professor of Astronomy
Ph.D., University of Arizona

LESTER G. PALDY
Assistant Professor of Physics
M.S., Hofstra University

ALLISON R. PALMER
Professor of Paleontology
Ph.D., University of Minnesota

FRANCES H. PALMER
Professor of Psychology and Provost for Educational Research and Development
Ph.D., University of Pittsburgh

JAMES J. PAPIKE
Associate Professor of Crystallography
Ph.D., University of Minnesota

PETER PAUL
Associate Professor of Physics
Ph.D., University of Freiburg

JOSEPH PEQUIGNEY
Associate Professor of English
Ph.D., Harvard University

CHARLES PERROW
Professor of Sociology
Ph.D., University of California, Berkeley

DONALD S. PETREY
Assistant Professor of French
Ph.D., Yale University

ANTHONY V. PHILLIPS
Associate Professor of Mathematics
Ph.D., Princeton University

DAVID P. PHILLIPS
Assistant Professor of Sociology
Ph.D., Princeton University

JOEL D. PINCUS
Professor of Mathematics
Ph.D., New York University

NED POLSKY
Associate Professor of Sociology
B.A., University of Wisconsin

DAVID M. POMERANZ
Associate Professor of Psychology and Director of Psychological Services
Ph.D., University of Rochester

T. ALEXANDER POND
Professor of Physics and Executive Vice President
Ph.D., Princeton University

RICHARD N. PORTER
Professor of Chemistry
Ph.D., University of Illinois

JOHN W. PRATT
Associate Professor of History
Ph.D., Harvard University

CHARLES T. PREWITT
Associate Professor of Crystallography
Ph.D., Massachusetts Institute of Technology

HOWARD C. RACHLIN
Associate Professor of Psychology
Ph.D., Harvard University

STEPHEN RALLIS
Assistant Professor of Mathematics
Ph.D., Massachusetts Institute of Technology

FAUSTO RAMIREZ
Professor of Chemistry
Ph.D., University of Michigan

ELVIRA S. RAPAPORT
Professor of Mathematics
Ph.D., New York University

RICHARD T. RAPP
Assistant Professor of History
Ph.D., University of Pennsylvania

STEPHEN S. RAPPAPORT
Assistant Professor of Engineering
Ph.D., New York University

JONAH RASKIN
Assistant Professor of English
Ph.D., University of Manchester

BRIAN T. REGAN
Assistant Professor of German
Ph.D., New York University

STANLEY REGELSON
Assistant Professor of Anthropology
B.A., City College of New York

IRVING RIBNER
Professor of English
Ph.D., University of North Carolina

MONICA RILEY
Associate Professor of Biological Sciences
Ph.D., University of California, Berkeley

ANTHONY RIZZUTO
Assistant Professor of Romance Languages
Ph.D., Columbia University

HELEN RODNITE
Assistant Professor of History
Ph.D., Columbia University

THOMAS ROGERS
Associate Professor of English
Ph.D., University of Pennsylvania

F. JAMES ROHLF
Associate Professor of Biological Sciences
Ph.D., University of Kansas

JOSEPH ROITBERG
Assistant Professor of Mathematics
Ph.D., New York University

RONALD ROSEMAN
Performing Artist in Residence
B.A., Queens College

[b]CHARLES ROSEN
Professor of Music
Ph.D., Princeton University

[a]JOEL T. ROSENTHAL
Associate Professor of History
Ph.D., University of Chicago

ALAN O. ROSS
Professor of Psychology
Ph.D., Yale University

FERDINAND A. RUPLIN
Associate Professor of German and Associate for Instructional Resources in Computer Assisted Instruction
Ph.D., University of Minnesota

JOHN R. RUSSELL
Assistant Professor of German and Associate for Instructional Resources in Computer Assisted Instruction
Ph.D., Princeton University

CHIH-HAN SAH
Professor of Mathematics
Ph.D., Princeton University

MAHMOUD SAKBANI
Assistant Professor of Economics
Ph.D., New York University

HOWARD L. SANDERS
Adjunct Professor of Biological Sciences
Ph.D., Yale University

MICHAEL J. SATTINGER
Assistant Professor of Economics
Ph.D., Carnegie Mellon University

OLIVER A. SCHAEFFER
Professor of Geochemistry and Chairman, Department of Earth and Space Sciences
Ph.D., Harvard University

STEVEN SCHANUEL
Associate Professor of Mathematics
Ph.D., Columbia University

ROBERT F. SCHNEIDER
Associate Professor of Chemistry
Ph.D., Columbia University

GREGORY K. SCHOEPFLE
Assistant Professor of Economics
Ph.D., Purdue University

EARL G. SCHREIBER
Assistant Professor of English
Ph.D., University of Illinois

ROGER SCHVANEVELDT
Assistant Professor of Psychology
Ph.D., University of Wisconsin

MICHAEL SCHWARTZ
Assistant Professor of Sociology
Ph.D., Harvard University

STEPHEN E. SCHWARTZ
Assistant Professor of Chemistry
Ph.D., University of California, Berkeley

SALLIE SEARS
Associate Professor of English
Ph.D., Brandeis University

LESLIE SEIGLE
Professor of Engineering
D.Sc., Massachusetts Institute of Technology

HANAN C. SELVIN
Professor of Sociology
Ph.D., Columbia University

BERNARD SEMMEL
Professor of History
Ph.D., Columbia University

PETER SHAW
Assistant Professor of English
Ph.D., Columbia University

FRANK H. SHU
Associate Professor of Astronomy
Ph.D., Harvard University

RICHARD W. SIEGEL
Associate Professor of Engineering
Ph.D., University of Illinois

