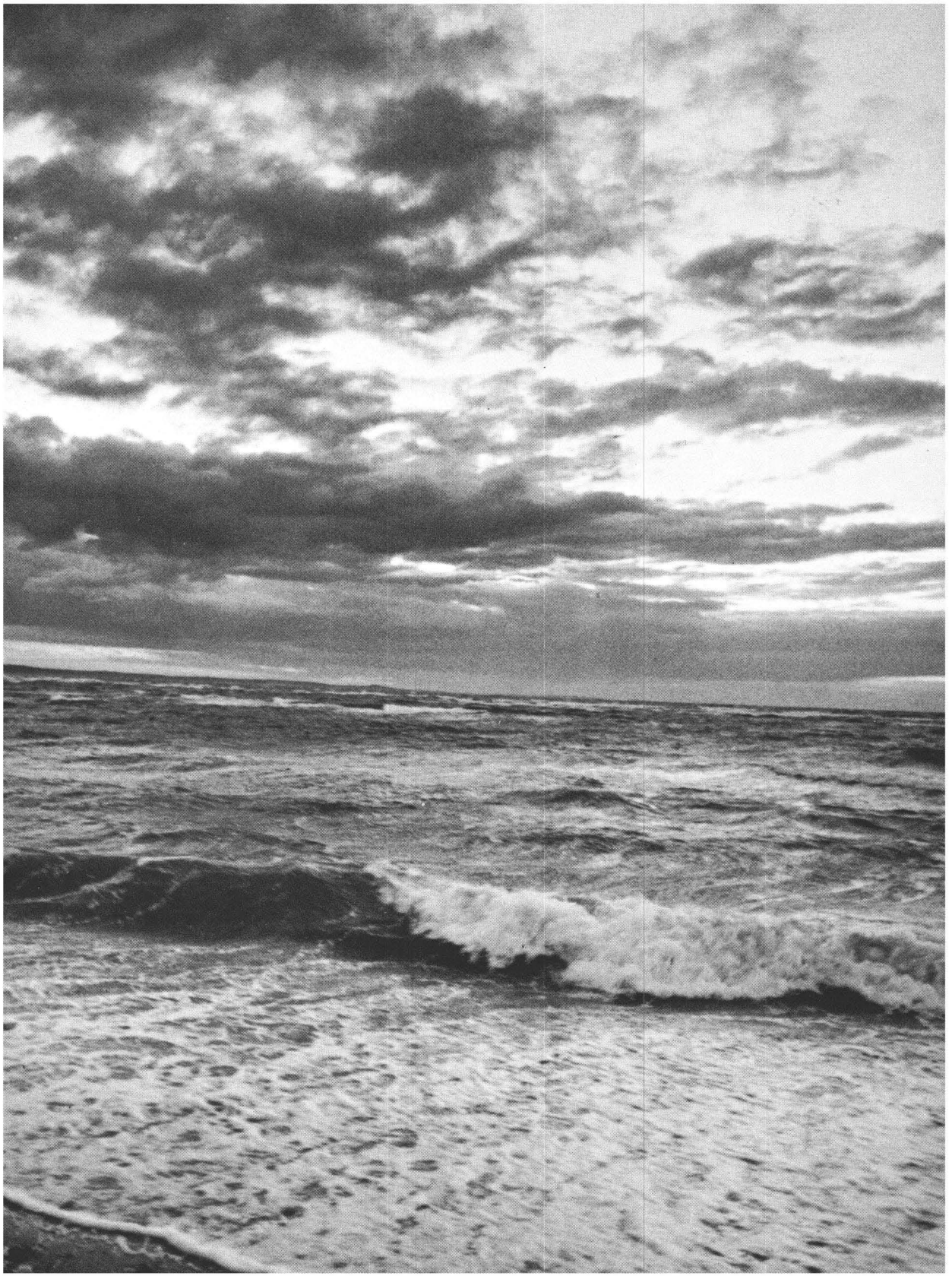
StonyBrook

1970-71 Graduate Bulletin

State University of New York at Stony Brook



ACADEMIC CALENDAR
1970-71

Fall Semester 1970

Wed., September 9	Residence Halls Open
Wed. & Thurs., September 9-10	Foreign Student Orientation
Thurs. & Fri., September 10-11	Graduate Student Registration
Sat. & Sun., September 12-13	New Student Orientation—Undergraduates
Mon. & Tues., September 14-15	Final Registration—Undergraduates
Wed., September 16	Classes Begin
Tues., September 29	End of Changes of Registration Period—Undergraduates
Thurs. & Fri., October 1-2	Two-day Recess (classes suspended)
Wed., October 14	Last Day for Graduates to Add or Drop a Course Without Penalty
Mon., November 2	Last Day for Removal of Incompletes from Spring Semester for Graduates and Undergraduates
Fri., November 6	Advisory Grade Reports Due
Mon. & Fri., November 9-13	Advance Registration for Spring Semester for Graduates and Undergraduates
Wed., November 25	Thanksgiving Recess Begins at Close of Classes
Mon., November 30	Classes Resume
Sat., December 19	Winter Recess Begins at Close of Classes
Mon., January 4	Classes Resume
Sat., January 9	Last Day of Classes
Mon. & Tues., January 11-12	Reading and Review Days
Wed., January 13	Final Examinations Begin
Sat., January 23	Final Examinations End—Fall Semester Ends
Tues., January 26	Final Grades Due in Office of Records—12 Noon

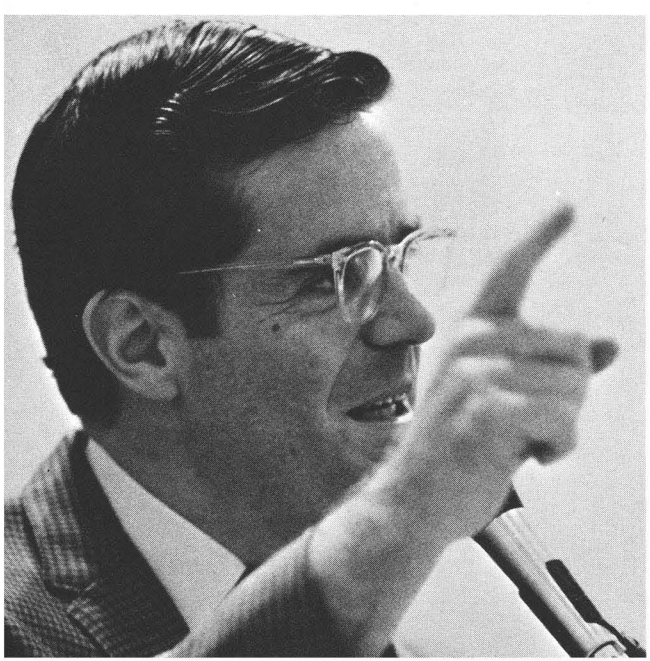
Spring Semester 1971

Mon. & Tues., February 1-2	Final Registration for Graduates and Undergraduates
Wed., February 3	Classes Begin
Tues., February 16	End of Change of Registration Period for Undergraduates
Wed., March 3	Last Day for Graduates to Add or Drop a Course Without Penalty
Mon., March 15	Last Day for Removal of Incompletes from Fall Semester for Graduates and Undergraduates
Fri., March 26	Advisory Grade Reports Due
Sat., March 27	Spring Recess Begins at Close of Classes
Mon., April 5	Classes Resume
Mon. & Fri., April 19-23	Advance Registration for Fall Semester and Summer Session for Graduates and Undergraduates
Sat., May 1	Last Day for Graduates to Submit Theses and Dissertations
Sat., May 15	Last Day of Classes
Mon. & Tues., May 17-18	Reading and Review Days
Wed., May 19	Final Examinations Begin
Sat., May 29	Final Examinations End—Spring Semester Ends
Tues., June 1	Final Grades Due in Office of Records—12 Noon
Sun., June 6	Commencement

Summer Session 1970

Mon., June 22	Final Registration
Tues., June 23	Classes Begin
Fri., July 31	Classes End

Celebrated visitors to the Stony Brook campus in 1970 have included, from the top, anthropologist Margaret Mead, former senator from Oregon Wayne Morse, former presidential aide Theodore C. Sorenson, and Congresswoman Shirley Chisholm.



Contents

AN INTRODUCTION TO STONY BROOK

Stony Brook is located in a region of wooded hills and small historic villages on the north shore of Long Island some 50 miles northeast of New York City and a short distance from Long Island Sound. The Atlantic shore is some 20 miles to the south. Despite its long history and nearness to great centers of population, the area retains a pastoral character with a distinctive New England flavor.

The University thus enjoys the relative seclusion of a semi-rural setting, coupled with proximity to the cultural, scientific and industrial resources of the nation's largest city. The campus is linked to Manhattan by a pattern of four and six lane highways and by the Long Island Rail Road (see map at back of *Bulletin*). The proximity of the University to Brookhaven National Laboratory makes possible the participation of faculty members and their graduate students in the research program of the laboratory.

The Stony Brook Campus

The Stony Brook campus is situated minutes away from the coves and beaches of Long Island Sound. The campus consists of 1000 acres of rolling, wooded terrain, with the central core area largely cleared for buildings now in use.

Large academic structures providing classroom, lecture hall, laboratory and office space include the Humanities Building, Social Sciences Center, Lecture Center and buildings for the Earth and Space Sciences, Chemistry, Biology and Engineering. The Physics Building houses the Departments of Physics and Mathematics. The new Administration Building was scheduled for occupancy during the summer of 1970. The Stony Brook Union, a comprehensive campus center for students, faculty and staff, opened in the spring of 1970.

Five residential quadrangles, including numerous lounges and dining halls, provide space for 5000 students. The Gymnasium, with its swimming pool, basketball and squash courts, and rooms for gymnastics and ballet, serves curricular, intramural and intercollegiate athletic programs. It also provides space for the Office of Physical Education and the University Theater.

Libraries

Stony Brook's Frank C. Melville Jr. Memorial Library is one of the fastest growing facilities on campus. New books are being added to its collection at the rate of 100,000 a year with the present total about 500,000 volumes.

A million-volume collection is anticipated by 1975 after a planned library expansion program. There is also a microfilm library consisting of 20,000 reels and 600,000 flat sheets. An additional 4000 reels and 100,000 flat sheets are being added each year.

Reading areas for 700 students are interspersed with book stacks in the main library to provide easy access to materials. During the regular semester, the library is open until midnight except on Saturdays. Specialized libraries are also maintained on campus. These include the chemistry, earth and space sciences, health sciences, physics-mathematics and engineering libraries.

Expansion

A host of new facilities will be constructed over the next several years. Currently under construction are the Instructional Resources Center, a laboratory-office-classroom building to accommodate the Health Sciences Center during its initial stages of growth, an additional residential college complex to house 1000 students and 11 academic buildings.

Other structures will include a physical science complex, 3½-fold expansion of the present library building, fine arts center, biology building, permanent Health Sciences Center, and additional dormitories and engineering facilities, all of which are in the design stage.

The academic program continues to expand on both the undergraduate and graduate levels as the University proceeds toward its goal of being a balanced institution with strength in all areas of the arts and sciences and engineering.

Students

Stony Brook's total enrollment surpassed the 8800 mark in 1969, and will be close to 10,000 in the fall of 1970.

The graduate student body consisted of 1336 matriculated students including 429 in the continuing education program and a number of post-doctoral fellows. There were also 754 special and non-matriculated students including 707 in the continuing education program. The total graduate enrollment was 2090, with males outnumbering females, 1213 to 877.

Accreditation

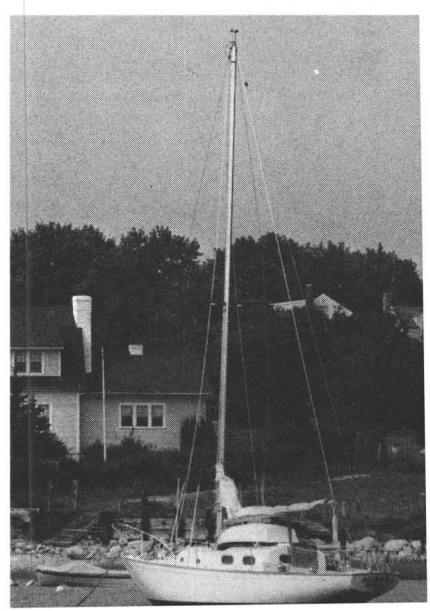
As part of the State University of New York, the University at Stony Brook is accredited by the Middle States Association of Colleges and Secondary Schools.

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

The Summer Session at Stony Brook covers a six-week period. Graduate and undergraduate courses are offered by the College of Arts and Sciences and the College of Engineering. Graduate courses are also available through the Center for Continuing Education. Graduate students are encouraged to remain on campus during the summer to continue study and research under faculty guidance in more informal situations. A limited number of summer research assistantships are available.

Students in good standing at Stony Brook and other collegiate institutions are eligible to attend the Summer Session.



Special Centers and Institutes

Computing Center

The Computing Center building in the engineering quadrangle provides the campus with an IBM System/360 Model 67 computer complex. Its time-sharing system—the most sophisticated in existence—permits simultaneous simulation of many virtual systems. As a result, each time-sharing user has the equivalent of his own computer available instantly. The computing facilities are used for such student activities as term papers, research projects and theses. The Computing Center serves the faculty in both sponsored and unsponsored research activities and is used by the administration in such areas as institutional research and administrative data-processing. Short courses in programming are held periodically for all users of the Center.

Economic Research Bureau

The Economic Research Bureau conducts research, training and service activities in applied economic analysis that go beyond normal instructional and research functions of an academic department. This work is carried out by faculty members, students, visiting scholars and consultants. Although closely related to the Department of Economics, the Bureau is a separately organized entity, expected to serve as a link between the needs and resources of the academic community and those of public and private agencies.

Institute for Colonial Studies

The Institute for Colonial Studies, founded in 1967, stimulates comparative research into the institutions, customs and history of colonies, especially those of the Western Hemisphere before 1800. The Institute has assembled 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. It plans to sponsor doctoral and postdoctoral research into subjects pertaining to the colonies in cooperation with the History Department.

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. Director of the Institute is Nobel Prize winner, C. N. Yang.

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 (CAI) programs, in the country. Thirty-two sophisticated IBM terminals, consisting of TV display screens, typewriter keyboards and light-sensing pencils are hooked into a 1500 IBM computer. The program aids students in physics, political science, statistics, data processing, French and German. CAI is expected to be used in the near future to simulate laboratory experiments enabling students to "conduct" experiments without turning on the Bunsen burner.

A new 44,000-square-foot IRC building is scheduled for completion in January 1971 at an estimated cost of $2.1 million. Television and radio studios, moving picture and other film-making facilities, audio-visual equipment and offices will be located in the two-story structure.

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.

Dock facilities for the Center's 40-foot research vessel are within ten minutes of the campus. 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. A laboratory in Discovery Bay, Jamaica, West Indies, is run jointly by the Center and the University of the West Indies.

Continuing Education Program

The Center for Continuing Education is one of Stony Brook's fastest growing units in this day when education must be a lifelong concern. The Center makes the resources of the University available to those who cannot study full-time. It offers a terminal master of arts in liberal studies, an interdisciplinary, non-thesis, 30-unit degree with a bachelors degree generally required for admission to the program. Prospective students without a degree may be granted special student status.

Health Sciences Center

The Health Sciences Center is being developed as an integral part of the Stony Brook campus, and represents a unique concept of unity and cooperation among all the health sciences and professions in a university setting. Innovation in the educational process, experimentation to develop better ways of delivering health care, and service to the community—with emphasis on maintaining the human and compassionate aspects of health care—are among the commitments of the Center.

As now planned, the Health Sciences Center will encompass six schools: medicine, dental medicine, basic health sciences, nursing, social welfare, and allied health professions; a university hospital, and a veterans' administration hospital. The academic plan of the total Health Sciences Center has been developed in a way that will insure to students in all these 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.

The School of Nursing will open its undergraduate program in the fall of 1970. The School of Allied Health Professions will also open in the fall of 1970 with a program for cardiopulmonary/respiratory specialists. The School of Basic Health Sciences will open in 1970 with graduate level students. The Schools of Social Welfare and of Medicine will accept their first classes in 1971, and at the same time several additional programs will open in the School of Allied Health Professions. The School of Dental Medicine is scheduled to admit students in September 1972. Students wishing information 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.

Student Services

Student services—including health services, psychological services, financial aid and part-time employment, general and vocational counseling, job placement, international student advisement and the Stony Brook Union—are administered through the Student Affairs Office. Students are encouraged to seek advice and assistance through these various services.

A staff of trained psychologists and counselors experienced in helping students with personal, social, educational and vocational problems is available through Psychological Services. This office is intended for students who have problems of a psychological nature or who are experiencing considerable difficulty in adjusting to university life and its demands.

The International Student Office is an administrative office of the University, responsible to the Vice President for Student Affairs. It is presently located on the main floor of the Gymnasium. The staff of the office is available to assist 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.

The University Health Service provides emergency aid to the whole university community. A registered nurse is on duty 24 hours a day, seven days a week, and one or more physicians are on call at all times. The University Health Service has an allergy clinic, orthopedic clinic, gynecology clinic and mental health service. Dental care is available by referral to a local team of dentists. Planned parenthood services are available. In-bed care can be provided for students with illnesses or injuries requiring short-term supervised bed rest. All students must file a health form and doctor's certificate with the Health Office before they can register for graduate studies. If a student comes to the State University of New York at Stony Brook without submitting a form, he will be required to go to a private physician to obtain the necessary certificates before he will be allowed to register.

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

Graduate Student Council

The Graduate Student Council was established by 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, Campus Center Policy Committee, Curriculum Committee and Faculty-Student Association. The Council also appoints representatives to other university committees, including the Parking Committee, Special Com-

mittee on Traffic, Computer Center Committee, Operations and Safety Committee, F.S.A. Bookstore Committee, Teaching Policy Committee and Instructional Resources Committee.

In addition, the Council has found that some of its most valuable essential work has involved investigation of areas of mutual concern to all graduate students and the formulation of solutions to problems in these areas.

Campus Activities

National and international leaders in government, science, education and the arts visit Stony Brook regularly for lectures and seminars. Recent visitors have included Arthur Goldberg, Stewart Udall, Julian Bond, W. H. Auden, Margaret Mead, Theodore Sorenson, Dr. Benjamin Spock, Dr. Linus Pauling, Allen Ginsberg and Igor Stravinsky.

Student theatrical productions range from traditional Shakespearian productions of "Twelfth Night" and "King Lear" to avant garde interpretations of "Hamlet" and experimental theater pieces such as "Abraham," an existential interpretation of the biblical hero presented recently with the use of song, dance and children's games.

A series of more than 20 professional music concerts throughout the year brings such famous groups and soloists to the campus as the Buffalo Philharmonic Orchestra, New York Woodwind Quintet, Soprano Camilla Williams and Guitarist Julian Bream.

A series of art exhibitions features the works of students and professionals.

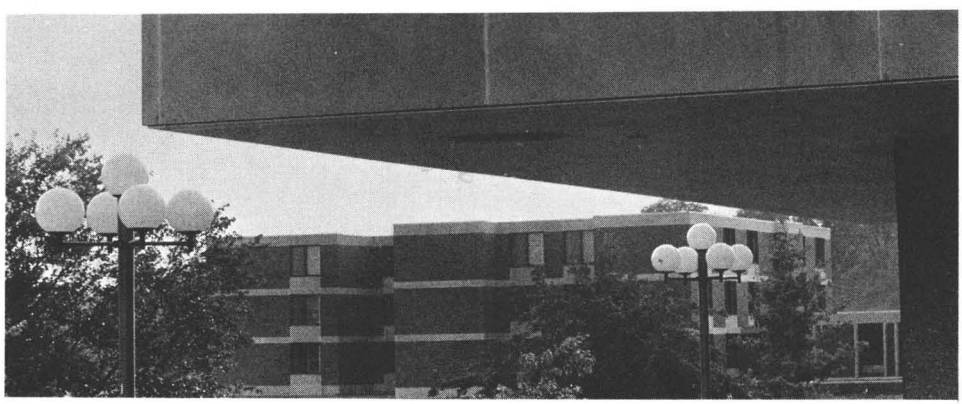
The Student Activities Board sponsors a series of entertainment programs. Recent appearances have included: The Living Theatre, Odetta, Joe Cocker, and Blood, Sweat and Tears.

The Committee on Cinematographic Arts presents a series of 27 foreign and domestic motion picture films each year. The films are shown twice-nightly on Friday, Saturday and Sunday.