HENRY B. SILSBEE
Professor of Physics
Ph.D., Harvard University

MICHAL SIMON
Assistant Professor of Astrophysics
Ph.D., Cornell University

SANFORD R. SIMON
Assistant Professor of Biochemistry
Ph.D., Rockefeller University

JAMES SIMONS
Professor of Mathematics and Acting Director, Division of Mathematical Science
Ph.D., University of California, Berkeley

[a]LOUIS SIMPSON
Professor of English
Ph.D., Columbia University

MELVIN V. SIMPSON
Professor and Chairman of Biochemistry
Ph.D., University of California, Berkeley

JEROME E. SINGER
Professor of Psychology and Associate Dean of the Graduate School
Ph.D., University of Minnesota

LEIF SJÖBERG
Associate Professor of Germanic Languages and Scandinavian Studies
Ph.D., Uppsala University, Sweden

LAWRENCE B. SLOBODKIN
Professor of Biological Sciences and Chairman, Department of Ecology and Evolution
Ph.D., Yale University

DAVID R. SMITH
Associate Professor of Engineering
Ph.D., University of Wisconsin

GREGG SMITH
Director of Choral Music
M.A., University of California at Los Angeles

JOHN SMITH
Assistant Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., University of Edinburgh, Scotland

MARIUS C. SMITH
Assistant Professor of Psychology
Ph.D., Indiana University

ROBERT E. SMOLKER
Associate Professor of Biological Sciences
Ph.D., University of Chicago

ROBERT R. SOKAL
Professor of Biological Sciences
Ph.D., University of Chicago

CHARLES S. SPRINGER, JR.
Assistant Professor of Chemistry
Ph.D., Ohio State University

GENE D. SPROUSE
Assistant Professor of Physics
Ph.D., Stanford University

DONALD F. SQUIRES
Professor of Biological Sciences, Professor of Earth and Space Sciences, Director of Marine Sciences Research Center
Ph.D., Cornell University

RAM P. SRIVASTAV
Associate Professor of Applied Mathematics and Statistics
Ph.D., Lucknow University, India; Ph.D., University of Glasgow, Scotland

CHARLES E. STALEY
Associate Professor of Economics
Ph.D., Massachusetts Institute of Technology

JOHN S. STAMM
Professor of Psychology
Ph.D., University of Southern California

JUDAH L. STAMPFER
Professor of English
Ph.D., Harvard University

JUNE OETTINGER STARR
Assistant Professor of Anthropology
Ph.D., University of California, Berkeley

LARRY STARR
Instructor in Music
B.A., Queens College

HERMAN O. STEKLER
Professor of Economics
Ph.D., Massachusetts Institute of Technology

GEORGE R. STELL
Professor of Engineering
Ph.D., New York University

ELISABETH STENGEL
Assistant Professor of German
Ph.D., University of Vienna

ROLF STERNGLANZ
Assistant Professor of Biological Sciences
Ph.D., Harvard University

SARAH H. STERNGLANZ
Assistant Professor of Psychology
Ph.D., Stanford University

MARTIN STEVENS
Professor of English
Ph.D., Michigan State University

ROBERT F. STEVENSON
Associate Professor of Anthropology
Ph.D., Columbia University

EDWARD I. STIEFEL
Assistant Professor of Chemistry
Ph.D., Columbia University

ARNOLD A. STRASSENBURG
Professor of Physics
Ph.D., California Institute of Technology

DAVID STREET
Associate Professor of Sociology
Ph.D., University of Michigan

GEORGE W. STROKE
Professor of Engineering and Medical Biophysics
Dr. es Sc., University of Paris (Sorbonne), France

STEPHEN E. STROM
Associate Professor of Astronomy
Ph.D., Harvard University

BENGT STROMGREN
Adjunct Professor of Astronomy
Ph.D., Copenhagen University

SEI SUJISHI
Professor of Chemistry
Ph.D., Purdue University

GERALD SUTTLES
Associate Professor of Sociology
Ph.D., University of Illinois

CLIFFORD E. SWARTZ
Professor of Physics
Ph.D., University of Rochester

PETER SZUSZ
Professor of Mathematics
Ph.D., Budapest University

JUDITH M. TANUR
Lecturer in Sociology
M.A., Columbia University

JAMES TASI
Associate Professor of Engineering
Ph.D., Columbia University

WILLIAM R. TAYLOR
Professor of History
Ph.D., Harvard University

CHING-SUNG TENG
Assistant Professor of Biological Sciences
Ph.D., University of Texas

ORVILLE TERRY
Assistant Research Biologist
Ph.D., State University of New York at Stony Brook

REGINALD P. TEWARSON
Professor of Applied Mathematics and Statistics
Ph.D., Boston University

DEVIKUMARA V. THAMPURAN
Associate Professor of Applied Mathematics and Statistics
Ph.D., University of Wisconsin

GARY L. THOMAS
Associate Professor of Engineering
Ph.D., University of California, Berkeley

[a]JOHN A. THOMPSON
Professor of English
Ph.D., Columbia University

ROBB M. THOMSON
Professor of Engineering and Chairman, Department of Materials Science
Ph.D., Syracuse University

JOHN A. THORPE
Associate Professor of Mathematics
Ph.D., Columbia University

JOHN S. TOLL
Professor of Physics and President
Ph.D., Princeton University

DAVID F. TRASK
Professor and Chairman, Department of History
Ph.D., Harvard University

HANG-SHENG TUAN
Associate Professor of Engineering
Ph.D., Harvard University

GAYE TUCHMAN
Assistant Professor of Sociology
Ph.D., Brandeis University

BERNARD D. TUNIK
Associate Professor of Biological Sciences
Ph.D., Columbia University

JAMES R. TWEEDY
Assistant Professor of Psychology
Ph.D., Stanford University

DANIEL H. TYCKO
Professor of Engineering and Computing Center Associate
Ph.D., Columbia University

STUART VALINS
Associate Professor of Psychology
Ph.D., Columbia University

EDWARD VAN ROY
Associate Professor of Economics
Ph.D., University of Texas

PRASAD VARANASI
Assistant Professor of Engineering
Ph.D., University of California, San Diego

CHARLES WALCOTT
Associate Professor of Biological Sciences and Acting Chairman, Department of Cellular and Comparative Biology
Ph.D., Cornell University

FRANKLIN F. Y. WANG
Associate Professor of Engineering
Ph.D., University of Illinois

JUINN-MING WANG
Assistant Professor of Physics and Member, Institute for Theoretical Physics
Ph.D., University of California, Berkeley

LIN-SHU WANG
Associate Professor of Engineering
Ph.D., University of California, Berkeley

PHIL C. WEIGAND
Assistant Professor of Anthropology
Ph.D., University of Illinois

EUGENE A. WEINSTEIN
Professor of Sociology
Ph.D., Northwestern University

FRED WEINSTEIN
Associate Professor of History
Ph.D., University of California, Berkeley

ARTHUR WEISBERG
Performing Artist in Residence
Pupil of Simon Kovar

WILLIAM I. WEISBERGER
Professor of Physics
Ph.D., Massachusetts Institute of Technology

DAVID W. WEISER
Associate Professor of Chemistry
Ph.D., University of Chicago

HERBERT WEISINGER
Professor of English and Dean of the Graduate School
Ph.D., University of Michigan

SASHA R. WEITMAN
Assistant Professor of Sociology
Ph.D., Washington University

RUBEN E. WELTSCH
Director of Libraries and Associate Professor of History
Ph.D., University of Colorado

PETER K. WEYL
Professor of Oceanography
Ph.D., University of Chicago

MARGARET C. WHEELER
Assistant Professor of Anthropology
Ph.D., Yale University

GROVER J. WHITEHURST
Assistant Professor of Psychology
Ph.D., University of Illinois

JERRY L. WHITTEN
Associate Professor of Chemistry
Ph.D., Georgia Institute of Technology

C. ROBERT WICHERS
Assistant Professor of Economics
Ph.D., University of Amsterdam

LEE WILCOX
Professor of Physics
Ph.D., Stanford University

ALLAN K. WILDMAN
Associate Professor of History
Ph.D., University of Chicago

KATHLEEN WILKINS
Assistant Professor of French
Ph.D., University of Southampton, England

GEORGE C. WILLIAMS
Professor of Biological Sciences and Member, Marine Sciences Research Center
Ph.D., University of California at Los Angeles

JOHN A. WILLIAMS
Associate Professor of History
Ph.D., University of Wisconsin

ALICE S. WILSON
Assistant Professor of English
Ph.D., Cornell University

PETER WINKLER
Assistant Professor of Music
M.F.A., Princeton University

ROBIN C. WINKLER
Visiting Assistant Professor of Psychology
Ph.D., University of New South Wales

ARNOLD WISHNIA
Associate Professor of Chemistry
Ph.D., New York University

CHARLES F. WURSTER, JR.
Assistant Professor of Biological Sciences and Member, Marine Sciences Research Center
Ph.D., Stanford University

EVERETT J. WYERS
Professor of Psychology
Ph.D., University of California, Berkeley

CHEN NING YANG
Albert Einstein Distinguished Professor of Physics and Director, Institute for Theoretical Physics
Ph.D., University of Chicago; D.Sc., Princeton University

CHING H. YANG
Professor of Engineering
Ph.D., Lehigh University

JOSEPH L. YOUNG
Assistant Professor of Psychology
Ph.D., Stanford University

EUGENE ZAUSTINSKY
Associate Professor of Mathematics
Ph.D., University of Southern California

ARMEN H. ZEMANIAN
Professor of Engineering
Eng.Sc.D., New York University

ROSE ZIMBARDO
Associate Professor of English
Ph.D., Yale University

DIETER K. ZSCHOCK
Associate Professor of Economics
Ph.D., Tufts University

PAUL ZUKOFSKY
Performing Artist in Residence
M.Mus., Juilliard School of Music

MICHAEL ZWEIG
Assistant Professor of Economics
Ph.D., University of Michigan

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[a] On leave academic year 1971-72.
[b] On leave fall semester 1971.
[c] On leave spring semester 1972.

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Director of the Division of Laboratory Animal Resources

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Assistant Clinical Professor of Restorative Dentistry and Assistant to the Dean for Continuing Education
D.D.S., University of Pennsylvania

EDGAR L. ANDERSON, JR.
Associate Professor of Health Sciences (Respiratory Therapy) and Chairman, Division of Therapeutic Programs
B.S., Champlain College; C.R.N.A.