Varied athletic programs are a part of student life at the State University of New York at Stony Brook. Varsity teams are fielded in 11 sports: soccer, cross country, crew, squash, basketball, baseball, track and field, swimming, judo, tennis and bowling. Teams are fielded on the junior varsity and freshman level with the exception of swimming, track, squash and tennis. Some 250 athletes participate on men's intercollegiate teams for Stony Brook.

Women's intercollegiate athletic teams at Stony Brook are in gymnastics, tennis, field hockey, basketball and softball. About 250 women participate in varsity and intramural programs.

Stony Brook competes in the Metropolitan Intercollegiate Soccer Conference, Eastern Collegiate Athletic Conference, Knickerbocker Basketball Conference, Metropolitan Squash Association, Metropolitan Swimming Association, and National Intercollegiate Squash Association.



Housing

Rooms are available for unmarried graduate students in the university residence halls. All rooms provide for double occupancy, and are furnished with a bed, mattress, bureau, study desk and chair, and closet for each occupant. Board may be purchased by resident students, and consists of 21 meals a week. Non-resident students may purchase meals in the university dining hall also.

Houses, apartments and rooms are available within reasonable driving distance of the Stony Brook campus. However, it is somewhat difficult to obtain off-campus accommodations within walking distance.

The University Housing Service, located in the Administration Building, aids students who are interested in renting rooms, apartments or houses in the Suffolk County area.

FINANCIAL INFORMATION

Tuition

The tuition rate for graduate students is $300 per semester. Tuition waivers are available for graduate assistants, graduate research assistants, and certain fellows, but they must pay other fees listed below. Tuition rate for a special graduate student part-time (eight or less credits) is $20 per credit each semester.

Other Fees

College Fee: $12.50 per semester.

Special students part-time: $.85 per credit per semester.

Student Health Insurance Fee[a]

Individual: $33.00 (payable at fall registration for 12 months-September to September. Pro rata premium available for February admits.).

Student & Spouse: $72.00.

Student, Spouse & Dependent Child or Children: $120.00.

General University Deposit

Commuting Student: $20.00.

Resident Student: $35.00.

Graduation Fee: $15.00 (payable upon completion of all degree requirements and prior to the award of the degree).

Identification Card: $2.00.

Late Registration Fee: $15.00 (paid by students registering after the close of the official registration period).

Transcript Fee: $1.00 for each transcript (A student who obtains a degree may receive two transcripts without charge. Account with the University must be clear.).

Students are responsible for payment of all fees for the academic year and summer sessions unless such fees are specifically waived under the conditions of an award.

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[a] Fee may be waived for students having alternative hospital and medical coverage. Consult the Business Office for details before registration.

Residence Charges

Room and board charges for students living on the Stony Brook campus are approximately $1015 per academic year, of which $565 represents the rent for 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 $450 per year.

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

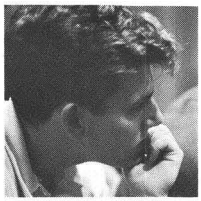
Refunds

A student who withdraws after the first five days of a semester is entitled to only a partial refund of monies collected. A schedule of refunds is available in the University Business Office. After a student has registered and occupied a room, there can be no refund for the balance of that quarter, except for entry into military service.

Financial Aid

Sources of direct financial aid include the New York State Scholar Incentive Program and the Division of Vocational Rehabilitation of the New York State Education Department. 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 program should be directed to the Financial Aid Officer in the Student Affairs Office.

The State University of New York has made available a limited number of tuition scholarships for foreign students. These awards are equivalent to $600 for the academic year, and are the only financial aid available for foreign students apart from assistantships and fellowship awards. Applications for tuition scholarships may be obtained from the International Student Office presently located in the Gymnasium.

Graduate Assistantships and Fellowships

An applicant seeking an assistantship or fellowship is strongly advised to make sure that all his application material including letters of recommendation and transcripts have been received by the University no later than February 1.

Teaching and graduate assistantships carry stipends of $2800 for the first academic year and tuition exemption. For advanced students the stipend is $2900 for the second, and $3000 for subsequent years.

University Fellowships are also available, with stipends of about $2600 and higher for the academic year and tuition exemption.

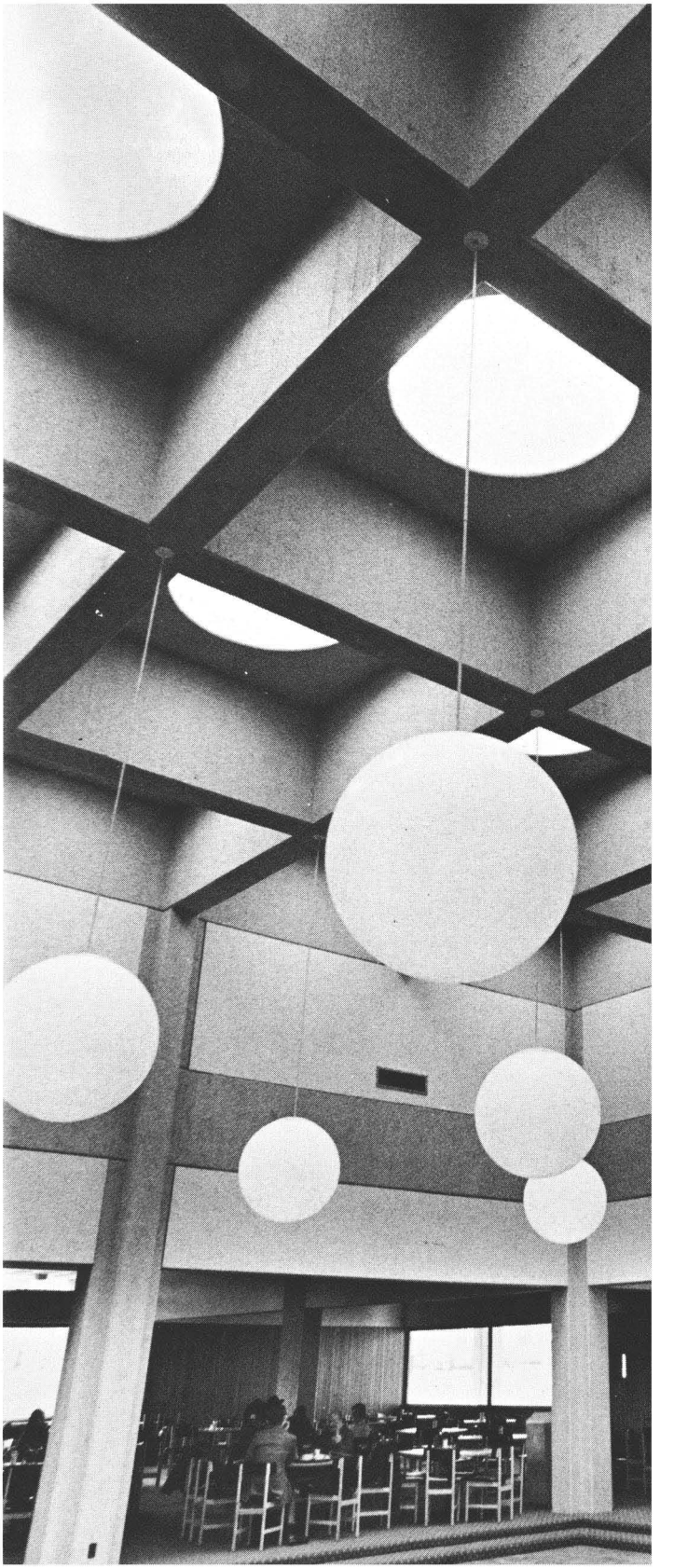
Teaching assistantships, graduate assistantships, and fellowships are awarded on a competitive basis by the Graduate School on recommendation of the department.

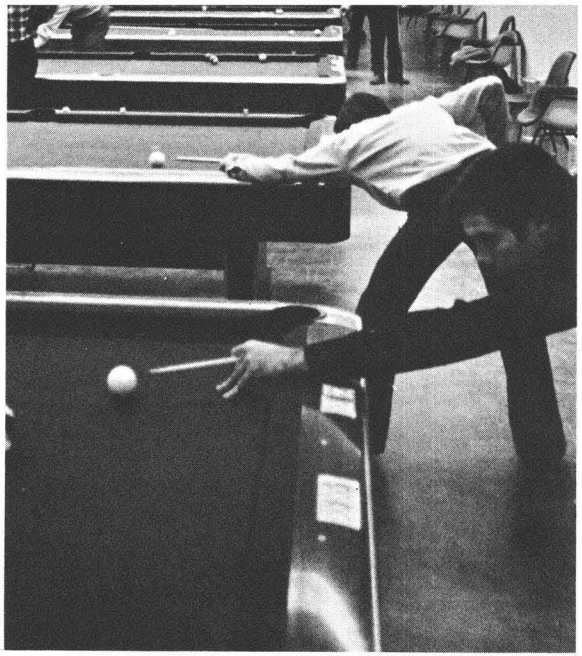
State University of New York at Stony Brook participates in such fellowship and traineeship programs as: NDEA Fellowships, NSF Traineeships and Fellowships, NASA Traineeships and New York State Regents' Fellowships. The stipends of university fellowships and graduate assistantships are subject to adjustment if held in conjunction with New York State Regents Awards and other extramural awards. If a student receives a stipend from the University and also from an outside source for the academic year, 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.

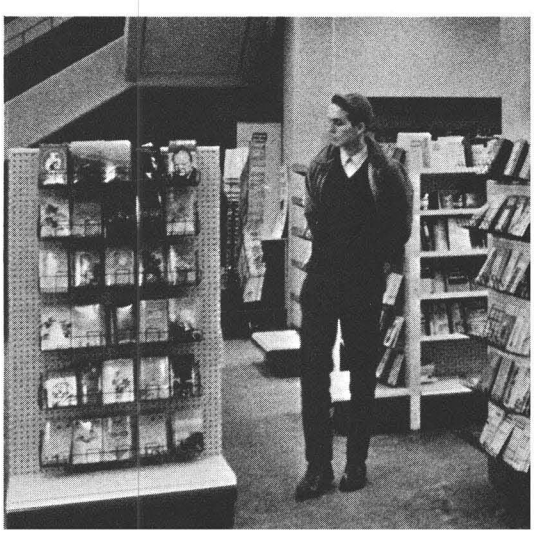
Students from the member states of the Organization of American States who wish to pursue graduate studies may apply, upon seeking admission to the University, for a fellowship grant under the terms of the Program of Fellowships and Professorships of the Organization of American States. Requests for O.A.S. fellowship applications should be directed to the 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.

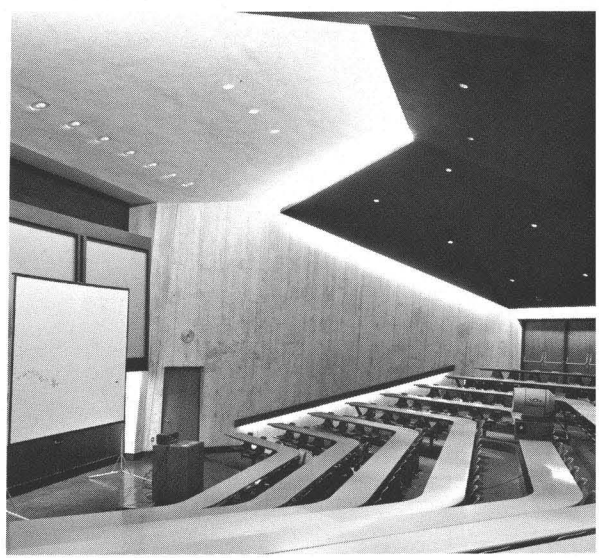
During the 1969-70 academic year, approximately 85% of the graduate students at Stony Brook held fellowships or assistantships.

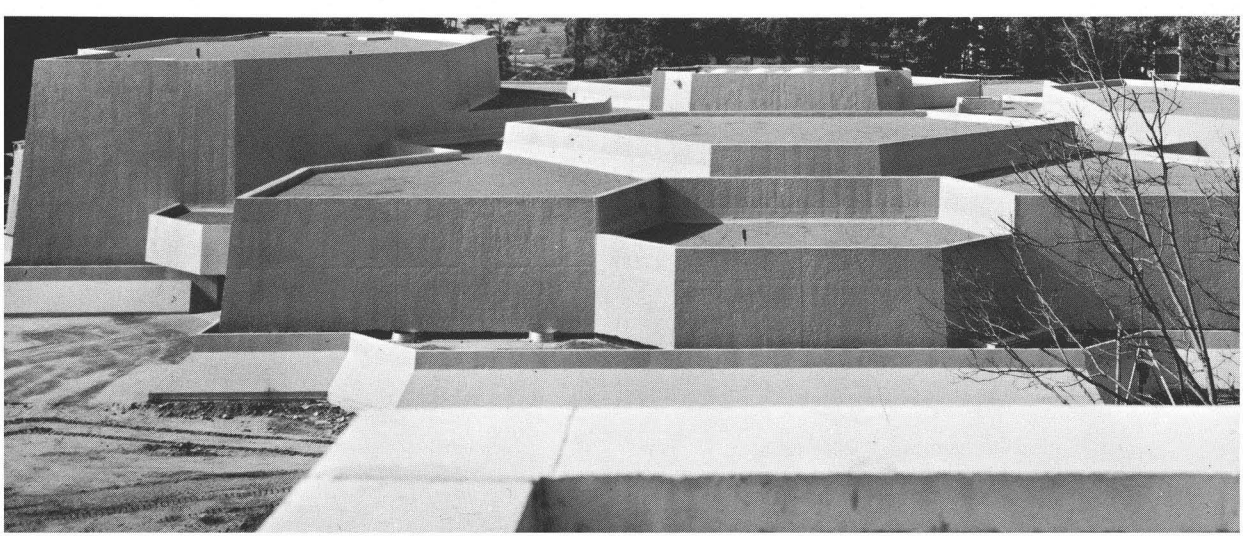

MAIN DESK
INFORMATION











ADMISSION 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 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 may be admitted provisionally, if he is considered to have a reasonable probability of making satisfactory progress in graduate studies. The department may set conditions which the admitted student must satisfy during the early period of his 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.*

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 assistantship (teaching or research) is considered part of the academic program; therefore, a graduate assistant, 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 con-

sultation 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.

Registration

All candidates for a graduate degree, whether in residence or in absentia, must be enrolled. This ruling includes those who are using the library, laboratories or computer facilities; who are consulting with the faculty while working on theses or dissertations; who are preparing for or taking qualifying or oral examinations at the masters or doctoral level; and who occupy teaching assistantships, research assistantships or pre-doctoral fellowships. Departments or individual faculty members do not have the authority to waive this rule.

Maintaining Matriculation

Students who have completed all degree requirements for the masters or doctoral degree, who have satisfied any residency requirement, and who are not on any appointment that requires full-time status, may submit a request to the Dean of the Graduate School for permission to register as a maintaining matriculated student. The student must complete a prepared form obtained from the Registrar and register for a one-semester, one-credit course in thesis or dissertation research for each semester that he is maintaining matriculation. Failure to maintain matriculation may result in ineligibility for a degree.

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 above. *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 may petition the Dean of the Graduate School for adjustment of these regulations to his case. In rare instances of this kind the letter "W" will be used to indicate withdrawal from a course.

Summer Registration

Students who will be supported on faculty research grants or assistantships and fellowships must be registered for six credits in Summer Session. A list of courses that are approved for the summer is available at the Office of Records and Studies.

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.

English Language Proficiency

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 (part of the admission process). 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.

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. If a student has taken the GRE, he should request the Educational Testing Service to forward the scores directly to the department or school to which he is applying.

Exchange Credits

When the special educational needs of a doctoral student at one SUNY institution can be served best by his taking a course for credit at another unit of the SUNY system, he should obtain a statement from his department chairman recommending that he be admitted to take the desired course at the visiting institution. The recommendation should state that the student has the prerequisites for the course and that, if he completes the course successfully, credit for it will be accepted toward his 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 visiting 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 visiting institution. If the student has a waiver of tuition at his home institution, that waiver will be recognized by the visiting institution. At the completion of the course the visiting 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.

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 to earn graduate credit. The acceptance of such credit by graduate schools other than Stony Brook is the responsibility of the student.

Off-Campus Research

If it becomes necessary for a student to perform his research off-campus in connection with his dissertation, he must obtain advance approval from his department and the Graduate School and maintain his registration in the Graduate School under the appropriate research course and must pay the necessary fees.

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.

Leaves of Absence

Leave of absence may be obtained for a specified time not to exceed two years with the permission of the department chairman and the Dean of the Graduate School. Military leave of absence will be granted automatically for the duration of obligated service to students in good standing.

Withdrawal from the University

A student finding it necessary to withdraw from the University must request, in writing, permission to withdraw from the department chairman. The department then recommends approval of this request to the Dean of the Graduate School. Once approval has been granted, the student must obtain a withdrawal card from the Office of Records and Studies. This card has to be approved by the offices indicated on the card in addition to the Dean of the Graduate School. Upon official voluntary withdrawal from the University, grades are assigned according to the effective date of the withdrawal as follows: If before the close of the first four weeks of classes, the withdrawal will be without grades. From the fourth week, through the end of the semester, a "W" grade will be given. In case of official withdrawal from the University, term fees are subject to refund according to the policy stated in this *Bulletin* under Refund of Fees.

Unauthorized Withdrawal. A student who leaves the University without obtaining an official withdrawal 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 for appropriate action.

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 needs and to satisfy departmental requirements. A student, well prepared on 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 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 his 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, his department chairman will appoint an appropriate supervisor or supervisory committee, in consultation with whom the student will conduct his investigation and write his 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 his dissertation research at an informal dissertation colloquium convened for that purpose by his 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 re-

quire evidence that the student is still properly prepared for the completion of his work. In particular, the student may be required to pass the Preliminary Examination again in order to be permitted to continue his work.

The Master of Arts (Liberal Studies) Degree

This is a terminal, non-research degree offered by the Center for Continuing Education primarily for persons interested in studying on a part-time basis. Details of the program and degree requirements are available from the Center.

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 as soon as feasible after all manuscripts have been received and all other university clearances completed. Formal investiture, however, will be at the spring commencement.

Waiver of Regulations

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

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

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.

INSTRUCTIONS FOR THE PREPARATION OF MASTERS THESES AND DOCTORAL DISSERTATIONS

The candidate should consult with his department or, in the case of engineering, his college, to determine if there are additional requirements, beyond those set forth in these instructions, which he will also be expected to follow in the preparation of his thesis or dissertation. 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 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 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 his 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 his dissertation, the Graduate School will advise him 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

The student should consult his advisor if he feels that the special nature of the thesis material 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]

GRADUATE PROGRAMS IN ARTS AND SCIENCES

ANTHROPOLOGY

Professors: ARMILLAS, P. BROWN *(Deputy Chairman)*, CARRASCO, [a]FARON *(Chairman)*

Associate Professor: STEVENSON

Assistant Professor: HICKS, REGELSON, STARR

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 his major or field of concentration.

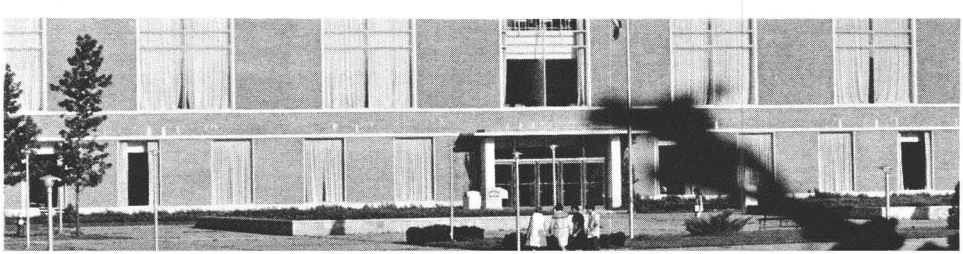
C. An applicant need not have majored in anthropology as an undergraduate but will be expected to make up deficiencies in his background by taking additional courses.

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.

[a] On leave academic year 1970-71.



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 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 Anthropology 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 two Indo-European languages 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 Comprehensive Examination before being permitted to do fieldwork under the sponsorship 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.

This department does not encourage students to work for a masters degree since such study does not accomplish the aims listed above. Rather, it leads to over concentration during the first year of residence and does not allow for a period of fieldwork, which is the hallmark of modern social anthropology. 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.

6 credits

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

The study 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 his material in a seminar and writes a paper on his research.