S. KENNETH ANDERSON
Instructor in Nursing
Diploma, Manhattan State Hospital School of Nursing; Certificate in Anesthesia, Harlem Hospital School of Anesthesia

STEPHEN ANTLER
Assistant Professor of Social Welfare Practice
M.S.W., Columbia University School of Social Work

NORMAN ARNHEIM, JR.
Assistant Professor of Biochemistry
Ph.D., University of California, Berkeley

HAROLD L. ATKINS
Associate Professor of Radiology
M.D., Harvard Medical School

ROBERT L. BECKMAN
Instructor in Clinical Community Medicine
M.S., University of Chicago

JAMES I. BERKMAN
Professor of Pathology
M.D., New York University

ROBERT M. BILTZ
Assistant Professor of Health Sciences Practice (Medical Technology) and Research Associate
B.S., University of Kentucky

VICTOR P. BOND
Professor of Medicine
M.D., University of California, San Francisco; Ph.D., University of California, Berkeley

ANNE HUNT BRANSFIELD
Associate Professor and Chairman, Department of Nursing in Mental Health
D.N.Sc., Boston University

LEROY T. BROWN
Assistant Professor of Anatomy
Ph.D., Stanford University

ROBERT B. BRUNER
Assistant Professor of Health Sciences (Health Care Administration) and Assistant Director for University Hospital Administration
B.A., Long Island University

SISTER MARIE K. BUCKLEY
Assistant Professor of Health Sciences Practice (Cardiopulmonary Technology)
M.S., C. W. Post College

ARJUN D. CHANANA
Associate Professor of Pathology
M.D., S.M.S. Medical College, Jaipur, India

VINCENT P. CIRILLO
Professor of Biochemistry
Ph.D., University of California at Los Angeles

ROBERT A. CONARD
Professor of Pathology
M.D., Medical College of South Carolina

JAMES W. CONKLIN
Instructor in Health Sciences (Medical Technology)
B.S., Maryville College

ROSE L. COSER
Professor of Medical Social Sciences
Ph.D., Columbia University

GEORGE C. COTZIAS
Professor of Medicine
M.D., Harvard Medical School

EUGENE P. CRONKITE
Professor of Medicine
M.D., Stanford University School of Medicine

OSCAR CUNANAN
Associate Professor of Health Sciences Practice (Respiratory Therapy)
M.D., University of Manila

LEWIS K. DAHL
Professor of Medicine
M.D., University of Pennsylvania

JOHN B. DAWSON
Assistant Professor of Medicine
M.A., Oxford University;
M.R.C.P., (Edinburgh)

MAYNARD M. DEWEY
Professor of Anatomy and Chairman, Department of Anatomy
Ph.D., University of Michigan

GERALD K. DOLAN
Instructor in Health Sciences (Respiratory Therapy)
B.S., Northeastern University

BERNARD S. DUDOCK
Assistant Professor of Biochemistry
Ph.D., Pennsylvania State University

LEON EISENBUD
Professor of Oral Pathology
D.D.S., New York University College of Dentistry

MORTIMER M. ELKIND
Professor of Pathology
Ph.D., Massachusetts Institute of Technology

FRANK ESPADA
Lecturer in Social Welfare

MAYNARD EVANS, III
Instructor in Health Sciences Practice (Respiratory Therapy)
A.A., Santa Fe Junior College, A.R.I.T.

ELLEN T. FAHY
Professor of Nursing and Dean, School of Nursing
Ed.D., Columbia University

VERA K. FARRIS
Assistant Professor of Pathology
Ph.D., University of Massachusetts

MARTIN FREUNDLICH
Associate Professor of Biochemistry
Ph.D., University of Minnesota

EMIL F. FREY
Assistant Professor of Health Sciences Communications and Director of the Health Sciences Library
M. A., University of Tennessee; M.S., University of North Carolina

JOHN GARCIA
Associate Professor of Medical Social Sciences
Ph.D., University of California, Berkeley

H. JACK GEIGER
Professor of Community Medicine and Chairman, Department of Community Medicine
M.D., Western Reserve University; M.Sc. (Hygiene) School of Public Health, Harvard University

RAYMOND F. GESTELAND
Assistant Professor of Biochemistry
Ph.D., Harvard University

BENTLEY GLASS
Professor of Social Biology
Ph.D., University of Texas; Sc.D., Washington College, Western Reserve University; LL.D., Baylor University

VIRGINIA M. GLOVER
Associate Professor of Nursing and Associate Dean, School of Nursing
Ph.D., Adelphi University

RICHARD S. GOODMAN
Assistant Professor of Anatomy
M.D., New York University

GERALD A. GREEN
Associate Professor of Psychiatry (Psychology) and Dean for Students
Ph.D., University of Southern California

CHARLES GUZZETTA
Professor of Social Welfare and Associate Dean, School of Social Welfare
Ed.D., Temple University

MARY B. HAGAMEN
Instructor in Child Psychiatry
M.D., Western Reserve Medical School

LEONARD D. HAMILTON
Professor of Medicine
D.M., Balliol College, Oxford; Ph.D., Trinity College, Cambridge

SHARON E. HAMILTON
Instructor in Nursing Practice
B.S.N., Central Missouri State College

CORNELIA P. HARNETT
Associate Professor of Nursing in Adult Health; Chairman, Department of Nursing in Adult Health
M.S., St. John's University

GLEN E. HASTINGS
Associate Professor of Community Medicine
M.D., University of Kansas

ROBERT O. HAWKINS, JR.
Assistant Professor of Health Sciences and Assistant Dean, School of Allied Health Professions
Ed.M., Northeastern University

E. GLENN HENNIG
Instructor in Health Sciences Practice (Respiratory Therapy)
A.A., Georgia Southwestern College

ANTOL HERSKOVITZ
Assistant Professor of Health Sciences Communications and Associate Director of the Division of Health Sciences Communications
M.M.S., Tulane University

STEPHEN M. HOLLOWAY
Assistant Professor of Social Welfare Practice and Assistant Dean, School of Social Welfare
M.S.W., Columbia University School of Social Work

HERBERT H. HOPF
Assistant Professor of Health Sciences Communications
B.A.E., M.S., Polytechnic Institute of Brooklyn

GABOR B. INKE
Associate Professor of Anatomy
M.D., Pazmany Peter University, Budapest; D.D.S., Halle/Saale, East Germany

AARON JANOFF
Professor of Pathology
Ph.D., New York University

HORTON A. JOHNSON
Professor of Pathology
M.D., Columbia University

H. PAUL JOLLY, JR.
Associate Professor of Health Sciences Communications and Associate Director of the Division of Health Sciences Communications
Ph.D., Harvard University

EDNA-ANN KATZ
Associate Professor of Social Welfare
M.S.W., Simmons College, School of Social Work

JOSEPH KATZ
Professor of Human Development
Ph.D., Columbia University

CHARLES W. KIM
Associate Professor of Microbiology
Ph.D., University of North Carolina

SANFORD L. KRAVITZ
Professor of Social Welfare and Dean, School of Social Welfare
Ph.D., Brandeis University

JOHN R. KRESS
Instructor in Health Sciences Practice (Health Care Administration)
M.A., Columbia University School of Public Health and Administrative Medicine

MARVIN C. KUSCHNER
Professor of Pathology and Chairman, Department of Pathology
M.D., New York University College of Medicine

SALVATORE LACERVA
Associate Professor of Health Sciences Practice
M.D., Albany Medical College

PAUL G. LEFEVRE
Professor of Physiology
Ph.D., University of Pennsylvania

BENJAMIN J. LEICHTLING
Assistant Professor of Biochemistry
Ph.D., Northwestern University

HERMAN LEON
Associate Professor of Social Welfare
Ph.D., Columbia University, School of Social Work

ROBERT A. LOVE
Associate Professor of Industrial Medicine
M.D., Cornell University Medical College

DAVID D. LYONS
Instructor in Health Sciences Practice (Respiratory Therapy)
A.A., Community College at Philadelphia; A.R.I.T.

ESTHER S. MARCUS
Associate Professor of Social Welfare
Ph.D., New York University

STANLEY J. MASIAK
Assistant Professor of Physiology
Ph.D., Rutgers University

ROBERT K. MATCH
Associate Professor of Health Sciences Practice
M.D., State University of New York Downstate Medical Center

EDMUND J. MCTERNAN
Associate Professor of Health Sciences and Dean, School of Allied Health Professions
M.S., Columbia University; M.P.H., University of North Carolina

DAVID P. MCWHIRTER
Assistant Professor of Psychiatry and Director of University Health Services
M.D., University of Southern California

LEONARD E. MEISELAS
Professor of Medicine and Associate Dean, School of Medicine
M.D., New York University School of Medicine; M.Sc. (Pathology), University of Virginia

DONALD J. MEYERS
Assistant Professor of Health Sciences (Health Care Administration) and Assistant Director for Administrative Services
B.S., City College of New York

PHILIP R. MEYERS
Assistant Professor of Biomathematics and Health Sciences Communications
Ph.D., University of Maryland

FREDERICK MILLER
Associate Professor of Pathology
M.D., New York University School of Medicine

IRENE B. MILLER
Instructor in Health Sciences Practice (Health Education)
M.P.H., University of California, Berkeley

KENNETH MILLS
Senior Lecturer in Social Welfare
P.Phil, Oxford University

MAUREEN F. MONCK
Assistant Professor of Nursing in Community Health
Ph.D., Adelphi University

CARL MOOS
Associate Professor of Biochemistry
Ph.D., Columbia University

MICHAEL MUNK
Assistant Professor of Medical Social Sciences
M.A., University of Oregon

J. HOWARD OAKS
Professor of Dental Medicine and Dean, School of Dental Medicine
D.M.D., Harvard University

HARRISON H. OWEN
Instructor in Clinical Community Medicine
M.A., Vanderbilt University

VINCENT S. PALLADINO
Professor of Pathology
M.D., Harvard Medical School

EDMUND D. PELLEGRINO
Professor of Medicine; Dean, School of Medicine; Vice President for the Health Sciences and Director of the Center
M.D., New York University College of Medicine

WILHELMINA PERRY
Associate Professor of Social Welfare
M.S.W., University of Pennsylvania, School of Social Work

DOROTHY R. POPKIN
Associate Professor and Chairman, Department of Nursing in Community Health
M.S., Adelphi University; Certificate: Washington School of Psychiatry

MELVIN PORTNOY
Lecturer on Health Education
D.M.D., University of Pennsylvania, School of Dental Medicine

DONALD POWELL
Instructor in Health Sciences Practice (Respiratory Therapy)
A.A., Lakeland Junior College

MONICA RILEY
Associate Professor of Biochemistry
Ph.D., University of California, Berkeley

MARGUERITE T. ROBEY
Assistant Professor of Nursing in Pediatrics
M.Ed., Columbia University

CHARLES V. ROBINSON
Assistant Professor of Biomathematics and Health Sciences Communications
Ph.D., University of Missouri

JAMES S. ROBERTSON
Professor of Medical Biophysics
M.D., University of Minnesota; Ph.D., University of California, Berkeley

PETER ROGATZ
Professor of Community Medicine and Associate Director for Patient Care Services and Administration
M.D., Cornell University; M.P.H., Columbia University School of Public Health and Administrative Medicine

SEYMOUR ROISTACHER
Professor of Dental Medicine
D.D.S., New York University College of Dentistry

STEPHEN ROSE
Associate Professor of Social Welfare
Ph.D., Brandeis University

MARTIN H. ROSENFELD
Associate Professor of Health Sciences (Medical Technology) and Chairman, Division of Diagnostic Programs
M.S., St. John's University

STUART W. ROSNER
Assistant Professor of Clinical Medicine
M.D., New York University College of Medicine

EDMUND L. ROSS
Associate Professor of Community Organization Practice and Director of Community Services
M.S.S., Columbia University School of Social Work