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 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 societies. 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

ANT 604 Tutorial in Anthropological Theory

Variable and repetitive credit

ANT 620 Research Seminar in Topical Problems

ANT 640 Research Seminar in Ethnography and Ethnology

ANT 650 Research Seminar in Cultural History

ANT 660 Language as an Analytical Tool

ANT 699 Research Seminar in Fieldwork Problems

BIOLOGICAL SCIENCES

BIOCHEMISTRY

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

Associate Professors: [a]FREUNDLICH, [e]MOOS, RILEY

Assistant Professors: ARNHEIM, DUDOCK, GESTELAND, LEICHTLING, S. SIMON, R. STERNGLANZ

BIOLOGY

Professors: [b]E. BAYLOR, CAIRNS, E. CARLSON, ERK, GLASS, JONES *(Chairman and Acting Provost of Biological Sciences)*, SANDERS *(Adjunct)*, SLOBODKIN, SOKAL, [c]SQUIRES, [b]G. WILLIAMS

Associate Professors: BATTLEY, LYMAN, MERRIAM, ROHLF, SMOLKER, TUNIK, WALCOTT

Assistant Professors: A. CARLSON, EDMUNDS, EMLEN, J. FARRIS, FOGG, J. FOWLER, FUTUYMA, GAUDET, HECHTEL, KERNAGHAN, KOEHN, KRIKORIAN, VANDERMEER, WURSTER

Lecturers: M. BAYLOR, GRACE

(Professors in Health Sciences: V. FARRIS, LEFEVRE, PELLEGRINO, UPTON) [d]

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[a] Research Career Development Award, U.S.P.H.S.
[b] Member, Marine Sciences Research Center.
[c] Director, Marine Sciences Research Center.
[d] Other scientists who may supervise graduate research in biological sciences.
[e] On leave academic year 1970-71.

Graduate Programs in the Biological Sciences

Graduate studies in the Division of Biological Sciences are centered around four independent programs under the direction of a program chairman and an executive committee. Currently the programs are: Developmental Biology, Ecology and Evolution, 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 he M.A. and Ph.D. degrees. Commencing in September 1970, a new graduate program in Marine Biology is to be initiated.

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 program in Developmental Biology 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.

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.

Marine Biology

In association with the Marine Sciences Research Center, the Division of Biological Sciences is initiating a graduate program in Marine Biology. For the fall of 1970, a masters degree program will be offered in marine sciences. For further information, contact Prof. Donald Squires, Director, Marine Sciences Research 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 Biology and Dr. John Garcia in Psychology.

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 performance of the student during his first year 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 503, 504 Nucleic Acids and Protein Biosynthesis

The material in these courses constitutes the essence of molecular biology. In the first semester, the structure of nucleic acids are considered in detail and their replication, both *in vivo* and on the enzymatic level, is taken up. The second semester is devoted to the machinery of protein synthesis, including amino acid activation, transfer RNA, ribosomes, the genetic code, and peptide chain initiation, elongation and termination.

Fall and Spring, 2 credits each semester

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

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. The student spends four periods of seven and one half weeks each during the course of the year in the laboratories 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, 4 credits (not offered 1970-71)

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 hy-

drogen 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 (not offered 1970-71)

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

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.

Each semester, 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.

Each semester, 1 credit

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 (not offered 1970-71)

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 (not offered 1970-71)

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 each semester

BIO 550 Practicum in Ecology

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

Each semester, 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, the origin of life, the fundamentals of organismal interaction, the ecology of the intertidal zone and the 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

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

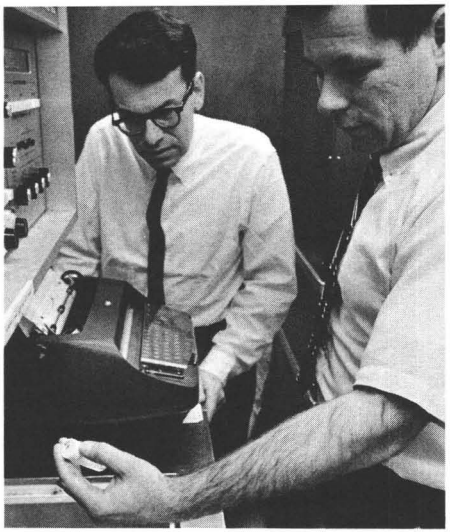
BIO 575 Macromolecular Evolution

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 (not offered Fall 1970)

BIO 583-598 Special Seminars

Topics to be arranged.



BIO 599 Research

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

Each semester, 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 semester of registration for BIO 600 is required for all candidates for graduate degrees in biological science, unless explicitly waived by the chairman.

Each semester, 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.

Each semester, 1 credit

BIO 671, 672 Seminar in Ecology and Evolution

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

Each semester, 1 credit

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.

Each semester, credit to be arranged

CHEMISTRY

Professors: ALEXANDER, BONNER (*Chairman*), CHU, FRIEDMAN, HAIM, KOSOWER, LAUTERBUR, LE NOBLE, OKAYA, RAMIREZ, SUJISHI

Associate Professors: GOLDFARB, HIROTA, PORTER, 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. 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 candidacy 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 each
Inorganic Chemistry	(CHE 511, 512)	3 credits
Quantum Chemistry II	(CHE 522)	3 credits
Chemical Kinetics	(CHE 526)	3 credits
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

[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.

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: Reading proficiency in German or another foreign language in which there exists a substantial body of chemical literature.

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 two foreign languages. In most cases students are expected to demonstrate reading proficiency in German and either French or Russian. Due to special circumstances regarding the research area of a student, the student may petition the Graduate Language Examination Committee if he wishes to substitute another language for one of the three languages mentioned above. Approval will be based on the importance of literature relevant to the research area of the student.

D. Formal course requirements: 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. Dissertation: 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.

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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, resonance and simple Huckel 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

The crystal and molecular structure of inorganic compounds including complex hydrides, halides, chalconides, organo-metallic compounds and transition metal complexes will be surveyed. Chemical properties of and reactions leading to these compounds will be discussed.

Fall, 3 credits

CHE 512 Inorganic Chemistry II

Topics presented include physical properties of inorganic substances, structural effects in chemical equilibria, mechanisms of inorganic reactions and interpretation in terms of electronic structure.

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 their application to a number of systems of interest to chemists. These systems include electrolytic and non-electrolytic 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 de 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 Mechcnics

Techniques will be discussed which permit the calculation of macroscopic properties for a variety of chemical systems, given the detailed nature of the microscopic substructure of the system. The above techniques, which lead to results paralleling those of thermodynamics, will be applied to ideal and real gases, crystals and liquids. In addition, some kinetic properties of systems will be examined.

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.

Fall, 2 credits

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.

Spring, 2 credits

CHE 604 Molecular Biochemistry

The application of physical-organic chemistry to biochemical reactions, including a survey of intermediary metabolism and mechanistic analysis of such reactions as decarboxylations, hydration, hydrolysis, electron-transfer reactions, hydrogen-transfer reactions and reactions of phosphates.

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 experimental techniques used to observe them. Applications of magnetic resonance spectroscopy to a number of topics of chemical interests, including rate processes, the electronic structures, conformations, and motions of molecules, and the structures and electronic properties of solids will be discussed.

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.

2 credits

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.

2 credits

CHE 699 Research

Variable and repetitive credit

EARTH AND SPACE SCIENCES

Professors: LINDSLEY, A. PALMER, SCHAEFFER, (*Chairman*), [a]SQUIRES, [b]STROMGREN, [c]WEYL

Associate Professors: [d]H. Y. CHIU, DODD, [c]GROSS, HARDORP, PAPIKE, PREWITT, STROM

Assistant Professors: BENCE, GEBEL, G. HANSON, SHU, M. SIMON, R. SMITH

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: No residency required.
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 24 credits without a thesis.
D. Evaluation:
   1. M.S. with thesis: Approval of the thesis by an examining committee.
   2. M.S. without thesis: Examination in three subject areas chosen by the student from a list of topics prepared by the department.
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.

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[a] Director of the Marine Sciences Research Center.
[b] Distinguished Professor of Astronomy, Royal Danish Observatory, Copenhagen; adjunct at Stony Brook.
[c] Member of the Marine Sciences Research Center.
[d] NASA/Goddard Space Studies Institute, part-time at Stony Brook.

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: Satisfactory performance in the Educational Testing Service language examination for either French, German or Russian.
C. Formal course work: Successful completion with a B average 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 four 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 306 Petrology
ESS 309 Structural Geology
ESS 312 Stratigraphy

Graduate Courses

ESS 503 Advanced Field Geology

Advanced problems in field geology.
Fall and Spring, variable credit

ESS 504 Sedimentary Petrology

Sedimentary rocks are studied at the outcrop, in hand specimen, and in thin sections using the petrographic microscope. Analyses of texture, mineralogy and sedimentary structures are used to interpret provenance, depositional environment, and subsequent diagnetic history of sandstone and carbonate rocks. Techniques of preparation and study are covered throughout the semester. Two hour lecture and four hour laboratory per week, plus at least two mandatory weekend field trips.
Prerequisite: Optical Mineralogy.
Alternate springs, 3 credits

ESS 506 Theoretical Petrology

Theory of phase diagrams, Schreinemaker's Rules, heterogeneous equilibria, experimen-

tal systems of petrologic interest. Laboratory: problems, experimental petrology.
Prerequisites: Metamorphic and Igneous Petrography, Optical Mineralogy 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, semi-quantitative, 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

Lecture sessions emphasizing selected examples of imaginatively resolved palentologic problems involving systematics, paleoecology, paleobiology, evolutionary patterns. Laboratory study of selected fossil assemblages, exploring the total potential for paleontologic interpretation of each sample and emphasizing the techniques required for full development of this potential.
Fall, 3 credits

ESS 512 Biostratigraphy

The uses of paleontologic data in problems involving dating and correlation of rocks and interpretations of geologic history.
Spring, 3 credits

ESS 513 Micropaleontology

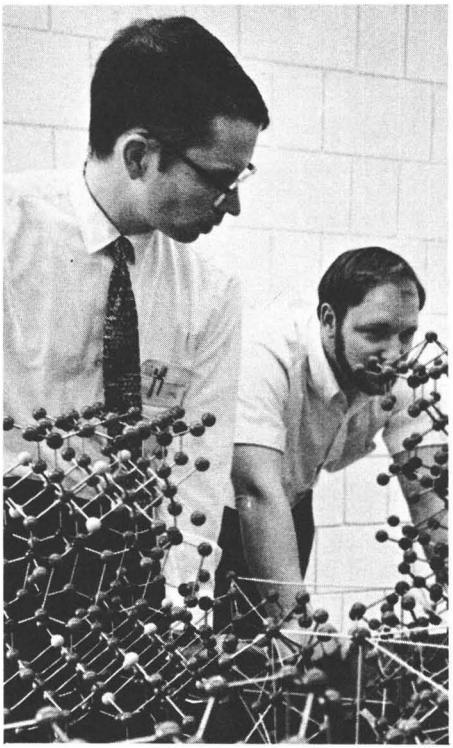
An introduction to the taxonomy, morphology, evolution, paleoecology and stratigraphic occurrence of foraminifera, ostracods, conodonts and other groups of microfossils. Laboratory work includes morphological study and special techniques applicable in the collection, preparation, study and photography of the various groups.
Fall, 3 credits

ESS 514 Advanced Stratigraphy

Study of the evolution of ideas concerned with interpretation of the physical and historical interrelationships of layered rocks and of the application of these ideas to selected stratigraphic problems.
Fall, 3 credits

ESS 515 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.
Prerequisites: Permission of instructor.
Alternate springs, 3 credits



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.

Spring, 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, 2 credits

ESS 523 Geochemistry

The study of the distribution and chemical combinations of elements on the earth including the atmosphere and the oceans.

Spring, 3 credits

ESS 531 Crystallography

Principles of symmetry, single-crystal and powder X-ray diffraction techniques and elements of crystal structure determination. Use of crystallographic data in the study of mineral systems. Laboratory in diffraction techniques includes extensive use of digital computers.

Fall, 3 credits

ESS 532 Crystal Chemistry

The application of crystallographic techniques to problems in mineral chemistry. Concepts of the crystalline state, order-disorder, atom radii, chemical bonding, atom coordination, solid solutions and physical properties of minerals. Emphasis on silicate and sulfide crystal structures.

Spring, 3 credits

ESS 541 Astrophysical Processes

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 non-thermal emission of electromagnetic radiation. Application of the theory to a variety of astronomical problems. Three one-hour lectures per week.

Fall, 3 credits

ESS 542 Interstellar and Galactic Astrophysics

The general properties of the interstellar gas and dust; the emission and absorption of the 21 cm. hydrogen line; the reddening and polarization of starlight and radio waves. Discussion of the interstellar magnetic field, the origin of cosmic rays and the mechanism of synchrotron radiation. Introduction to the dynamics of star clusters and galaxies. Application to the study of the large-scale structure of galaxies. Three hour lecture per week.

Spring, 3 credits

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 562 Physical Oceanography

The application of fluid mechanics to the study of waves, tides and ocean currents.

Spring, 3 credits

ESS 563 Sediments and Sedimentary Processes

A study of sedimentary processes as related to the ocean. Sediment environment as related to the coastal ocean, marginal ocean basins, the deep ocean bottom, lakes and fluvial environments are studied. The sediment minerals and the processes important in sediment formation are discussed. Two hour lecture and one three-hour laboratory per week.

Fall, 3 credits. (alternate years)

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)

ESS 599 Research

Fall and spring, variable and repetitive credit

ESS 600 Practicum in Teaching

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.

ESS 601 Topics 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

ECONOMICS

Professors: E. AMES (*Chairman*), HOFFMANN, LEKACHMAN, NEUBERGER, STEKLER

Associate Professors: JAMES, KALMAN, KANOVSKY, KRISTEIN, STALEY

Assistant Professors: CORNEHLS, DAWES, DUSANSKY, L. MILLER, NORDELL, SAKBANI, SCHOEPFLE, VAN ROY, WICHERS, ZSCHOCK, ZWEIG

Admission to Graduate Study

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

A. A baccalaureate degree, with an average of B in the undergraduate major subject.

B. Proficiency in introductory calculus (differential and integral calculus), demonstrated either by a grade of at least B in such a course or by special examination.

C. Results from the Graduate Record Examination. (The Aptitude Test and the test for the undergraduate major.)

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 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.
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.

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 for all students:

A. Mathematics: Specifically, differential and integral calculus of several variables, linear algebra and set theory. Proficiency may be demonstrated by a grade of at least B in an acceptable one year course or in a special examination.This requirement should be met during the first year of study.

B. Core fields of economics: Microeconomic theory, macroeconomic theory and quantitative methods. These requirements are to be met by achieving a grade of at least B in special written examinations in each field, normally at the end of the second year. An oral examination may supplement the written ones at the discretion of the examiners. 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.

2. 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 notifies both the student and the graduate committee, who will arrange the details of the proficiency examination.

3. 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.

4. 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. These fields are satisfied by achieving a grade of at least B in special written examinations, supplemented by an oral examination at the discretion of the examiners. One of these examinations may be waived if the student has achieved a satisfactory grade in all his course or other work in the field. These examinations will normally be taken at the end of the second year of graduate study. The department will allow one repetition of a field examination in either the core or optional fields. In preparing for the examinations, experimentation and flexibility are expected and encouraged; the

student may elect courses given by the department or other departments, an individual reading program under faculty supervision, research seminars or appropriate part-time work for governmental or other agencies. Prior approval of such a program must be obtained from a qualified faculty member, and carried out under his general supervision.

5. Degree candidacy. Successful completion of course and other work in the core and optional fields, mathematics proficiency, language proficiency if required, and the five field examinations are necessary for admission 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) but 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 intrauniversity program such as the Economic Research Bureau, Health Sciences Center, Marine Sciences Center or in extrauniversity 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 his own independent research and that it otherwise meets departmental standards.

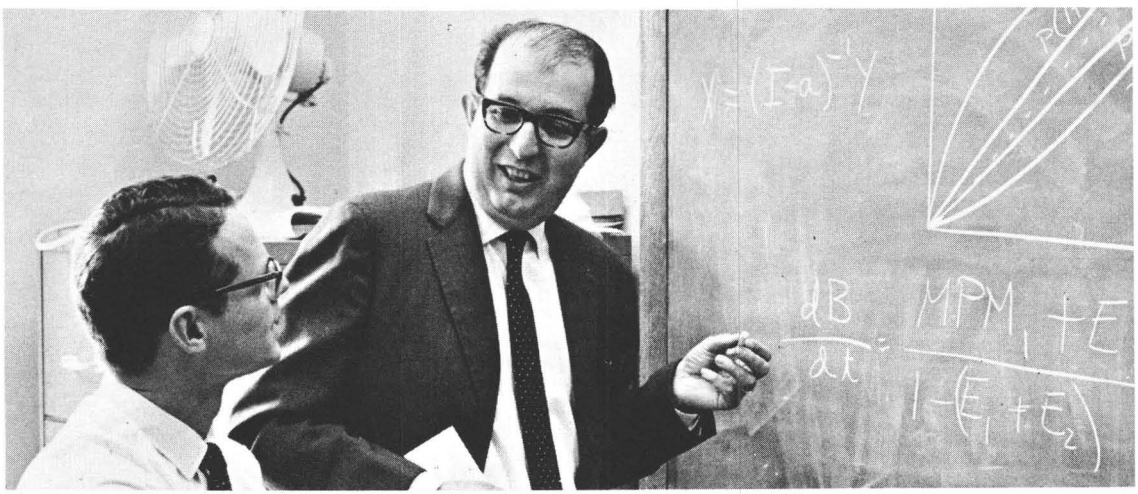
Miscellaneous Information

1. Teaching. The department is committed to achieving a high quality of teaching and encourages all graduate students to acquire teaching experience during their graduate study.

2. Time limit. In order to encourage early completion of all degree requirements, special 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.



Advanced Undergraduate Courses

ECO 331 Mathematical Foundations of Economics I

ECO 332 Mathematical Foundations of Economics II

ECO 333 Mathematical Foundations of Economics III

ECO 339 Income Distribution

See *Undergraduate Bulletin* for Descriptions.

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 502 Optimization Theory

General optimization theory, local and global. Theory of linear and non-linear programming. Elements of game theory.

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 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 Economics 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. Modification of analytic techniques to incorporate changes in the relative structure and level of economic models. Uncertainty as a factor in economic model building. Application of Bayesian analysis to economic behavior and models. Examples from dynamic input-output systems, production models and growth.

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 Economics 520. The application of mathematical and statistical methods to economic theory, including the concept of an explanatory economic model; multiple regression; hypothesis testing; simultaneous equations models and estimating techniques. Emphasis is placed on the application of econometric methods to economic issues and the interpretation of econometric studies.

Spring, 3 credits

ECO 522 Theory in Sampling

Elements in the design of samples. Probability sampling. Properties of sample functions. The asymptotic properties of some sample functions. Some distribution forms and their implications for sampling. Order statistics.

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 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. Individual behavior and optimization. Externalities. Societal optimization under various assumptions about societal goals.

3 credits

ECO 541 Economics of Medicine

Not offered 1970-71.

ECO 542 Urban Economics

Not offered 1970-71.

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

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 multi-disciplinary insights into widely variable institutional patterns of economic organization.

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 599 Research in Special Topics

Variable and repetitive credit

ECO 698 Practicum in Teaching

Variable and repetitive credit

ECO 699 Thesis Research

Variable and repetitive credit

ENGLISH

Professors: Altizer, Erdman, Kazin, Kranidas, Levin, Ludwig, Ribner, [a]L. Simpson, Stampfer, Stevens, Thompson, Weisinger

Associate Professors: Dolan *(Chairman),* Fiess, Fry, Goldberg, R. A. Levine, Maresca, R. Miller, Neumeyer, Pequigney, Rogers, Zimbardo

Assistant Professors: Abrahams, Anshen, Bennett, Carpenter, Egleson, Fortuna, Hall, Halperin, Nelson, Newlin, Petty, Raskin, Schreiber, Sears, 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 his doctorate within four years after taking the B.A. or three years after the M.A. During his first two years of doctoral study he 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, he will be free in his last year to complete his dissertation.

Fellowships and Assistantships

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 University Fellowship Program and also 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 assistantships with a stipend of $2,800 for the academic year.

Tuition is waived for holders of fellowships and graduate assistantships.

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[a] On leave fall semester 1970.

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 undergaduate 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 Master's 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.

Before his 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 dur-

ing 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 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 his 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 his 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 will receive "No Credit" for the course.

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

E. Foreign language proficiency: The student must demonstrate as early as possible his 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 his graduate study.
C. A sample of recent critical or scholarly writing. This requirement can be met by the submission of the masters thesis or a seminar paper.

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. He must take at least one course at either the 600- or 500-level, during each of the first three semesters of his 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 his studies through the more formal guidance of courses taken in addition to the required seminars.

It is recommended that when the student is teaching he take no more than two courses in any combination of 600-level seminars and

500-level courses, and that when he is not teaching he 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 linguistics 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: (1) is taking at least one 500-level course or 600-level seminar or is, in the opinion of his doctoral committee, properly preparing himself 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 he is taking and his 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 his own section of the composition course or a section of one of the University Lecture courses. During his apprenticeship and his teaching, the student will receive guidance in discussions with the director of teaching interns and the professor he assists, advice from senior members of the department who visit his classes, participation in staff meetings of large courses, and seminars in which he and his fellow students are joined by senior members of the staff.

During those semesters in which he 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 his ability to translate and/or comprehend writings of moderate difficulty in two foreign languages appropriate to his area of study and hence his ability to make use of relevant literary and scholarly writings in those languages.

Option II. The student must, on examination, demonstrate (1) his ability to read, understand and speak well one living foreign language, or his ability to read and understand well one classical language appropriate to his area of study, and (2) his knowledge of the major literature of that language in the original language, and hence his 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 his knowledge and critical understanding of the literature of four fields in English literary history.

The student will choose his 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 doctoral committee, shall define a cohesive area of special competence on which he 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 his doctoral committee, shall prepare reading lists for his preliminary examinations in his 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 his 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 reexamination 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 director and his 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 his 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

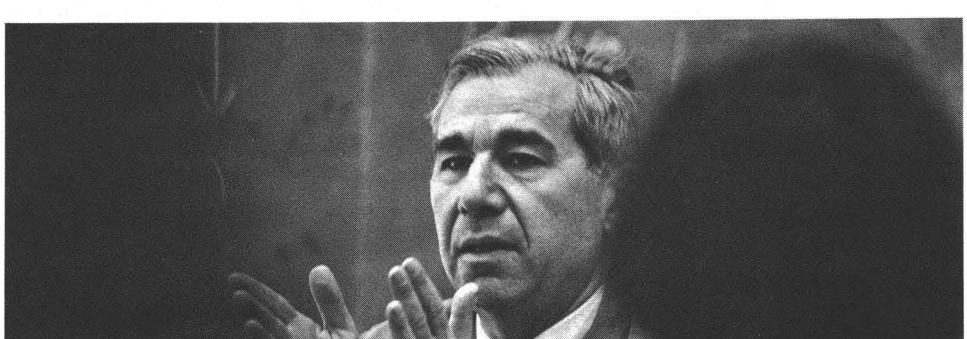
A. Advisory program: Every graduate student will at the beginning of his graduate studies at Stony Brook be assigned an advisor. The advisor will help the student plan his program on the basis of his wishes and needs and in the light of his total preparation, both undergraduate and graduate.

As soon as the student is admitted to the Ph.D. program he is asked to recommend to the graduate program committee the names of four or five professors he would like to serve on his doctoral committee. The student may include the name of the advisor originally assigned to him. The graduate program committee will then ask three of the student's nominees to serve as his 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 his 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 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 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

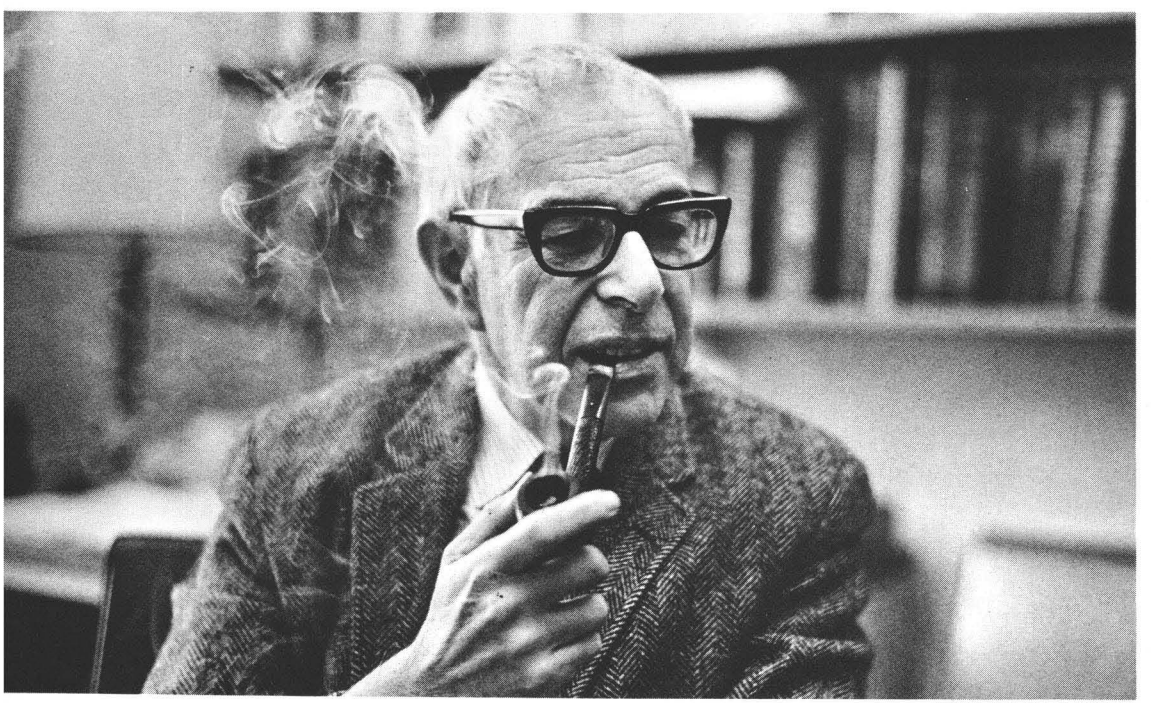
EGL 570 Studies in 20th Century American Literature
Variable and repetitive credit

EGL 580 Studies in British and American Literature
Variable and repetitive credit

EGL 590 Masters Paper Direction

EGL 597 Practicum in Methods of Research
Variable and repetitive credit

EGL 599 Independent Studies



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: SJÖBERG, WHITE (*Chairman*)

Assistant Professors: BERR, R. BROWN, NIRENBERG, O'NEIL, RUPLIN, RUSSELL, STENGEL

Fellowships and Assistantships

Applicants who have earned only the bachelors degree or its equivalent prior to study at Stony Brook will be eligible for followship support and will not normally assume teaching responsibilities in the first year of graduate study. The department participates in the University Fellowship Program and also 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 assistantships with a stipend of $2800 for the academic year.

Tuition is waived for holders of fellowships and graduate assistantships.

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 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 level of preparation up to the required standard.

If the applicant's credentials and background seem to indicate deficiencies in the German language, he may be required at the outset of his first semester of study to take a written and oral examination testing his 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 the State University of New York 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 departmental graduate committee.

Requirements for the M.A. Degree

A. Formal course requirements:	Credit Hours
1. One proseminar chosen from the 540-546 series or, for students wishing to specialize in Germanic philology and linguistics, one seminar from the 570-572 series.	3
2. GER 547 Special Author Studies	3
GER 548 Special Period Studies	3
3. Two seminars from the 550-555 series	6
4. GER 556 Bibliography and Methods	3
GER 557 History of the German Language	3
GER 558 Middle High German	3
	24 Cr. Hrs.

B. Performance: Grades 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 departmental graduate committee.

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

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 M.A. 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 graduate admissions committee of the Department of Germanic Languages.

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 during any of these years is not normally permitted.

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

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

D. Dissertation subject: Presentation of a proposal for a doctoral dissertation acceptable to the departmental graduate committee.

E. A student intending to prepare for a Ph.D. in Germanic philology must demonstrate proficiency in a second Germanic language.

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

	Credit Hours
1. One seminar from the 550-555 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	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 Cr. Hrs.

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 550-555 not previously taken.	3
2.	One seminar from the 570-572 series not previously taken.	3
3.	GER 562 Gothic and Indo-European	3
	GER 563 Old High German	3
	GER 564 Old Saxon or Old Norse or Old English or Medieval French or Comparative Modern Scandinavian	3
	GER 565 Middle High German Literature	3
	GER 603 Medieval Literature	3
	GER 610 Germanic Philology or Medieval Literature	3
		24 Cr. Hrs.

B. Language requirements:
   1. Candidates for the Ph.D. degree in Germanic philology will be required to demonstrate a working knowledge of *two* of the following languages: Latin, Classical Greek, Sanskrit, Old Church Slavonic, Celtic.
   2. Candidates for the Ph.D. degree in Germanic philology will be required to demonstrate a working knowledge of a non-Indo-European language.

Granting of the Ph.D. Degree

After the student's dissertation has been accepted, he must successfully defend it 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 his graduate studies in Stony Brook every student will be assigned a tutor. Tutors will be members of the department of professorial rank who will advise the student in the planning of his program ac-

cording to his special interests and needs against the background of his 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 graduate program committee of the department and normally for one year at a time.

C. Incompletes: If a student wishes to request an Incomplete he must, before getting the course instructor's approval, apply to the graduate program committee for its approval.

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 pro-seminars 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 his 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.

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 550 Seminar I: The Middle Ages
3 credits

GER 551 Seminar II: Reformation, Baroque, Enlightenment
3 credits

GER 552 Seminar III: The Classical Period
3 credits

GER 553 Seminar IV: Romanticism and Realism
3 credits

GER 554 Seminar V: 20th Century Literature
3 credits

GER 555 Seminar VI: 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 560 Theory and Criticism
3 credits

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. Topic to be selected by instructor.

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

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

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

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

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

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

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

H. Advanced seminar for candidates for Ph.D. in Germanic philology.

GER 610 Germanic Philology or Medieval Literature
3 credits

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GER 612 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.
Repetitive credit

GER 699 Doctoral Dissertation

Taken after advancement to candidacy.

HISTORY

Professors: ANGRESS, CHINCHILLA AGUILAR, LAMPARD, MAIN, SEMMEL, TAYLOR, TRASK (*Chairman*)

Associate Professors: BURNER, CLELAND, KUISEL, LEBOVICS, PRATT, J. T. ROSENTHAL, [b]STRAUDENRAUS, [a]F. WEINSTEIN, WELTSCH, WILDMAN, J. WILLIAMS

Assistant Professors: ALIN, BOTTIGHEIMER, HAMNETT, KNIGHT, [a]LAM, [c]R. H. G. LEE, R. M. LEVINE, MARCUS

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.

C. Results of the Gradute 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.

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a Not in residence academic year 1970-71.
b Not in residence fall 1970.
c Not in residence spring 1971.

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 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 a teaching assistant will perform research functions in his first year of graduate study, teach in his second and third, and assist with research again when he reaches 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, each M.A. candidate shall be assigned an advisor in his anticipated area of study (e.g., U.S., Europe, Latin America). The student shall work out with his advisor a field of examination, and a schedule 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 history (or intellectual or diplomatic or social).
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 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. A student is advanced to Ph.D. candidacy by passing a Qualifying Examination, both written and oral, in which he demonstrates a command of a major field and two minor fields. After advancement to candidacy, a student 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 his 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 his 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. The department expects to begin offering major fields in Early Modern European and Asian history in the near future. Minor fields can be taken in these fields and in Ancient and Medieval history.

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 his advisor, who will be appointed by the departmental chairman. The student will select his 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, and Latin American history. The department anticipates adding Early Modern and Medieval Europe as dissertation fields as soon as additional faculty appointments in this field 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 his 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 furher 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 1970-71 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 we have no regular course. 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 instructor. 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

History 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. A student should consult his advisor 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

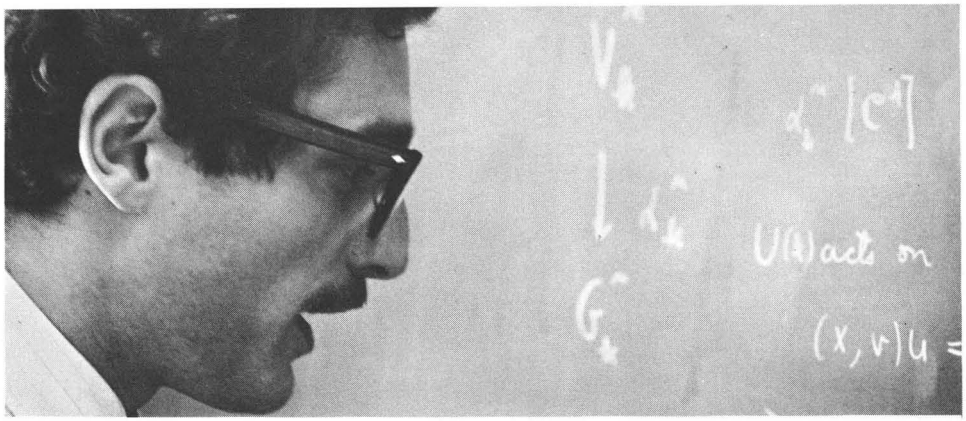
HIS 661 Research Seminar in East Asian History

HIS 682-686 Directed Reading for Ph.D. Candidates

Variable and repetitive credit

HIS 699 Research for Ph.D. Candidates

Variable and repetitive credit



MATHEMATICS

Professors: Adler, Ax, Barcus, Doss, Douglas, Gromoll, Lister, Pincus, Rapaport, Sah, Simons *(Chairman)*, Szüsz

Associate Professors: Charlap *(Director of Graduate Studies)*, Cheeger, Ebin, Farkas, W. Fox, Kra, Meyer, Schanuel, Thorpe, Zaustinsky

Assistant Professors: Bachelis, D'Alarcao, Feiner, Fried, Helton, Howe, Kumpel, Phillips, Roitberg, J. Rosenthal, Shantaram

Admission to Graduate Study

For admission to graduate study in mathematics, the following 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.

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 gaps may be admitted on a provisional basis. Upon admission, the student will be informed of the requirements which he must satisfy 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 his 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 his committee and begin preparation for the oral examination if he has fulfilled Ph.D. requirement B. 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.

MAT 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

MAT 503 Algebra II

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

4 credits

MAT 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

MAT 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

MAT 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 from valuation theory.

4 credits each semester

MAT 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

MAT 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

MAT 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

MAT 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

MAT 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

MAT 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

MAT 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

MAT 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

MAT 524, 525 Riemann Surfaces and Automorphic Functions

Analytic continuation, the complete analytic function and analytic configuration. Covering manifolds, monodromy theorem and cov-

ering 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

MAT 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

MAT 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

MAT 534 Differential Topology

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

4 credits

MAT 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

MAT 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

MAT 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

MAT 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

MAT 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.

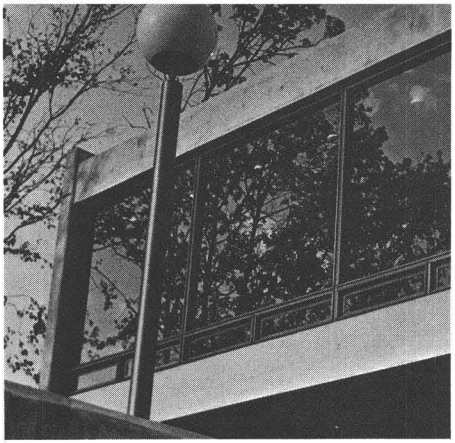
4 credits each semester

MAT 598 Independent Study

Variable and repetitive credit

MAT 600 Practicum in Teaching

Variable and repetitive credit



MAT 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

MAT 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

MAT 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

MAT 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

MAT 644 Characteristic Classes

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

4 credits

MAT 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

MAT 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

MAT 648 Minimal Varieties

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

4 credits

MAT 652, 653 Topics in Logic

Topics will vary from term to term so that students may take repeatedly for credit. Topics wil be chosen from model theory, set theory, proof theory, recursion theory, etc.

4 credits each semester

MAT 699 Thesis Research

Variable and repetitive credit

MUSIC

Professors: LAYTON (*Chairman*), NEMIROFF

Associate Professors: [a]BONVALOT, LESSARD, LEWIN

Assistant Professor: FULLER

Instructors: [a]R. KRAMER, LAWTON

Director of Choral Music: G. SMITH

Director of the University Band: KARASICK

Performing Artists in Residence: ADDISON, ANDERSON, BARON, BREHM, CANIN, DES ROCHES, DUPOUY, FROELICH, GLAZER, GREENHOUSE, KREISELMAN, ROSEMAN, [a]ROSEN, 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.
3. The harmonization of a chorale in four voices.

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[a] On leave academic year 1970-71.

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 undergraduate 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 the 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 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.

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 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 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

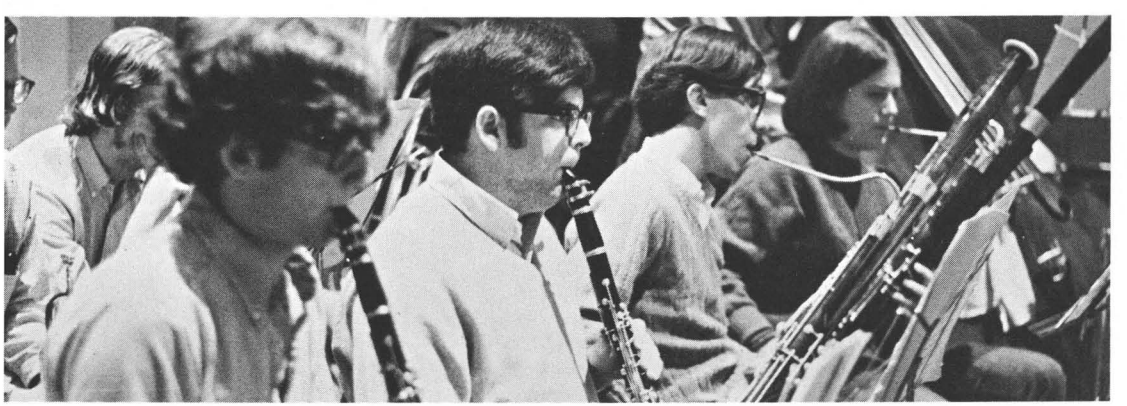
Instruction in the department under the supervision of the faculty. (Mus 591 may not be included in the courses taken in fulfillment of degree requirements.)

Variable credit

MUS 599 Independent Studies

Individual study under the guidance of a member of the faculty.

Variable credit



PHYSICS

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

Associate Professors: O. AMES *(Chairman)*, BLIEDEN *(Visiting)*, [a]CRAIG, DEZAFRA, FOSSAN, GRANNIS, A. JACKSON, KAHN, KAO, KIRZ, KUO, LEE-FRANZINI, MOULD, PAUL, STROM

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

Admission to Graduate Study

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

A. Baccalaureate degree in physics, from an accredited institution, with departmental course requirements in physics equivalent to those at this institution (including courses at the junior and senior level in electromagnetic theory, mechanics, methods of theoretical physics, quantum mechanics and modern physics, advanced laboratory).

B. A minimum grade average of B in all undergraduate course work, and of B in physics, mathematics and chemistry.

C. Acceptance by the Department of Physics and by the Graduate School.

In special cases, a student not meeting requirement A (or, in unusual cases, requirement B), may be admitted on a provisional basis. Upon 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.

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[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.

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 Ph.D. Degree

A. Two years of residence.

B. Demonstration of proficiency in one language (French, German or Russian).

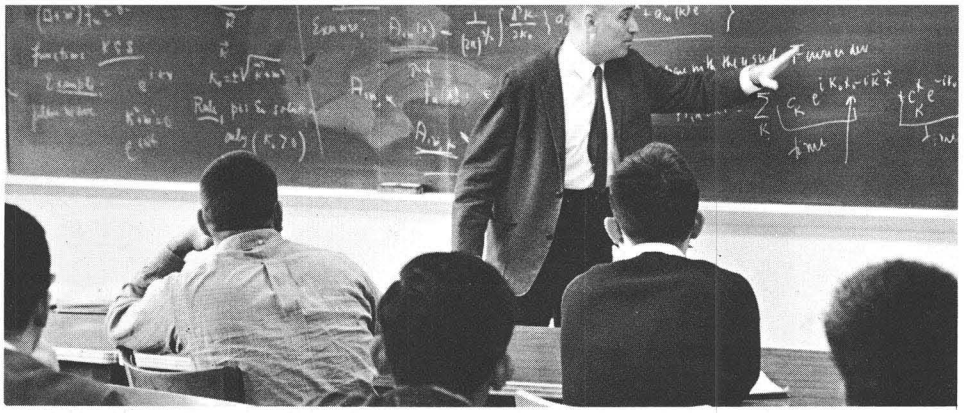
C. A grade of A or B in each of the following courses: Classical Physics I, II, Quantum Mechanics I, II, Statistical Mechanics. This requirement may be satisfied in any of the above three areas by satisfactory performance in a Basic Examination in the area in lieu of taking the specific courses. A student 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 per 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. Identical with PHY 343, 344. This course should be taken only by entering graduate students who have a deficiency in this area.