SHELDON SCHER
Assistant Professor of Health Sciences (Laboratory Animal Resources) and Assistant Director of the Division of Laboratory Animal Resources
B.S., City College of New York

MORTIMER L. SHAKUN
Associate Professor of Health Sciences Communications and Dental Medicine
D.D.S., New York University College of Dentistry

CLAIRE J. SHELLABARGER
Professor of Pathology
Ph.D., Indiana University

SANFORD R. SIMON
Assistant Professor of Biochemistry
Ph.D., Rockefeller University

MELVIN V. SIMPSON
Professor of Biochemistry and Chairman, Department of Biochemistry
Ph.D., University of California, Berkeley

MALCOLM H. SKOLNICK
Associate Professor of Health Sciences Communications and Director of the Division of Health Sciences Communications
Ph.D., Cornell University

DANIEL N. SLATKIN
Assistant Professor of Pathology
M.D., McGill University, Montreal

MARTIN STERN
Professor of Oral Surgery
D.M.D., Harvard School of Dental Medicine

ROLF STERNGLANZ
Assistant Professor of Biochemistry
Ph.D., Harvard University

GEORGE W. STROKE
Professor of Engineering and Biophysics
Dr.es.Sc., University of Paris (Sorbonne), France

F. WILLIAM STUDIER
Associate Professor of Biochemistry
Ph. D., California Institute of Technology

MARTIN B. TIMIN
Associate Professor of Social Welfare
M.A., University of Michigan

WILLIAM J. TREANOR
Assistant Professor of Health Sciences (Cardiopulmonary Technology)
M.S., Adelphi University

ARTHUR C. UPTON
Professor of Pathology and Dean, School of Basic Health Sciences
M.D., University of Michigan

WILLIAM G. VAN DER KLOOT
Professor of Physiology and Biophysics and Chairman, Department of Physiology and Biophsics
Ph.D., Harvard University

H. Barry Waldman
Associate Professor of Community Dentistry
D.D.S., New York University College of Dentistry; M.P.H., Columbia University School of Administrative Medicine and Public Health; Ph.D., University of Michigan School of Public Health

David E. Weeks
Associate Professor of Community Medicine
M.D., Northwestern University Medical School

Sidney B. Weinberg
Professor of Forensic Pathology
M.D., University of Buffalo School of Medicine

Steven H. Weisbroth
Associate Professor of Pathology and Director of the Division of Laboratory Animal Resources
M.S., D.V.M., Washington State University

Thomas B. Williams
Instructor in Social Welfare
M.S.W., New York University

Howard Winant
Instructor in Social Welfare
B.A., Brandeis University

Catharine L. Wingate
Assistant Professor of Radiological Physics and Assistant to Dean, School of Basic Health Sciences
Ph.D., Columbia University

Richard M. Zaner
Professor of Humanities in Medicine
Ph.D., New School for Social Research

Stanley Zimering
Associate Professor of Health Sciences (Health Education) and Chairman, Division of Community and Mental Health Programs
B.S., New York University; M.P.H., Harvard School of Public Health

STATE UNIVERSITY OF NEW YORK GENERAL DESCRIPTION

The State University of New York, established by the State Legislature in 1948, comprises 70 colleges and centers. At present, 68 conduct classes: four university centers, two medical centers, 13 colleges of arts and science, two specialized colleges, six two-year agricultural and technical colleges, five statutory colleges, and 36 locally-sponsored, two-year community colleges.

Permanent campuses for two of the colleges of arts and science are under construction, the College at Purchase in Westchester County and the College at Old Westbury in Nassau County. Old Westbury conducts classes on a limited enrollment basis in temporary quarters at Oyster Bay, Long Island. Special credit programs are conducted by Purchase, including joint operation of a Cooperative College Center in Mount Vernon. A third arts and science campus, upper-divisional in concept, will serve the Herkimer-Rome-Utica area. Evening courses are being offered in temporary facilities in the West Frankfort Elementary School, with construction of a permanent campus in the town of Marcy scheduled to begin in 1972.

Three upstate community colleges moved from the planning stage into actual operation in September 1969. They are Schenectady County Community College, Clinton Community College and Columbia-Greene Community College.

Hostos Community College in South Bronx will admit its first students in temporary facilities at 900 Grand Concourse in September. It is the seventh community college sponsored by the New York City Board of Higher Education, with an eighth in the planning and development stage.

The University further comprises the Ranger School, a division of the College of Forestry, which offers a 43-week technical forestry program at Wanakena; the Center for International Studies and World Affairs at Albany; and five urban centers administered by community colleges.

University-wide research programs include the Atmospheric Sciences Research Center with campus headquarters at Albany, Institute for Theoretical Physics and the Marine Sciences Research Center at Stony Brook, and Water Resources and Polymer Research Centers at the College of Forestry. Two research facilities headquartered at State University of New York at Buffalo are the Western New York Nuclear Research Center and Center for Immunology.

Graduate study at the doctoral level is offered by State University at 12 of its campuses, and graduate work at the masters level at 22. The University is continuing to broaden and expand over-all opportunities for advanced degree study.

Graduate study areas embrace a wide spectrum including agriculture, business administration, criminal justice, dentistry, education, engineering, forestry, law, liberal arts and science, library science, medicine, nursing, pharmacy, social work and veterinary medicine.

Four-year programs strongly emphasize the liberal arts and science and also include specializations in teacher education, business, forestry, maritime service, ceramics and the fine and performing arts.

Two-year programs include nursing and liberal arts transfer programs and a wide variety of technical curriculums such as agriculture, business, and the industrial and medical technologies.