3 credits per semester

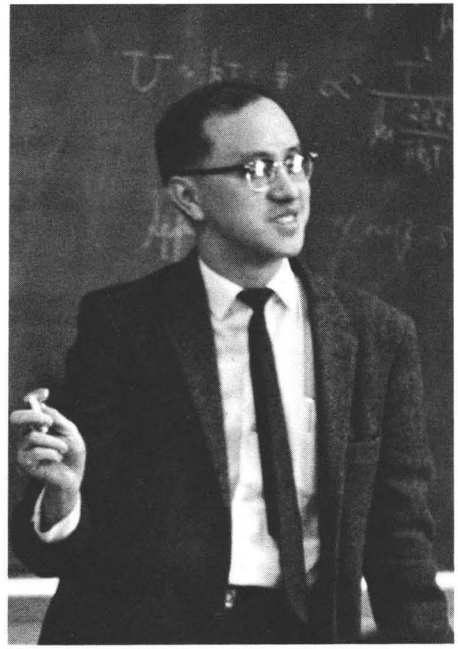
PHY 511, 512 Quantum Mechanics I, II

Aimed principally at developing complete familiarity with the nature of quantum mechanical systems. Topics include basic quantum physics and mathematical apparatus, angular momentum, symmetries, semi-classical theory of radiation, Dirac theory, and numerous concrete applications to atoms, nuclei, etc.
Prerequisite: Undergraduate exposure to physical foundations of quantum mechanics.

3 credits per 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 the 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 non-separable 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 ferro-electric models; introduction to fluctuation and non-equilibrium 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 per semester

PHY 620 Relativity

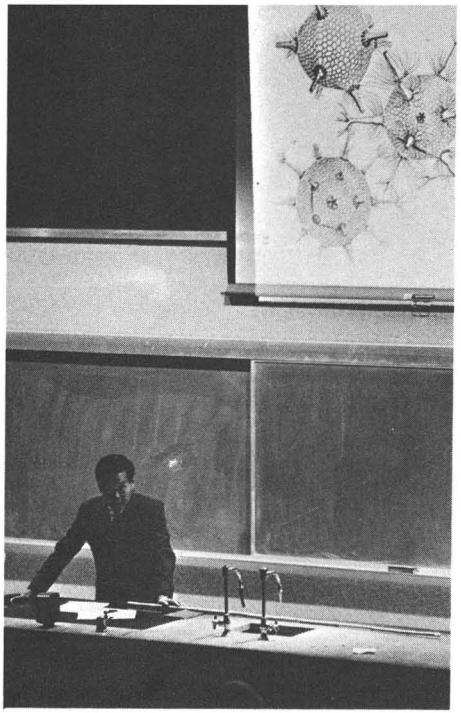
General theory of relativity; cosmology.

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 1970-71 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

PSYCHOLOGY

Professors: GARCIA, KALISH (*Chairman*), [a]KRASNER, M. LEVINE, [b]MERLIS, [g]F. PALMER, ROSS, STAMM, WYERS

Associate Professors: BRAMEL, DAVISON, GEER, [h]GOLDFRIED, [c]MORRISON, [f]POMERANZ, RACHLIN, SINGER, VALINS

Assistant Professors: BRANSFORD, CALHOUN, [d]DOLL, D'ZURILLA, EMMERICH, FEHMI, FRIEND, [e]GHOLSON, KESTENBAUM, F. LEVINE, NEALE, O'LEARY, SCHVANEVELDT, M. SMITH, S. STERNGLANZ, WEINTRAUB, WHITEHURST, [e]WINKLER, YOUNG

Clinical Associate: MCCONNELL

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.

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.

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a Director of Clinical Training.
b Visiting Clinical Professor.
c Associate in Instructional Resources.
d Member, Institute for Research in Learning.
e Visiting Assistant Professor.
f Director of Psychological Services.
g Provost for Educational Research and Development.
h Not in residence academic year 1970-71.

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.

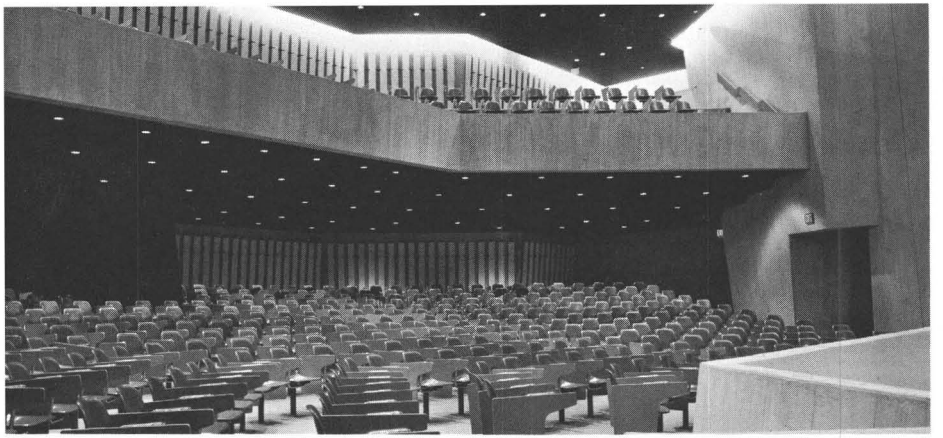
C. First year evaluation: The progress of each first year graduate student is reviewed at the end of the academic year by the entire faculty. The purpose of this review is to allow the student to withdraw without an unusually heavy investment of time when, in the opinion of the department, the student 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 him with 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 562 (340) Physiological Psychology

PSY 565 (341) Nervous System

PSY 566 (343) Synaptic Processes

PSY 610, 620 (391, 392) Seminars in Special Topics

Graduate Courses

PSY 501 Quantitative Methods I

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

Fall, 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.

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 research project which each student will formulate and complete within the year.

Fall and Spring, 3 credits per 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 per 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

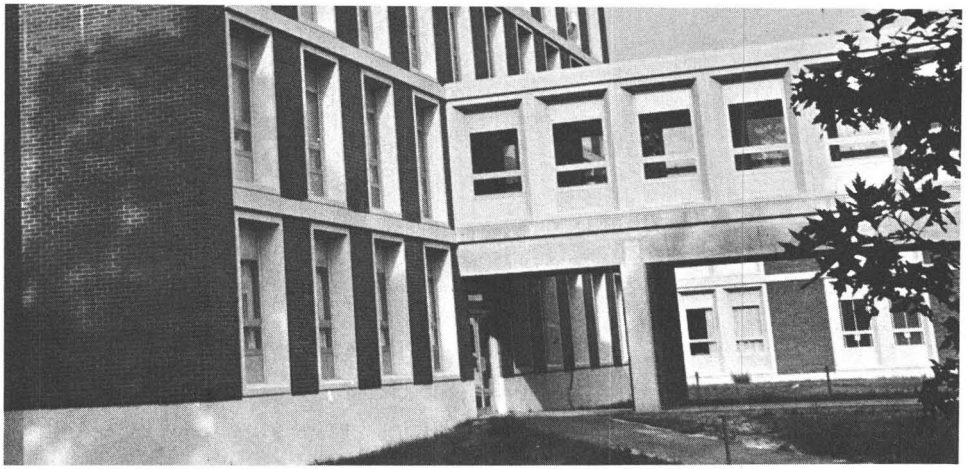
Theories, data and research methods involved in the study of deviant behavior will be covered. Emphasis will be on experimental approaches to psychopathology.

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 Practicum, PSY 532.

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 per 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 per 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 per 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 per 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 per 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 per semester

PSY 583, 584 Experimental Psychology Colloquium

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

Fall and Spring, 3 credits per 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 Reading

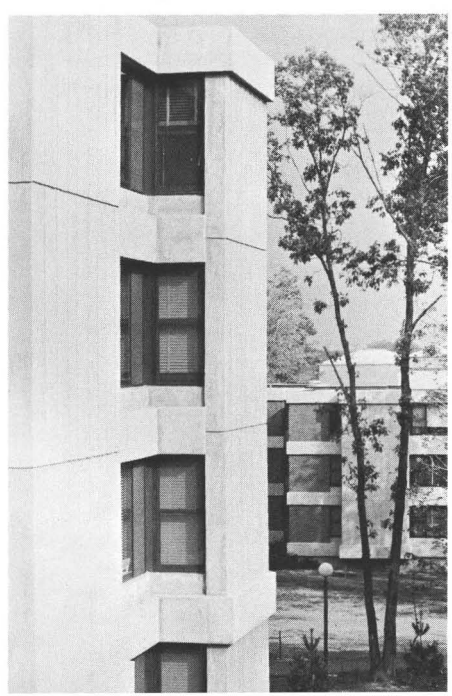
Variable and repetitive credit each semester

PSY 698 Research

Variable and repetitive credit each semester

PSY 699 Doctoral Research

Variable and repetitive credit each semester



ROMANCE LANGUAGES AND LITERATURES

FRENCH

Professors: BIEBER, [a]BRUGMANS, HAAC, LAIDLAW *(Chairman)*

Associate Professors: F. BROWN, MILLS *(Graduate Secretary)*

Assistant Professors: ALLENTUCH, PETREY, RIZZUTO

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.

In case the student's background in French is inadequate, he will be accepted as a candidate on a provisional basis during which time he will be able to complete his undergraduate requirements in French before starting on the masters program.

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 1971: French Medieval Drama.

This course may be repeated for credit when topic changes.

Spring, 3 credits

[a] On sabbatical leave during spring semester 1971.

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 599 Practicum in Teaching

Variable and repetitive credit

SOCIOLOGY

Professors: L. COSER, R. COSER, [b]LANG, PERROW, SELVIN, E. WEINSTEIN *(Chairman)*

Associate Professors: COLLVER, FELDMAN, GAGNON, [b]GOODMAN, [a]POLSKY, STREET

Assistant Professors: BERGER, K. BRYSON, S. COLE, FARBERMAN, GOODE, M. HARRISON, [b]HERRICK, HUDSON, D. PHILLIPS, M. SCHWARTZ, TUCHMAN, WEITMAN

Lecturers: 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 E below. Deficiencies must be made up before they 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 more credit hours per semester. Since a graduate assistantship (teaching or research) 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.

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[a] On leave spring 1971.
[b] On leave academic year 1970-71.

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. Requirements outside of the department: The student must choose *one* of three possible options. He may elect (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" a program of three courses in other departments determined in consultation with his advisor.

E. Research report: Every student must submit a research report that demonstrates his ability to analyze empirical data and to present his 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.

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 depth of his knowledge in the broad area from within which he has selected his dissertation topic and will include a consideration of his dissertation proposal. The content of this area is to be defined individually for each student.

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

G. Advancement to candidacy: The department's recommendation that a student be advanced to candidacy for the Ph.D. is based on his 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, his Ph.D. candidacy may lapse and he 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 his Ph.D. within four years from the time he begins graduate work.

Courses

Advanced Undergraduate Courses

SOC 341 Historical Sociology

Sociological theories and methods applied to the study of historical phenomena, such as revolutions, migration and industrialization.
Mr. S. Weitman
Prerequisites: SOC 103 *and* permission of instructor.
Fall, 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.
Fall, 3 credits

SOC 358 War and Military Institutions

The role of violence in social affairs; military organizations; civil-military relations.
Mr. K. Lang
Prerequisites: SOC 103 *and* senior standing.
Fall, 3 credits

SOC 361 Historical Development of Contemporary Sociology

Main currents in the development of theories and empirical studies of society, culture and personality.
Mr. H. Farberman
Prerequisite: SOC 103 or permission of instructor.
Fall and Spring, 3 credits each semester

SOC 362 Introduction to Sociological Theory

A systematic treatment of the dominant general orientations in Sociology including structural functional analysis and symbolic interactionism.
Mr. D. Phillips, Mr. S. Weitman
Prerequisite: SOC 103.

Fall, 3 credits

SOC 363 Sociology Today

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

Fall and Spring, 3 credits each semester

Graduate Courses

SOC 501 Sociological Analysis

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

Fall, 3 credits

SOC 502 Advanced Statistics

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

Spring, 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.
Mr. E. Weinstein
Prerequisite: SOC 501.

Fall, 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."
Mr. L. Coser

3 credits

SOC 508 Experimental Methods

The design, conduct, analysis of laboratory and field experiments.
Mr. E. Weinstein

3 credits

SOC 509 Field Work

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

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.
Mr. O. A. Collver
Prerequisite: One course in statistics.

Fall, 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.
Mr. O. A. Collver, Mr. D. Street

3 credits

SOC 521 Social Interaction

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

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.
Mr. K. Feldman, Mr. N. Goodman

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.
Mr. E. Goode

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.
Mr. J. Hudson, Mr. C. Perrow

3 credits

SOC 541 Conflict and Violence

Conflict and violence as related to social change. Examination of community controversies, social movements, uprisings and war.
Mr. L. Coser, Mr. K. Lang

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.
Mr. J. Gagnon, Mr. N. Polsky

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.
Mr. K. Lang

3 credits

SOC 549 Social Change

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

3 credits

SOC 561 Sociology of Intellectual Life

A compartive and historical analysis of the social conditions leading to the development of intellectual professionals.
Mr. L. Coser

3 credits

SOC 562 Sociology of the Arts

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

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.
Mr. S. Cole

3 credits

SOC 564 Communications

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

3 credits

SOC 571 Sociology of Health and Medicine

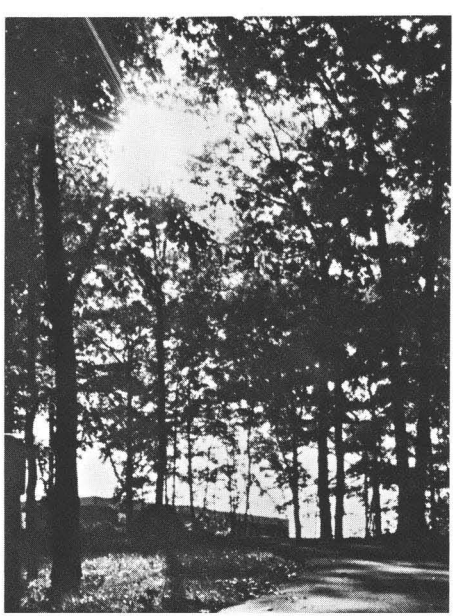
Social factors in health and illness; the socialization of health practitioners; the social organization of hospitals, clinics and other facilities.
Mrs. R. Coser

3 credits

SOC 590 Independent Study

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

Each semester



SOC 591, 595 Special Seminars

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

3 credits

SOC 598 Research

Staff

Each semester, credit to be arranged

SOC 603 Advanced Topics in Quantitative Analysis

Mathematical and statistical methods in the analysis of quantitative data.
Mr. H. Selvin
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.
Mr. S. Berger

3 credits

SOC 606 Sociological Theory Construction

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

Spring, 3 credits

SOC 691 Practicum in the Teaching of Sociology

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

SOC 698 Research for Ph.D.

Staff

Each semester, credit to be arranged

GRADUATE PROGRAMS IN ENGINEERING

The College of Engineering offers graduate study with degree programs leading to the M.S. and Ph.D. The College consists of four academic departments 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.

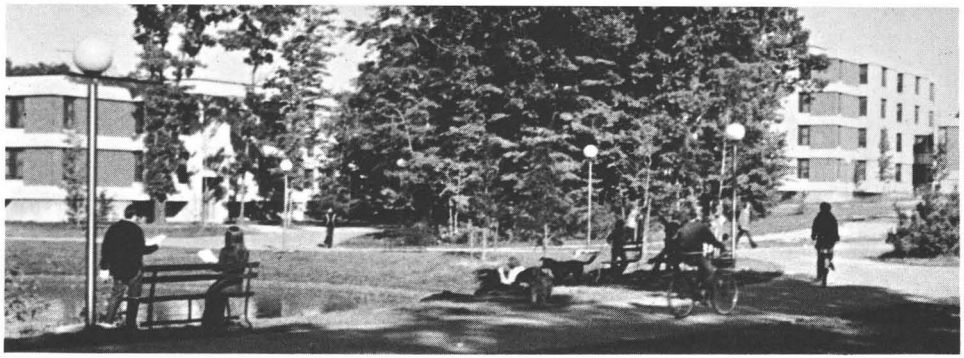
C. Acceptance by the College of Engineering and the Graduate School.

Requirements for the M.S. Degree

A. Formal course requirements: At least 21 credits (exclusive of credits for Research or Practicum in Teaching), 15 of which must be for graduate courses, while six credits may be for 300-level courses or their graduate equivalents in engineering, science or mathematics, at the discretion of the advisor. 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 grade for all courses taken must also be B or better. Also, the faculties of the various programs may require certain courses to be taken by the candidates.

B. Satisfactory completion of a thesis in the student's area of specialty. An Oral Examination on the thesis may be required by the faculties of any graduate program. At the option of the department, this requirement may be replaced by extra course credits and a comprehensive examination. Under this option the formal course requirements must total at least 27 credits.

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 his 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 the student has successfully completed all requirements for the degree other than the dissertation, he is eligible to be recommended for advancement to candidacy. This status is conferred by the Dean of the Graduate School upon recommendation of the chairman of the graduate program.

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

F. The student must defend his 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 doctor of philosophy degree must be completed within four years after advancement to candidacy.

APPLIED ANALYSIS

Professors: BELTRAMI, DICKER, DOLEZAL, FINERMAN, GELERNTER, GERST (*Chairman*), HELLER, [a]TEWARSON, TYCKO, ZEMANIAN

Associate Professors: BERNSTEIN, Y. CHEN, LEIBOWITZ, SRIVASTAV, [a]THAMPURAN.

Assistant Professors: HELTON, JOSEPH, KIM

The graduate program of this department provides a course of study in modern applied mathematics with a view to their 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. As part of this program, this department has instituted a cooperative project with the Department of Electrical Sciences for the development of specializations in the fields of automatic control theory, network theory and statistical communication theory.

In addition, the department sponsors a joint interdepartmental graduate program in computing science with the Department of Electrical Sciences, as described on page 139.

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 129-130. 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 129, the department requires a course in advanced calculus or equivalent material.

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[a] Not in residence academic year 1970-71.

Courses

ESA 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: ESA 505.

3 credits

ESA 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: ESA 501.

3 credits

ESA 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

ESA 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

ESA 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

ESA 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

ESA 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

ESA 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: ESA 505.

3 credits

ESA 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: ESA 501.

3 credits

ESA 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 ESA 316.

3 credits

ESA 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; nonlinear 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 ESA 317.

3 credits

ESA 520 Introduction to Applied Probability Theory

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, queueing problems, theory of games, problems of strategy, decision-making, etc. This course is equivalent to ESA 320.

3 credits

ESA 521 Introduction to Applied Statistics

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 ESA 321.

3 credits

ESA 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

ESA 526 Numerical Analysis I

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

3 credits

ESA 527 Numerical Analysis II

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

3 credits

ESA 535 Computer Organization and Programming

Logical basis of computer structure, machine representation of number and characters, flow of control, instruction codes, arithmetic and logical operations, indexing and indirect addressing, input-output, subroutines, linkages, macros, interpretive and assembly systems, pushdown stacks and recent advances in computer organization. Several computer projects to illustrate basic concepts are incorporated. This course is equivalent to ESA 335.

3 credits

ESA 537 Methods of Operations Research I

Elementary maxima and minima problems and the Lagrange multiplier. Linear programming including the simplex technique. The transportation problem. Queueing problems under different assumptions on input, service mechanism, and queue discipline. Dynamic programming. Basic ideas of inventory theory.

3 credits

ESA 538 Methods of Operations Research II

Non-linear programming and programming under uncertainity; 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: ESA 537.

3 credits

ESA 540 Introduction to the Theory and Applications of Computers

Topics covered include: introduction to the notions of effective calculability and computability, Turing machines, representation of information in a digital computer, axiomatic development of Boolean algebra, digital computer organization and logic, computer storage, control and input-output devices, online data acquisition systems, information display devices, image scanning and processing systems, very large read-only memories and information retrieval. Appropriate problems in engineering, physics, chemistry and biology are discussed and analyzed. This course is equivalent to ESA 340.

3 credits

ESA 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

ESA 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

ESA 550 Algebraic Coding Theory

Utilizing concepts and results from modern algebra and number theory which are developed in the course, a study is made of those error-correcting codes whose basic structure is algebraic. Among the classes of codes considered are those designated, respectively, as: linear, cyclic, BCH, perfect and residue.
Prerequisite: Permission of instructor.
3 credits

ESA 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: ESA 501.
3 credits

ESA 557, 558 Elasticity I and II

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

ESA 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: ESA 502.
3 credits

ESA 565 Wave Propagation I

This course is identical with ESE 520.
3 credits

ESA 566 Wave Propagation II

This course is identical with ESE 521.
Prerequisite: ESA 565.
3 credits

ESA 579, 580 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, PL/I and the techniques used in their compilation. Study of syntax, semantics, ambiguities, procedures and recursion in these languages.
Prerequisites: ESA 535, 540 or permission of instructor.
3 credits per semester

ESA 581 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.
Prerequisite: ESA 535 or permission of instructor.
3 credits

ESA 582 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.
Prerequisite: ESA 535 or permission of instructor.
3 credits

ESA 583 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. The inverse simulation problem, black-box modelling. Simulation using the FORTRAN language, in physics, chemistry and engineering.
Prerequisites: ESG 162, elements of statistics, linear algebra and ordinary differential equations or permission of instructor.

3 credits

ESA 584 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: Permission of instructor.

3 credits

ESA 587 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

ESA 588 Theoretical Foundations of Computing II

Recursive function theory and effective computability. The partial recursive functions, Gödel 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

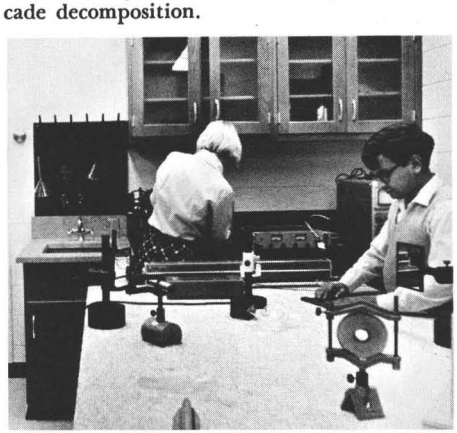
ESA 589 Automata Theory I

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

3 credits

ESA 590 Automata Theory II

The basic notions are the semigroup 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.
Prerequisites: Permission of instructor.

3 credits

ESA 591 Mathematical Theory of Computation

This course is identical with ESE 591.

3 credits

ESA 592 Laboratory in Computer Science

This course is identical with ESE 592.

3 credits

ESA 599 Research

Variable and repetitive credit

ESA 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, queueing problems, extinction of populations.
Prerequisite: ESA 504 and ESA 520.

3 credits

ESA 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 of response relationships, time series, optimization techniques, factor analysis.
Prerequisite: ESA 504 and ESA 521.

3 credits

ESA 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: ESA 605.

3 credits

ESA 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: ESA 502.

3 credits

ESA 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: ESA 504 and ESA 505.

3 credits

ESA 627 Theory of Integral Equations and Their Applications

Integral equations with degenerate kernels, equations of the second kind, iterative solutions, contraction maping 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: ESA 504 and ESA 505.

3 credits

ESA 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: ESA 504 and ESA 505.

3 credits

ESA 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 fomulisms. Representation theorems. oo-ports. Synthesis of Hilbert ports.
Prerequisite: Advanced calculus.
Corequisite: Functional analysis.

3 credits per semester

ESA 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: ESA 505.

3 credits

ESA 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 per semester, repetitive

ESA 698 Practicum in Teaching

3 credits, repetitive

ESA 699 Research

Variable and repetitive credit

INTERDEPARTMENTAL GRADUATE PROGRAM IN COMPUTING SCIENCE

Students enrolled in the Departments of Applied Analysis or Electrical Sciences may elect to participate in a joint program sponsored by both these departments, leading to an advanced degree with a designated option in computing science. To elect this program, a student should seek advice from a participating faculty member early in his or her graduate career, since the qualifying procedures and recommended course sequences are differentiated as described below. The computing science program faculty consists of members of the parent departments whose major research and teaching interests center in the computer related sciences, and at present includes Professors Bernstein, Finerman, Gelernter, Heller, Helton, Kieburtz, Smith and Tycko. Professors Smith and Tycko are co-chairmen of the program.

The program operates a computing science laboratory consisting of a Digital Equipment Corporation PDP 15/30 digital computer and an Electronic Associates TR 48 analog computer. Plans are under way to link the PDP 15/30 to the IBM 360/67 in the University Computing Center. A full graphics facility should also become available some time during 1970. Opportunities are available for students to become involved with hardware and software design projects associated with these systems.

The areas of faculty research in computing science in which a student may elect to pursue his thesis research are expanding rapidly as the faculty associated with the program are augmented. At present this includes artificial intelligence, computability theory, information organization and retrieval, pattern recognition, systems programming, switching theory and digital systems. In addition, facilities and associated faculty are available for topics in digital communications and control, graphic information processing and numerical analysis.

A qualifying examination in computing science subjects is taken in the second year of full-time study by all students working towards the Ph.D. degree. The examination also serves as a comprehensive examination for students desiring masters degrees.

The sequence of courses for each student is dependent on the student's background and interests, and is determined by consultation with an advisor. A typical course sequence suitable for new students and preparation for the above examination is given below:

First Semester — 12 credits

ESA 582 Data Structures
ESA 587 Theoretical Foundations of Computing I
ESE 317 or ESE 550 Digital Logic and Systems/Combinational Switching Theory
ESA 535 Computer Organization and Programming

Second Semester — 12 credits

ESA/ESE 579 Algorithmic Languages and Compilers I
ESA 588 or ESE 551 Theoretical Foundations of Computing II/ Sequential Machines
ESA 506 Finite Structures
ESA/ESE 592 Laboratory in Computer Science

Third Semester — 9 credits

ESA/ESE 581 Systems Programming
ESA/ESE 591 Mathematical Theory of Computation
ESA 514 Applied Algebra II

Thereafter, the program is determined by the student and advisor. Some other suitable courses are:

ESE 316 Digital Devices and Circuits

ESA 540 Introduction to the Theory and Applications of Computers

ESA/ESE 589 Automata Theory I

ESA/ESE 590 Automata Theory II

ESA 583 Simulation and Modelling

ESA 584 Information Organization and Retrieval

ESA 526, 527 Numerical Analysis I and II

ESA 507 Introduction to Probability and Stochastic Processes

ESA 550 Algebraic Coding Theory

ESE 535 Information Theory and Coding

Notices of new courses will appear as they are approved.

ELECTRICAL SCIENCES

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

The Department of Electrical Sciences offers graduate programs leading to the M.S. and Ph.D. degrees. Graduate programs are tailored to the needs of each student to provide him with a strong analytical background to apply to advanced engineering problems. Ample opportunities exist for students to initiate independent study and to become involved in active research programs, both experimental and theoretical.

In addition to its emphasis on modern electrical engineering, the department participates in interdepartmental graduate programs in computing science and in urban science and engineering, which are described in adjoining sections of this catalog.

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

Requirements for Graduate Degrees

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

Immediately upon arrival, every graduate student entering the department is assigned by the graduate program chairman to a temporary advisor, with whom he plans the first semester of courses. Before the start of the second semester he should seek the permission of a faculty member to act as research advisor, and with his approval compose a plan of course work which is then filed with the graduate program chairman. Any subsequent changes of advisor or courses should also be reported to the graduate program chairman.

In addition, every incoming student is required to take a comprehensive written examination during the first year. This examination is offered once per semester in a form, and at times, advertised to all graduate students. The results contribute to the decision of the faculty in awarding M.S. degrees as well as in qualifying a student for further work toward the Ph.D. degree.

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.

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

Courses

ESE 510 Physical Electronics

The theory of electronic processes and devices. Electron ballistics, applications to vacuum and microwave devices. Elements of solid-state electronics, conduction in solids; solid-state devices, diodes and transistors. Magnetism, dielectrics, ferroelectrics; introduction to superconductivity and cryotrons. Elementary theory of masers and lasers.

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.

3 credits

ESE 515 Quantum Electronics

A detailed treatment of the physics of microwave and optical masers. Topics include: a review of quantum mechanics and the theory of angular momentum; atomic spectroscopy with applications to gas lasers; theory of the interaction between matter and radiation; the steady-state and dynamic characteristics of masers and lasers.
Prerequisite: An undergraduate course in modern physics and/or quantum mechanics.

3 credits

ESE 520 Wave Propagation I

Theory of propagation of vector and scalar waves in bounded and unbounded regions. Equivalence theorems of field theory. Development of methods of geometrical optics. Propagation in inhomogeneous and in anisotropic media. Green's function for boundary-value problems.

3 credits

ESE 521 Wave Propagation II

Mode theory of guided waves. Expansion of wave functions in eigen-function series. Applications to propagation of electromagnetic waves in waveguides and around the earth. Propagation on periodic structures, and consequences of higher order symmetries. Operators with a continuous spectrum. Evaluation of radiation integrals by the method of steepest descent.
Prerequisite: ESE 520.

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. ESA 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.

Prerequisites: ESE 340 or equivalent or permission of instructor.

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 nonstationary systems. Pontryagin's maximum principle and applications. Bang-Bang and Pang-Bang systems. Dynamic programming and generalized maximum principle.

3 credits per semester

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 analy-

sis), 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 per semester

ESE 579, 580 Algorithmic Languages and Compilers I and II

This course is identical with ESA 579, 580.

3 credits per semester

ESE 581 Systems Programming

This course is identical with ESA 581.

3 credits

ESE 589 Automata Theory I

This course is identical with ESA 589.

3 credits

ESE 590 Automata Theory II

This course is identical with ESA 590.

3 credits

ESE 591 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: ESA 587.

3 credits

ESE 592 Laboratory in Computer Science

A significant programming problem or digital system design will be undertaken, tested, and thoroughly documented.
Prerequisite: Permission of instructor.

3 credits

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 Sciences

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, 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 in crystals, polymers, biomedical materials, magnetic interactions in solids, thermodynamics of solids, mechanisms of solid-state sintering, surface structure, neutron diffraction in crystals and structure of amorphous materials.

In addition to the requirements for the M.S. and Ph.D. degrees listed on pages 111-113, 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 every student during the first week of the second semester in which he is enrolled as a full-time or part-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 four semesters of full-time study including at least two consecutive semesters 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 inperfections 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 tranformations in solids is considered. Kinetics and mechanisms of nucleation and growth and martensitic tranformations.

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

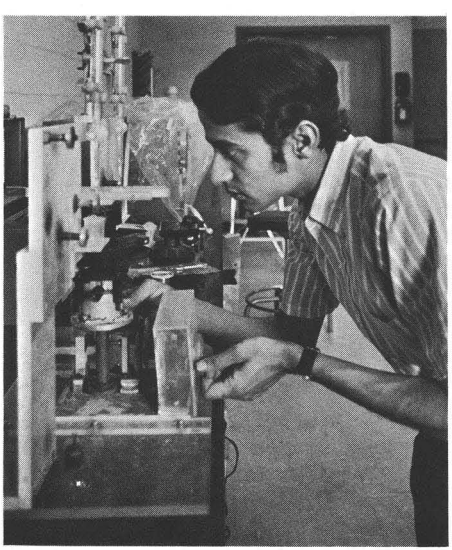
ESM 520 Structure of Solids

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, semiconductors 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

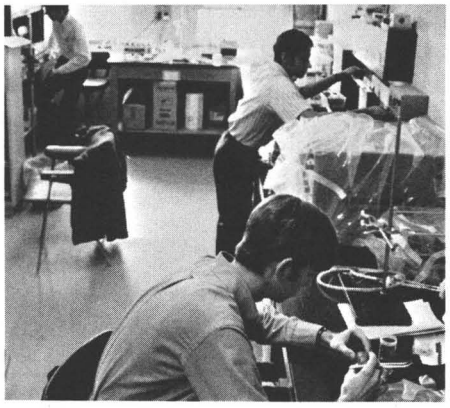
ESM 615 Electron Theory of Solids

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 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; thermodynamcal 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 antiferro-magnetic 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 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, C. H. YANG
Associate Professors: S. HARRIS, STELL, TASI
Assistant Professors: CHEVRAY, CHIANG, VARANASI, L. WANG

The Department of Mechanics offers graduate work leading to the master of science and doctor of philosophy degrees. The department offers a broad program emphasizing fundamental knowledge in the basic academic areas of 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 129-130. The residence requirement for the Ph.D. degree is two consecutive semesters of full-time study; there is no residence requirement for the M.S. degree.

Courses

ESC 501 Convective Energy Transfer

Discussion of the laws of conservation of mass, momentum and energy, with particular emphasis on the proper formulation of the energy equation and its subsequent reduction to physically useful limits such as that of incompressible flow. Introduction of the method of singular perturbations and the application of this method to develop the velocity and thermal boundary layer equations. Similarity solutions of the boundary layer equations, asymptotic formulations of the energy equation for large and small Prandtl number and methods of treating boundary layer problems which do not reduce to a similarity transformation.

3 credits

ESC 502 Radiative Energy Transfer

Discussion of the basic physics of black body radiation with emphasis upon the respective roles of electromagnetic theory and quantum statistics. Radiative absorption and emission processes for both opaque surfaces and absorbing-emitting gases. Radiative properties of surfaces, and formulation of the radiative exchange equations for systems of surfaces separated by a non-participating medium. Derivation of the equation of transfer for absorbing, emitting and scattering media, subsequent formulation of the radiative flux vector within such media, and application of this formulation to conservation of energy within systems involving absorbing, emitting and scattering media.

3 credits

ESC 511, 512 Advanced Fluid Mechanics I and II

Volume forces and surfaces acting on a fluid. Mechanical equilibrium of a fluid. Diffusion and heat conduction in isotropic media at

rest. Manifestations of departure from equilibrium. Transition relations at a material boundary. Kinematics of the flow field. Use of a stream function. The velocity distribution with specified rate of expansion and vorticity. Flows with zero rate of expansion and zero vorticity. The equations governing the motion of a fluid. Consideration of moving axes. Kinetically prescribed boundary conditions. Determination of pressure distributions. Energy integral relation. D'Alembert's paradox. Forces in nonsteady motions. Lagrange's equations. Plane-flow and axisymmetric singularities. Body representation in unsteady motion. Inversion theorems. Analytic solutions. Harmonic functions. Approximate solution of integral equations and use of digital computer. Conformal transformations in hydrodynamics foil theory. Mappings with multiple singularities. Schwarz-Christoffel theorem. Potential solutions via approximate methods. Graphical methods. Lattice-point solutions in matrix form. Iteration solution via digital computer. Analogies. Applications.

3 credits per semester

ESC 513 Transport Phenomena

An introduction to the transport of momentum, energy and mass in fluid media. The equations of change for isothermal systems. Interphase transport in isothermal systems. Macroscopic balances for isothermal systems. Mechanism of energy transport. The equations of change for nonisothermal systems. Interphase transport in nonisothermal systems. Mechanism for mass transport. Concentration distributions in solids and in laminar flow. Concentration distributions in turbulent flow. Interphase transport in multicomponent systems.

3 credits

ESC 514 Introduction to Turbulence

Introductory concepts and statistical description. Kinematics of random velocity fields. Equations of motion and their interpretation. Experimental techniques: isotropic turbulence and the closure problem. Transport processes in a turbulent medium. Turbulent jets, wakes and boundary layers.

3 credits

ESC 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 per semester

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 combusion, condensation, crystallization and other phase transition and transport phenomena. 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 combus-

tion 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 boundary 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 Gasdynamics

One-dimensional gasdynamics 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 gaskinetics. 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 interactions between an electrically conducting fluid and an applied electromagnetic field are studied, and the ramifications of these with respect to engineering applications such as power production, thermo-nuclear confine-

ment, 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 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 per 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 photoelasticity, birefringent coating, fringe multiplication and sharpening. Technique of absolute retardation. Dynamic photoelasticity and photothermoelasticity.

3 credits

ESC 591 Thermodynamics

An advanced course in classical thermodynamics presented from the postulational point of view. Also considered are such topics as Pfaff differentials and Caratheodorys principle, thermodynamics of irreversible processes, and the thermodynamics of small systems and solutions.

3 credits

ESC 599 Research

Variable and repetitive credit

ESC 611 Advanced Reactive Media I

Thermodynamics, rate processes, flow and stability of reactive media. Thermokinetic and thermophysical properties of nonequilibrium systems. Spectroscopic states and energy transfer in reactive systems. Nonequilibrium 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 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 per 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

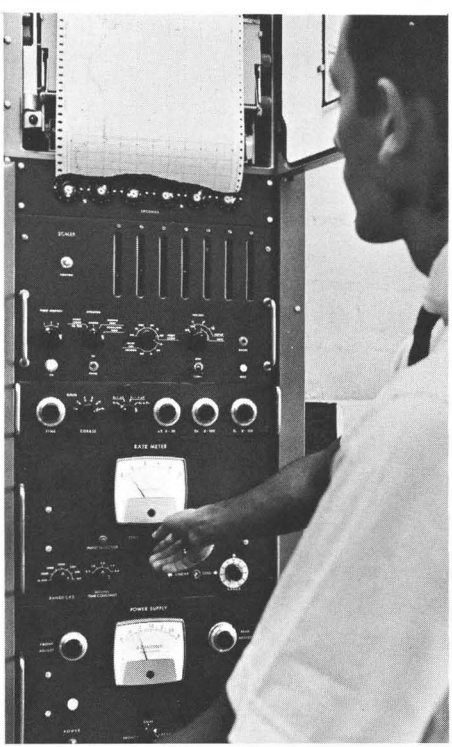
Theory of the BBGKY equations. Derivation of the Boltzmann and generalized Boltzmann equations. The correlation function approach to transport theory. Some explicit results for dense gases are considered.

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

INTERDISCIPLINARY GRADUATE PROGRAM IN URBAN SCIENCE AND ENGINEERING

The Master of Science program in urban science and engineering is designed to provide a 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 knowledge 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 the 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 public sector problems, but lacking the proper prerequisites in mathematics, may extend their period of study in order to take additional undergraduate courses in the Applied Analysis and Economics Departments.

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 approved 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 affiliated faculty from the departments in the College of Engineering and the Economics and Political Science Departments. The faculty includes Professors Ames, Berlad, Beltrami, Blum (Visiting), Carleton, Carroll, Dawes, Dollard, Dusansky, Finerman, Friedland, Heller, James, Jona, Nathans (Chairman), Nordell, Rappaport, Sakbani, Schoeple, Thomas, Thomson and Tycko.

Program of Study

Core Curriculum: To provide the student with an in-depth coverage of the quantitative methods in applied analysis and economics which bear on public sector problems, the courses listed below are recommended:

ESA 521 or ECO 520 Introduction to Applied Statistics/ Mathematical Statistics

ECO 502 Optimization Theory

ESA 583 Simulation and Modelling

ESA 325 Mathematics in the Social and Behavorial Sciences

ECO 521 Econometrics

ECO 506 Welfare Economics

ECO 514 Dynamic Economic Models

ESA 537, 538 Methods of Operations Research I and II

ESG 162 or ESA 165 Introduction to Computing Science/ Elements of Digital Computers

ECO 542 Urban Economics

ECO 215 Intermediate Mathematical Microeconomic Theory

ECO 504 Operations Research and Economic Theory

ECO 530 Public Finance

Notices of new courses will appear as they are approved.

Electives: Listed below are examples of suggested courses:

SOC 532 Complex Organizations

SOC 541 Conflict and Violence

SOC 362 Introduction to Sociological Theory

POL 254 The Politics of Governmental Planning

POL 256 Problems of Urban Areas

POL 257 Political and Administrative Decision Making

POL 272 Advanced Topics in Quantitative Political Analysis

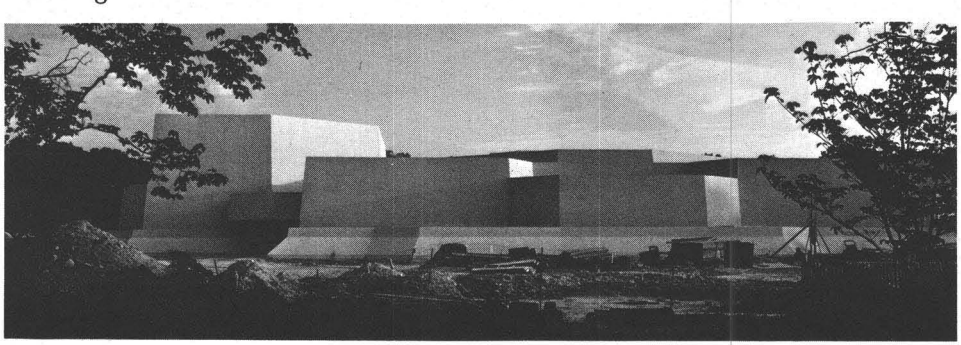
Case Studies: The role of the student in the Case Studies is expected to be an active one. The Case Studies provide the linkage between formal course work and real world situations. During the first year, actual problem situations are presented to the student by the faculty. Student participation grows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

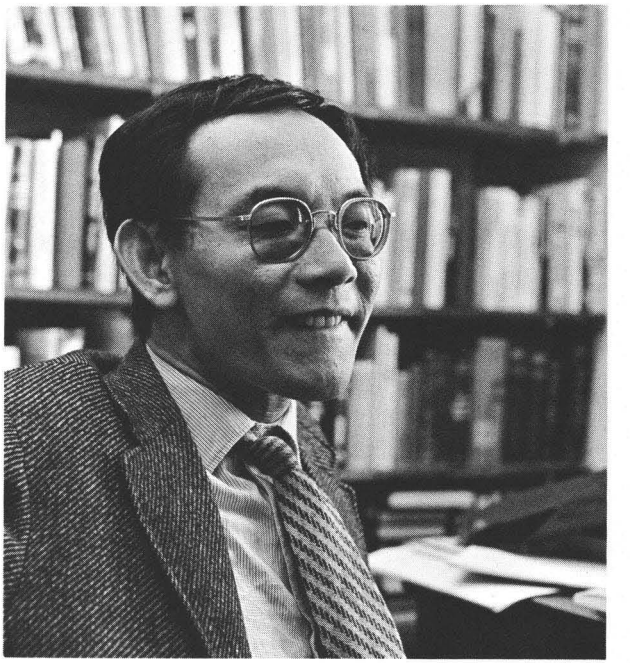
At the beginning of the second year a single large project involving a small group of students working with several members of the faculty in the program is arranged. Problem conditions, taken from the research activities of faculty in the program, are presented to the student to structure and investigate; he 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.