The University's urban centers provide training for skilled and semi-skilled occupations and college foundation courses for youths in the inner city areas.

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The State University motto is: "Let Each Become All He Is Capable of Being."

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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
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

SPECIALIZED COLLEGES

College of Forestry at Syracuse University
Maritime College at Fort Schuyler (Bronx)

AGRICULTURAL AND TECHNICAL COLLEGES (Two-Year)

Alfred
Canton
Cobleskill
Delhi
Farmingdale
Morrisville

STATUTORY COLLEGES

College of Ceramics at Alfred University
College of Agriculture at Cornell University
College of Human Ecology at Cornell University
School of Industrial and Labor Relations at Cornell University
Veterinary College at Cornell University

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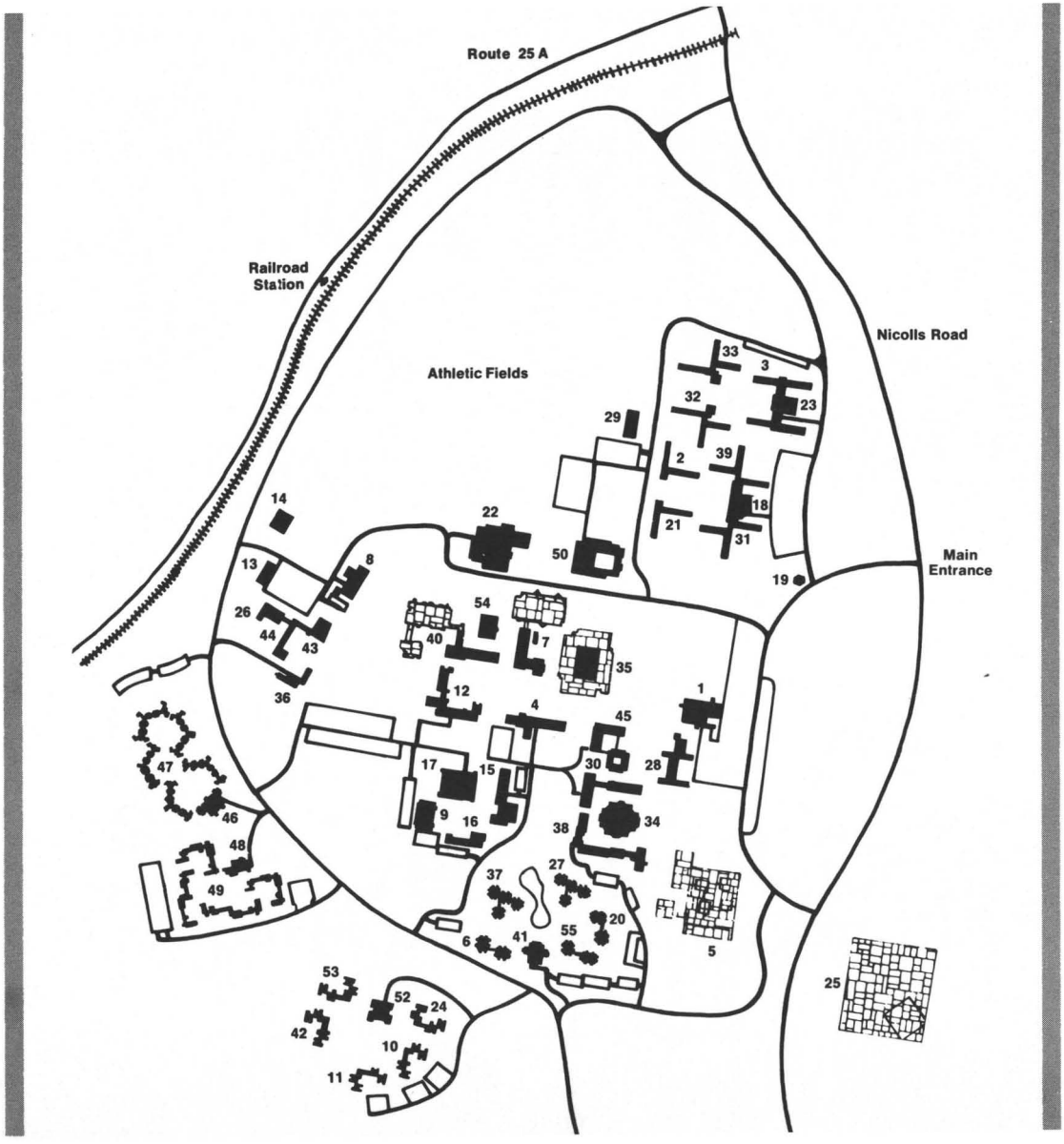
(Locally-sponsored, two-year colleges under the program of State University)

Adirondack Community College at Glens Falls
Auburn Community College at Auburn
Borough of Manhattan Community College
Bronx Community College
Broome Technical Community College at Binghamton
Clinton Community College at Plattsburgh
Columbia-Greene 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 Ilion
Hostos Community College in South Bronx
Hudson Valley Community College at Troy
Jamestown Community College at Jamestown
Jefferson Community College at Watertown
Kingsborough Community College
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 Niagara Falls
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

(An eighth New York City community college, sponsored by the New York City Board of Higher Education, is in development.)