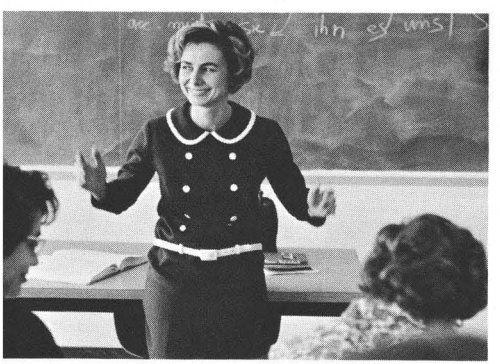
Internship: Normally, a student in the program is expected to devote the intervening summer between the first and second year of study gaining field experience by working with local or state agencies, consulting firms or non-profit institutions in areas related to urban or environmental problems. These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

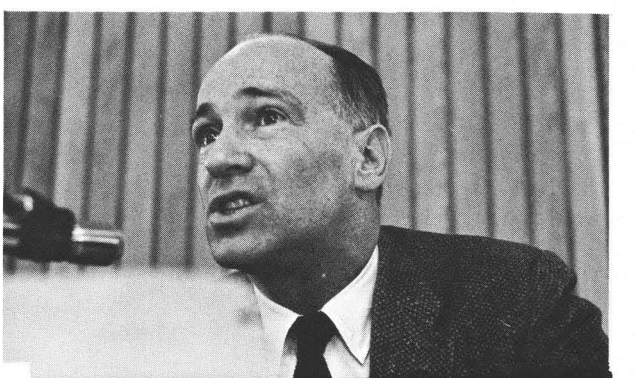
The critical examination of field work experience in light of the formal training in analysis taken during the first year of study, is an important part of the internship program. The student is expected to summarize his field work in a case study to be submitted at the beginning of his second year.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

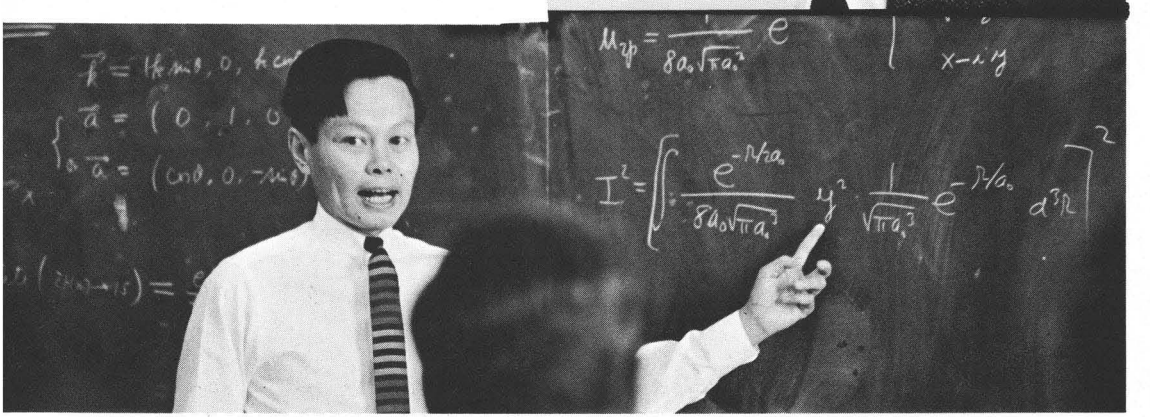
Research activities by members of the program currently involve a number of problem areas. These include: solid waste sources and flow; fire protection; housing maintenance and rehabilitation; patient flow in state mental institutions; noise pollution. Student participation in the ongoing research in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

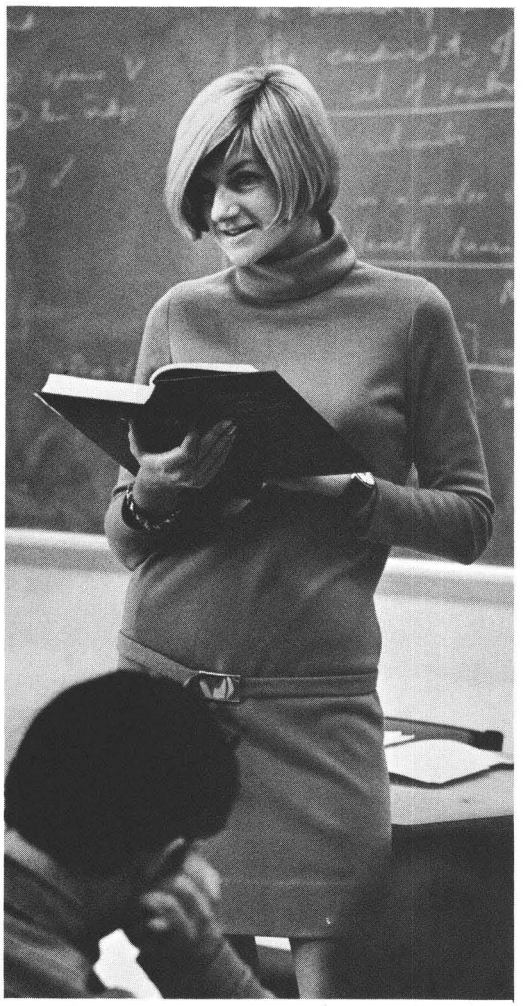


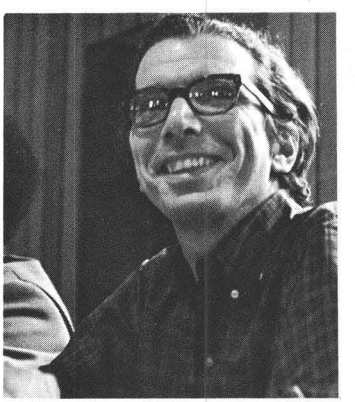


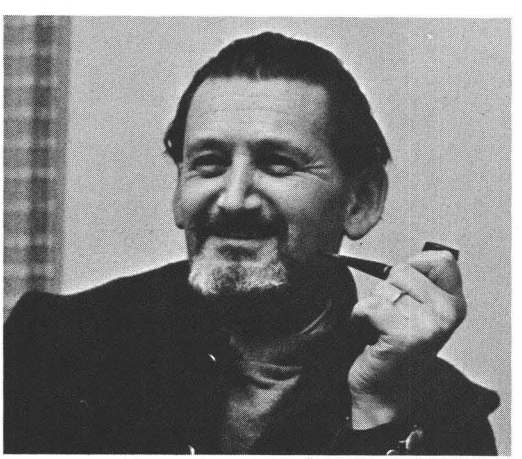


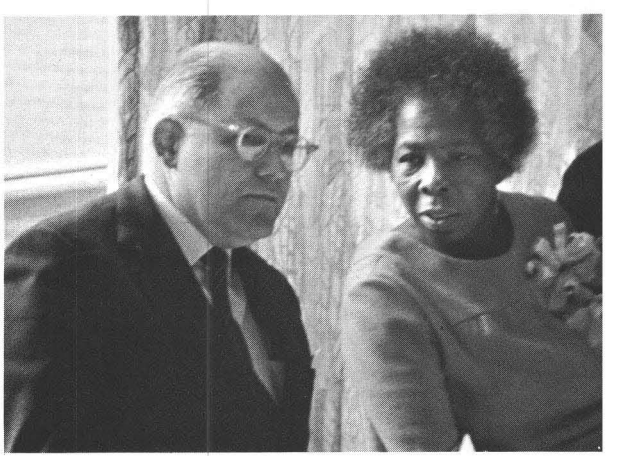



$\vec{k} = (k_x, 0, k_z)$
$\vec{a} = (0, 1, 0)$
$\vec{a} = (\cos\theta, 0, -\sin\theta)$
$M_{\gamma\psi} = \frac{1}{8a_0\sqrt{\pi a_0^3}} e$
$x - iy$
$I^2 = \left[\int \frac{e^{-r/a_0}}{8a_0\sqrt{\pi a_0^3}} y^2 \frac{1}{\sqrt{\pi a_0^3}} e^{-r/a_0} d^3r \right]^2$









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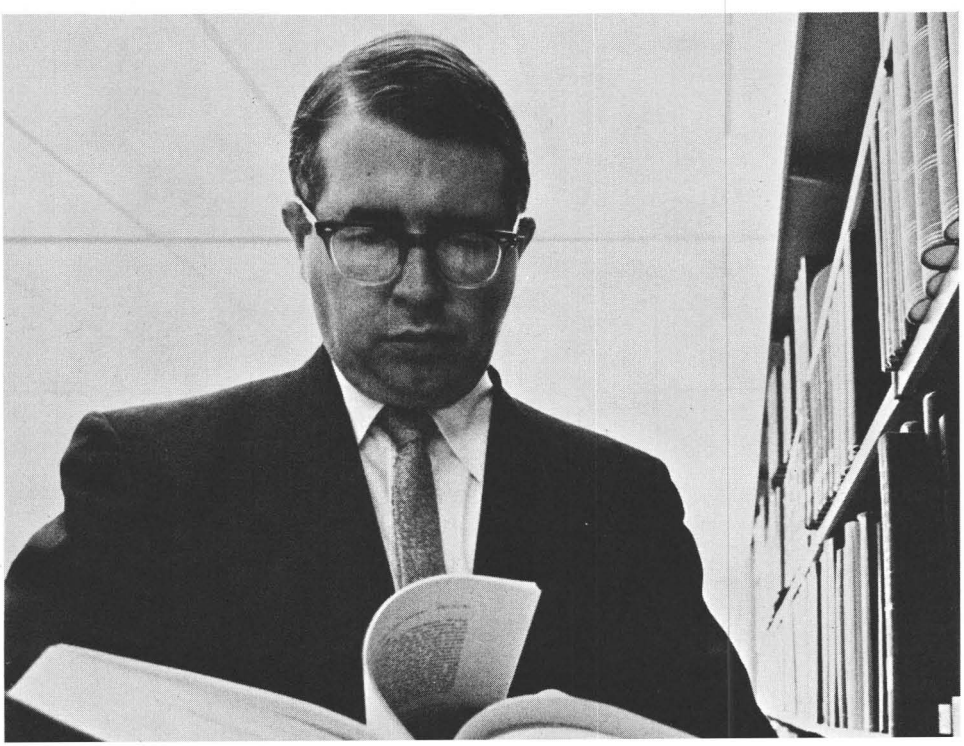

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EUGENE P. CRONKITE
Profesor of Medicine
M.D., Stanford University School of Medicine

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

MARY B. HAGAMEN
Instructor in Child Psychiatry
M.D., Western Reserve Medical School

LEONARD D. HAMILTON
Professor of Microbiology
D.M., Balliol College, Oxford; Ph.D., Trinity College, Cambridge

SHARON E. HAMILTON
Instructor in Nursing Practice (Community Health)
B.S.N., Central Missouri State College

GLEN E. HASTINGS
Associate Professor of Community Medicine
M.D., University of Kansas

HORTON A. JOHNSON
Associate Professor of Pathology
M.D., College of Physicians and Surgeons, Columbia University

JOHN R. KRESS
Instructor in Health Sciences Practice (Health Care Administration)
M.A., Columbia University School of Public Health and Administrative Medicine

ROBERT A. LOVE
Associate Professor of Industrial Medicine
M.D., Cornell University Medical College

IRENE B. MILLER
Instructor in Health Sciences Practice (Health Education)
M.P.H., University of California, Berkeley

HARRISON H. OWEN
Instructor in Clinical Community Medicine
M.A., Vanderbilt University

JAMES S. ROBERTSON
Professor of Medical Biophysics
M.D., University of Minnesota; Ph.D., University of California

STUART W. ROSNER
Assistant Professor of Clinical Medicine
M.D., New York University College of Medicine

STATE UNIVERSITY OF NEW YORK AT STONY BROOK
MEMBERS OF THE FACULTY

KENNETH T. ABRAMS
Assistant Professor of English
Ph.D., Cornell University

ADELE ADDISON
Performing Artist in Residence
B. Mus., Westminster Choir College, New England Conservatory of Music

ALFRED ADLER
Professor of Mathematics
Ph.D., University of California at Los Angeles

JOHN M. ALEXANDER
Professor of Chemistry
Ph.D., Massachusetts Institute of Technology

PER A. ALIN
Assistant Professor of History
Ph.D., University of Vienna

HARRIET ALLENTUCH
Assistant Professor of Romance Languages
Ph.D., Columbia University

THOMAS J. J. ALTIZER
Professor of English
Ph.D., University of Chicago

EDWARD AMES
Professor of Economics and *Chairman, Department of Economics*
Ph.D., Harvard University

OAKES AMES
Associate Professor of Physics
Ph.D., Johns Hopkins University

RONALD ANDERSON
Performing Artist in Residence
Ed. D., Columbia University

WERNER T. ANGRESS
Professor of History
Ph.D., University of California, Berkeley

FRANK S. ANSHEN
Assistant Professor of English
Ph.D., New York University

AKITO ARIMA
Professor of Physics
Ph.D., University of Tokyo

PEDRO ARMILLAS
Professor of Anthopology
Bachiller Universitario en Ciencias, University of Barcelona

NORMAN ARNHEIM, JR.
Assistant Professor of Biological Sciences
Ph.D., University of California, Berkeley

JAMES AX
Professor of Mathematics
Ph.D., University of California, Berkeley

GREGORY BACHELIS
Assistant Professor of Mathematics
Ph.D., University of Oregon

NANDOR L. BALAZS
Professor of Physics
Ph.D., University of Amsterdam

WILLIAM D. BARCUS, JR.
Professor of Mathematics
Ph.D., Oxford University

SAMUEL BARON
Performing Artist in Residence
B.S., Juilliard School of Music; Pupil of Georges Barrere and Arthur Lora

PATRICK E. BARRY
Assistant Professor of Engineering
Ph.D., State University of New York at Stony Brook

EDWIN H. BATTLEY
Associate Professor of Biological Sciences
Ph.D., Stanford University

EDWARD R. BAYLOR
Professor of Biological Sciences and *Senior Research Biologist, Marine Sciences Research Center*
Ph.D., Princeton University

MARTHA R. BAYLOR
Lecturer in Biological Sciences
Ph.D., University of Illinois

EDWARD J. BELTRAMI
Professor of Engineering
Ph.D., Adelphi University

A. E. BENCE
Assistant Professor of Petrology
Ph.D., Massachusetts Institute of Technology

JOSEPH T. BENNETT
Assistant Professor of English
Ph.D., New York University

STEPHEN D. BERGER
Assistant Professor of Sociology
Ph.D., Harvard University

ABRAHAM L. BERMAN
Professor of Engineering
Ph.D., Ohio State University

ARTHUR J. BERNSTEIN
Associate Professor of Engineering
Ph.D., Columbia University

SAMUEL BERR
Assistant Professor of German
Ph.D., New York University

KONRAD BIEBER
Professor of Romance Languages and Comparative Literature
Ph.D., Yale University

JOHN C. BILELLO
Assistant Professor of Engineering
Ph.D., University of Illinois

H. RICHARD BLIEDEN
Visiting Associate Professor of Physics
Ph.D., Florida State University

FRANCIS T. BONNER
Professor and *Chairman, Department of Chemistry*
Ph.D., Yale University

aEDWARD A. BONVALOT
Associate Professor of Music
Ph.D., Harvard University

KARL S. BOTTIGHEIMER
Assistant Professor of History
Ph.D., University of California, Berkeley

WALTER S. BRADFIELD
Professor of Engineering
Ph.D., University of Minnesota

DANA BRAMEL
Associate Professor of Psychology
Ph.D., Stanford University

JOHN D. BRANSFORD
Assistant Professor of Psychology
Ph.D., University of Minnesota

ALVIN BREHM
Performing Artist in Residence
M.A., Columbia University

FREDERICK BROWN
Associate Professor of French
Ph.D., Yale University

GERALD E. BROWN
Professor of Physics and *Member, Institute for Theoretical Physics*
Ph.D., University of Wisconsin; Ph.D., Yale University; D.Sc., University of Birmingham, England

PAULA BROWN
Professor of Anthropology
Ph.D., University of London

RUSSELL E. BROWN
Assistant Professor of German
Ph.D., Harvard University

cLINETTE BRUGMANS
Professor of French
Ph.D., New York University

KENNETH BRYSON
Assistant Professor of Sociology
Ph.D., University of Wisconsin

DAVID B. BURNER
Associate Professor of History
Ph.D., Columbia University

JOHN CAIRNS
Professor of Biological Sciences (Joint appointment with Cold Spring Harbor Laboratory for Quantitative Biology, Cold Spring Harbor, N. Y.)
M.D., Oxford University

JAMES F. CALHOUN
Assistant Professor of Psychology
Ph.D., University of Illinois

HERBERT R. CARLETON
Associate Professor of Engineering
Ph.D., Cornell University

ALBERT D. CARLSON
Assistant Professor of Biological Sciences
Ph.D., State University of Iowa

ELOF A. CARLSON
Professor of Biological Sciences
Ph.D., Indiana University

MARTIN CANIN
Performing Artist in Residence
M.S., Juilliard School of Music

WILLIAM E. CARPENTER
Assistant Professor of English
Ph.D., University of Kansas

PEDRO CARRASCO
Professor of Anthropology
Ph.D., Columbia University

T. OWEN CARROLL
Assistant Professor of Engineering
Ph.D., Cornell University

ROBERT D. CESS
Professor of Engineering
Ph.D., University of Pittsburgh

SHELDON S. L. CHANG
Professor of Engineering
Ph.D., Purdue University

LEONARD S. CHARLAP
Associate Professor of Mathematics
Ph.D., Columbia University

JEFF CHEEGER
Associate Professor of Mathematics
Ph.D., Princeton University

CHI-TSONG CHEN
Associate Professor of Engineering
Ph.D., University of California, Berkeley

YUNG MING CHEN
Associate Professor of Engineering
Ph.D., New York University

RENE CHEVRAY
Assistant Professor of Engineering
Ph.D., University of Iowa

FU-PEN CHIANG
Assistant Professor of Engineering
Ph.D., University of Florida

ERNESTO CHINCHILLA AGUILAR
Professor of History
Maestro en Historia, Escuela Nacional de Antropología e Historia, México, D.F.