Route 25 A
Railroad Station
Athletic Fields
Nicolls Road
Main Entrance
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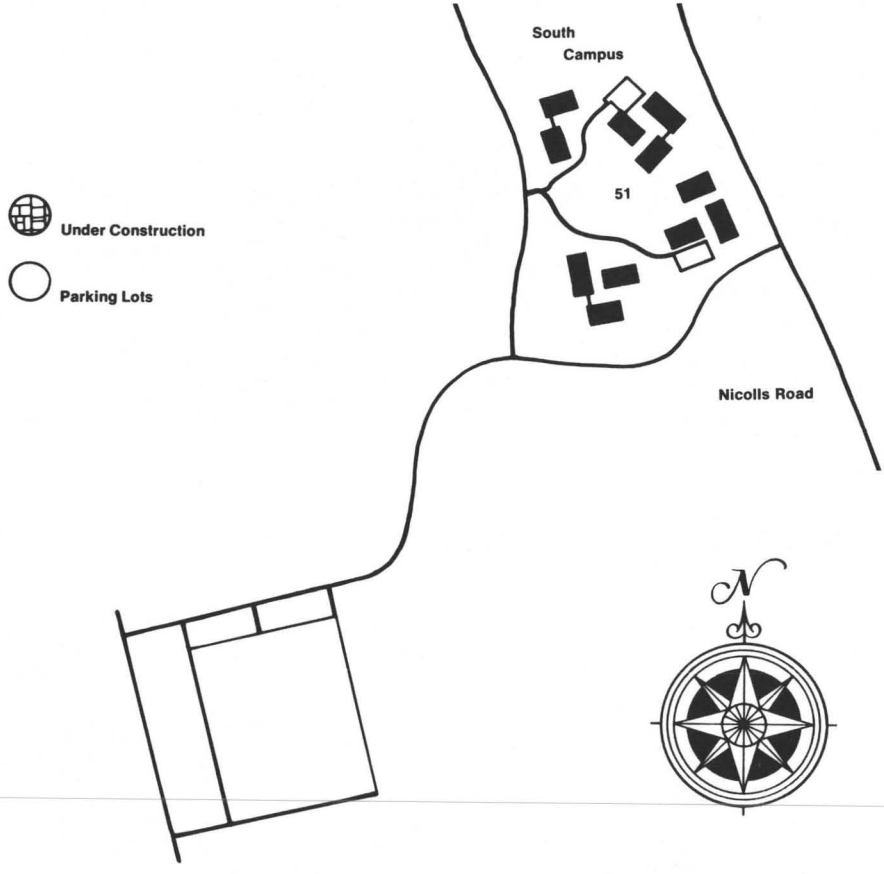

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at

StonyBrook

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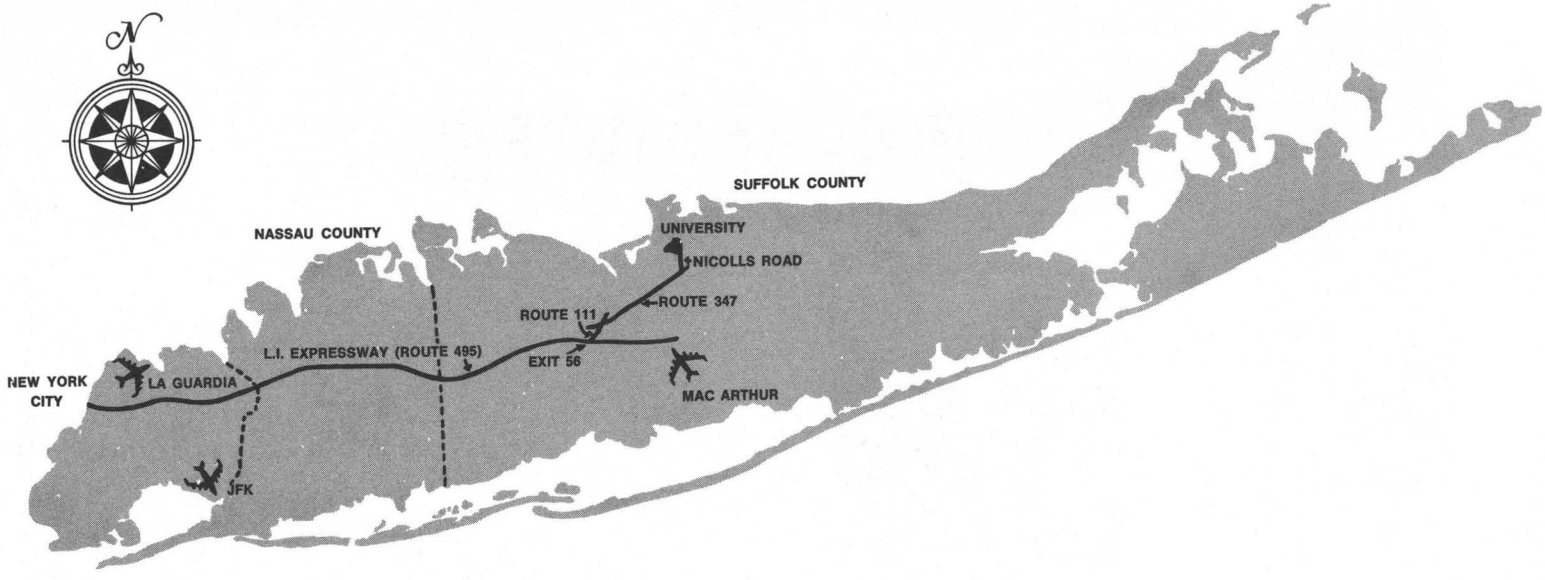

TRANSPORTATION TO STONY BROOK

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 56 and follow Route 111 north for two miles. Turn right onto Route 347. After six miles, turn left onto Nicolls Road and continue two miles to the main entrance. Stop at gatehouse for parking permit.

BY RAILROAD

Take the Long Island Railroad's Port Jefferson line from Pennsylvania Station (Manhattan) or Flatbush Avenue Station (Brooklyn), change trains at Jamaica for the Stony Brook Station. Inquire for free campus bus.

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