HONG-YEE CHIU
Adjunct Professor of Astrophysics
Ph.D., Cornell University

BENJAMIN CHU
Professor of Chemistry
Ph.D., Cornell University

VINCENT P. CIRILLO
Ph.D., University of California at Los Angeles
Professor of Biological Sciences

HUGH G. CLELAND
Associate Professor of History
Ph.D., Western Reserve University

JAMES A. COLE
Assistant Professor of Physics
Ph.D., Johns Hopkins University

STEPHEN COLE
Assistant Professor of Sociology
Ph.D., Columbia University

O. ANDREW COLLVER
Associate Professor of Sociology
Ph.D., University of California, Berkeley

JAMES V. CORNEHLS
Assistant Professor of Economics
Ph.D., University of Texas

LEWIS A. COSER
Distinguished Professor of Sociology
Ph.D., Columbia University

ROSE L. COSER
Adjunct Professor of Sociology
Ph.D., Columbia University

ERNEST D. COURANT
Professor of Physics and Engineering and
Member, Institute for Theoretical Physics
Ph.D., Rochester University

PAUL P. CRAIG
Associate Professor of Physics
Ph.D., California Institute of Technology

HUGO D'ALARCAO
Assistant Professor of Mathematics
Ph.D., Pennsylvania State University

GERALD C. DAVISON
Associate Professor of Psychology
Ph.D., Stanford University

WILLIAM S. DAWES
Assistant Professor of Economics
Ph.D., Purdue University

RAYMOND DES ROCHES
Performing Artist in Residence
M.M., Manhattan School of Music

ROBERT LEE DEZAFRA
Associate Professor of Physics
Ph.D., University of Maryland

DANIEL DICKER
Professor of Engineering
Eng.Sc.D., Columbia University

ROBERT T. DODD, JR.
Associate Professor of Mineralogy
Ph.D., Princeton University

PAUL J. DOLAN
Associate Professor of English and
Chairman, Department of English
Ph.D., New York University

VACLAV J. DOLEZAL
Professor of Engineering
CSc., Czechoslovak Academy of Sciences

THEODORE DOLL
Assistant Professor of Psychology and
Member, Institute for Research in Learning
Ph.D., Kent State University

PETER M. DOLLARD
Associate Professor of Engineering
Ph.D., Polytechnic Institute of Brooklyn

RAOUF DOSS
Professor of Mathematics
Ph.D., Cairo University, Egypt

RONALD G. DOUGLAS
Professor of Mathematics
Ph.D., Louisiana State University

MAX DRESDEN
Professor of Physics and
Executive Officer, Institute for Theoretical Physics
Ph.D., University of Michigan

BERNARD S. DUDOCK
Assistant Professor of Biological Sciences
Ph.D., Pennsylvania State University

RICHARD DUSANSKY
Assistant Professor of Economics
Ph.D., Brown University

JEAN DUPOUY
Performing Artist in Residence
Conservatoire National de Musique, Paris

THOMAS J. D'ZURILLA
Assistant Professor of Psychology
Ph.D., University of Illinois

DAVID EBIN
Associate Professor of Mathematics
Ph.D., Massachusetts Institute of Technology

LELAND N. EDMUNDS, JR.
Assistant Professor of Biological Sciences
Ph.D., Princeton University

JANET F. EGLESON
Assistant Professor of English
Ph.D., New York University

LEONARD EISENBUD
Professor of Physics
Ph.D., Princeton University

JOHN MERRITT EMLEN
Assistant Professor of Biological Sciences
Ph.D., University of Washington

DAVID EMMERICH
Assistant Professor of Psychology
Ph.D., University of Indiana

DAVID V. ERDMAN
Professor of English
Ph.D., Princeton University

FRANK C. ERK
Professor of Biological Sciences
Ph.D., Johns Hopkins University

HARVEY A. FARBERMAN
Assistant Professor of Sociology
Ph.D., University of Minnesota

HERSHEL FARKAS
Associate Professor of Mathematics
Ph.D., Belfer Graduate School of Science

LOUIS C. FARON
Professor of Anthropology and *Chairman, Department of Anthropology*
Ph.D., Columbia University

JAMES S. FARRIS
Assistant Professor of Biological Sciences
Ph.D., University of Michigan

VERA K. FARRIS
Assistant Professor of Pathology and
Lecturer in Biological Sciences
Ph.D., University of Massachusetts

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

LAWRENCE FEINER
Assistant Professor of Mathematics
Ph.D., Massachusetts Institute of Technology

ARNOLD M. FEINGOLD
Professor of Physics
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
Assistant Professor of 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 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

DANIEL Z. FREEDMAN
Assistant 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
Assistant 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 A. 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 H. GAGNON
Associate Professor of Sociology
Ph.D., University of Chicago

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

JOHN J. GAUDET
Assistant Professor of Biological Sciences
Ph.D., University of California, Berkeley

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

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 of Engineering and *Chairman, Department of Applied Analysis*
Ph.D., Columbia University

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

JON BARRY GHOLSON
Visiting Assistant Professor of Psychology
Ph.D., State University of Iowa

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
Associate Professor of English
Ph.D., University of Chicago

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

aMARVIN 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

B. ERICH GOODE
Assistant Professor of Sociology
Ph.D., Columbia University

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

DALE GRACE
Lecturer in Biological Sciences
Ph.D., University of California at Los Angeles

ERLEND 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
Associate Professor of Oceanography and *Research Oceanographer, Marine Sciences Research Center*
Ph.D., California Institute of Technology

aOSCAR 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
Assistant 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
Ph.D., University of Michigan

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

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

F. JOANNE HELTON
Assistant Professor of Engineering
Ph.D., Stanford University

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

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

CLINTON S. HERRICK
Assistant Professor of Sociology
Ph.D., Johns Hopkins University

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

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

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

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

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

RUDOLPH C. HWA
Assistant Professor of Physics and *Member, Institute for Theoretical Physics*
Ph.D., 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
D.Phil., Oxford University, England

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

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

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

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

FRANCO P. JONA
Professor of Engineering
Ph.D., Eidgenössische Technische Hochschule, Zürich, Switzerland

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 Engineering
Ph.D., Case Institute of Technology

PETER B. KAHN
Associate Professor of Physics
Ph.D., Northwestern University

HARRY I. KALISH
Professor of Psychology 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 and *Russion*
Ph.D., Lodz University, Poland
Ll.D., Jagielonsky University, Poland

W. KEITH KAVENAGH
Lecturer in History
Ph.D., New York 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
Assistant Professor of Engineering
Ph.D., Carnegie Institute of Technology;
Ph.D., Carnegie-Mellon University

JANOS KIRZ
Associate Professor of Physics
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

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 of Mathematics
Ph.D., Columbia University

aRICHARD 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

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

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

PAUL G. KUMPEL, JR.
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 and
Chairman, Department of Romance
Languages
Ph.D., Columbia University

aTRUONG BUU LAM
Assistant Professor of History
Doctorat en Philosophie e Lettres, Histoire
Moderne, Université Catholique de
Louvain, Belgium

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 of Music 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, Nuclear Structure Laboratory*
Ph.D., Yale University

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

aROBERT H. G. LEE
Assistant Professor of History
Ph.D., Columbia University

YONG Y. LEE
Assistant Professor of Physics
Ph.D., University of Michigan

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

MARTIN A. LEIBOWITZ
Associate Professor of Engineering
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 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
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

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

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

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

WOLFGANG MEYER
Visiting Lecturer in Mathematics
Ph.D., University of Bonn, Germany

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 and *Graduate Secretary*
Litt.D., University of Rome;
Ph.D., Columbia University

aCARL 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

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
Ph.D., University of Pennsylvania

JOHN MAXWELL 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

PETER F. NEUMEYER
Associate Professor of English
Ph.D., University of California, Berkeley

EGON NEUBERGER
Professor of Economics
Ph.D., Harvard University

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

MORTON NIRENBERG
Assistant Professor of German
Ph.D., Johns Hopkins 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

YOON YONG OH
Assistant Professor of Mathematics
Ph.D., Brandeis University

YOSHI OKAYA
Professor of Chemistry
Ph.D., Osaka University

K. DANIEL O'LEARY
Assistant 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

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 B. PERROW
Professor of Sociology
Ph.D., University of California, Berkeley

DONALD S. PETREY
Assistant Professor of French
Ph.D., Yale University

GEORGE R. PETTY
Assistant Professor of English
Ph.D., New York University

ANTHONY PHILLIPS
Assistant Professor of Mathematics
Ph.D., Princeton University

DAVID 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
Associate 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

FAUSTO RAMIREZ
Professor of Chemistry
Ph.D., University of Michigan

ELVIRA S. RAPAPORT
Professor of Mathematics
Ph.D., New York University

STEPHEN S. RAPPAPORT
Assistant Professor of Engineering
Ph.D., New York University

JONAH RASKIN
Assistant Professor of English
Ph.D., University of Manchester

STANLEY REGELSON
Assistant Professor of Anthropology
B.A., City College of New York

IRVING RIBNER
Professor of English and *Chairman, Department 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

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

aCHARLES ROSEN
Performing Artist in Residence
Ph.D., Princeton University

JOEL T. ROSENTHAL
Associate Professor of History
Ph.D., University of Chicago

JOHN ROSENTHAL
Assistant Professor of Mathematics
Ph.D., Massachusetts Institute of Technology

ALAN O. ROSS
Professor of Psychology
Ph.D., Yale University

FERDINAND A. RUPLIN
Assistant 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 R. SANDERS
Adjunct Professor of Biological Sciences
Ph.D., Yale University

OLIVER A. SCHAEFFER
Professor of Geochemistry and *Chairman, Department of Earth and Space Sciences*
Ph.D., Harvard University

ROGER SCHVANEVELDT
Assistant Professor of Psychology
Ph.D., University of Wisconsin

STEVEN SCHANUEL
Associate Professor of Mathematics
Ph.D., Columbia University

ROBERT F. SCHNEIDER
Associate Professor of Chemistry
Ph.D., Columbia University

GREGORY SCHOEPFLE
Assistant Professor of Economics
Ph.D., Purdue University

EARL G. SCHREIBER
Assistant Professor of English
Ph.D., University of Illinois

DAVID SCHROER
Assistant Professor of Mathematics
Ph.D., Cornell University

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
Assistant Professor of English
Ph.D., Brandeis University

LESLIE L. 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

R. SHANTARAM
Assistant Professor of Mathematics
Ph.D., Pennsylvania State University

PETER SHAW
Assistant Professor of English
Ph.D., Columbia University

FRANK SHU
Assistant 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 *Chairman, Department of Mathematics*
Ph.D., University of California, Berkeley

LOUIS SIMPSON
Professor of English
Ph.D., Columbia University

[b]MELVIN V. SIMPSON
Professor of Biochemistry
Ph.D., University of California, Berkeley

JEROME E. SINGER
Associate Professor of Psychology
Ph.D., University of Minnesota

LEIF SJOBERG
Associate Professor of Germanic Languages and Scandinavian Studies
Ph.D., Uppsala University, Sweden

LAWRENCE B. SLOBODKIN
Professor of Biological Sciences
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

RAYMOND N. SMITH
Assistant Professor of Paleontology
Ph.D., University of Michigan

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 and *Director, Marine Sciences Research Center*
Ph.D., Cornell University

RAM P. SRIVASTAV
Associate Professor of Engineering
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 STAMM
Professor of Phychology
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

PHILIP J. STAUDENRAUS
Associate Professor of History
Ph.D., University of Wisconsin

HERMAN O. STEKLER
Professor of Economics
Ph.D., Massachusetts Institute of Technology

GEORGE R. STELL
Associate 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
M.A., Boston 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 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

CLIFFORD E. SWARTZ
Professor of Physics
Ph.D., University of Rochester

PETER SZUSZ
Professor of Mathematics
Ph.D., Budapest University, Hungary

JUDITH M. TANUR
Lecturer, Part-Time, 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

aREGINALD P. TEWARSON
Professor of Engineering
Ph.D., Boston University

aDEVIKUMARA V. THAMPURAN
Associate Professor of Engineering
Ph.D., University of Wisconsin

GARY L. THOMAS
Assistant Professor of Engineering
Ph.D., University of California, Berkeley

JOHN A. THOMPSON
Professor of English
Ph.D., Columbia University

ROBB M. THOMPSON
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

HENRY TRAMER
Assistant Professor of Mathematics
Ph.D., Johns Hopkins University

DAVID F. TRASK
Professor of History 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

DANIEL H. TYCKO
Professor of Engineering and *Computing Center Associate*
Ph.D., Columbia University

STUART VALINS
Associate Professor of Psychology
Ph.D., Columbia University

JOHN H. VANDERMEER
Assistant Professor of Biological Sciences
Ph.D., University of Michigan

EDWARD VAN ROY
Assistant 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
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
Assistant Professor of Engineering
Ph.D., University of California, Berkeley

EUGENE A. WEINSTEIN
Professor of Sociology and *Chairman, Department of Sociology*
Ph.D., Northwestern University

FRED WEINSTEIN
Associate Professor of History
Ph.D., University of California, Berkeley

SHELDON WEINTRAUB
Assistant Professor of Psychology
Ph.D., University of Minnesota

ARTHUR WEISBERG
Performing Artist in Residence
Pupil of Simon Kovar

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 and *Senior Research Oceanographer, Marine Sciences Research Center*
Ph.D., University of Chicago

ANDREW WHITE
Associate Professor of German and *Chairman, Department of Germanic and Slavic Languages*
Ph.D., University of Munich

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

JOHN A. WILLIAMS
Associate Professor of History
Ph.D., University of Wiconsin

GEORGE C. WILLIAMS
Professor of Biological Sciences and *Senior Research Biologist, Marine Sciences Research Center*
Ph.D., University of California at Los Angeles

ALICE S. WILSON
Assistant Professor of English
Ph.D., Cornell University

ROBIN CHRISTOPHER WINKLER
Visiting Assistant Professor of Psychology
Ph.D., University of New South Wales, Australia

ARNOLD WISHNIA
Associate Professor of Chemistry
Ph.D., New York University

CHARLES F. WURSTER, JR.
Assistant Professor of Biological Sciences
Ph.D., Stanford University

EVERETT J. WYERS
Professor of Psychology
Ph.D., University of California, Berkeley

CHEN NING YANG
Albert Einsten 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
Assistant 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 Not in residence academic year 1970-71.
b On leave fall semester 1970.
c On sabbatical leave spring semester 1971.

StonyBrook

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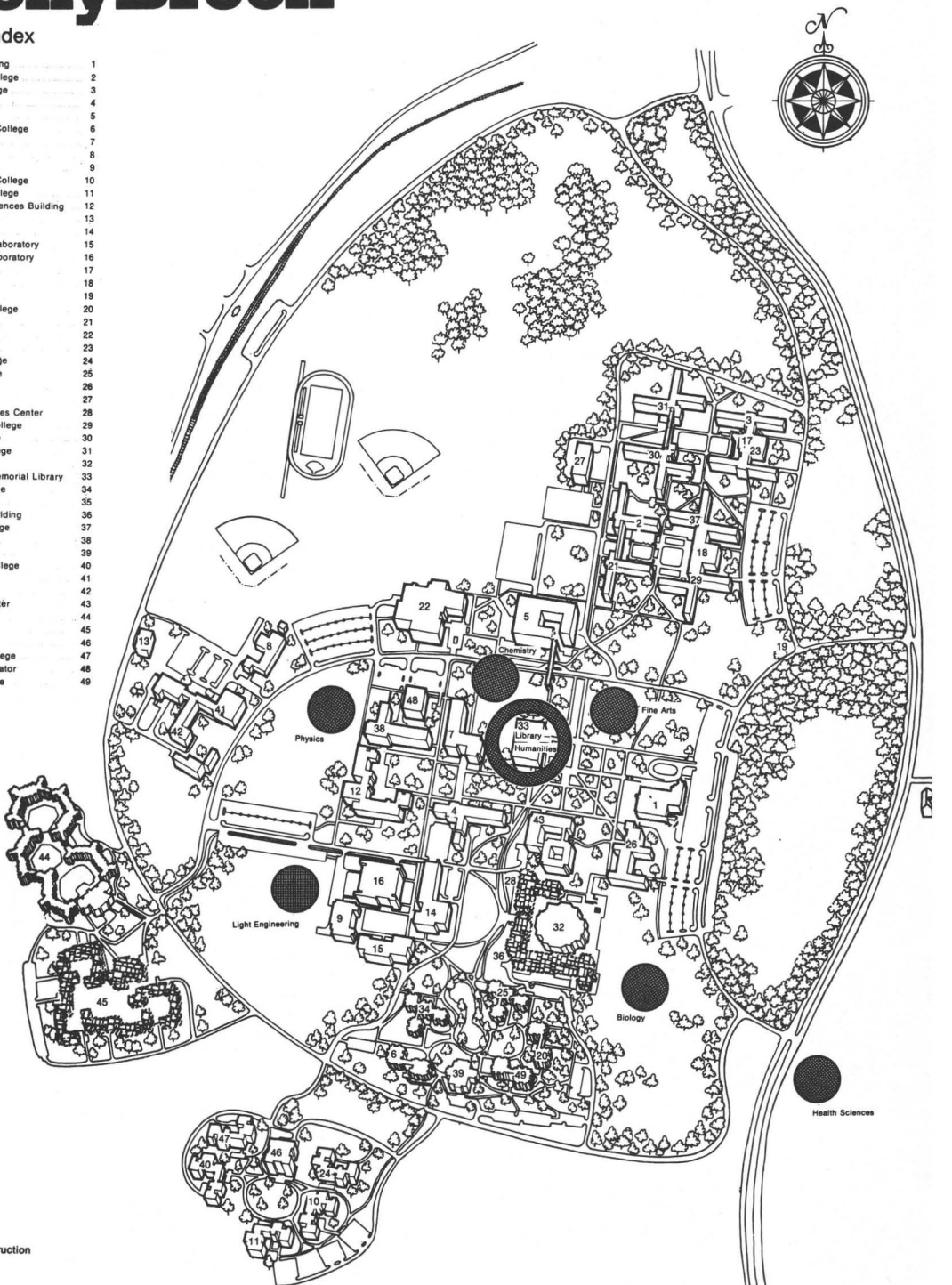
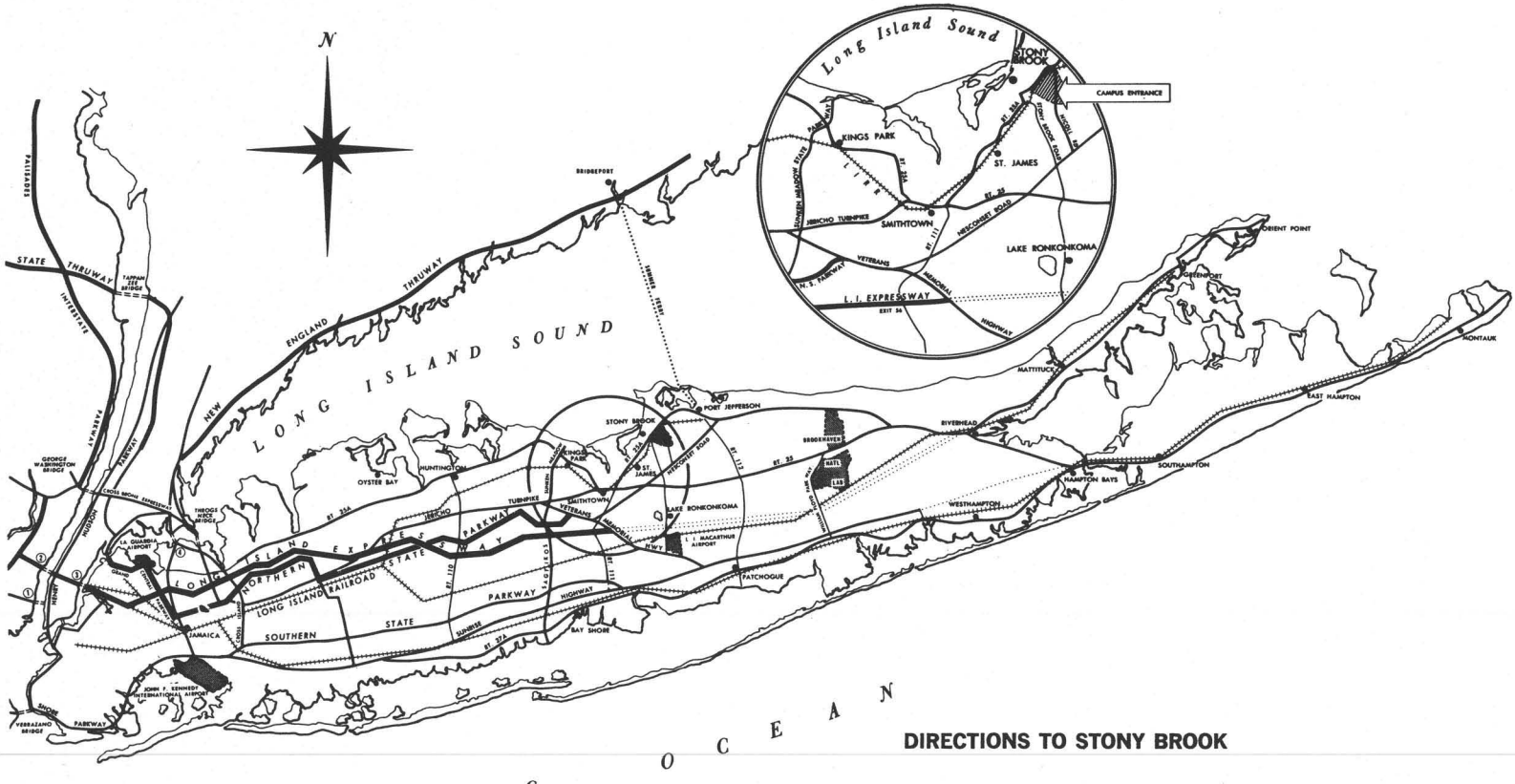


Under Construction

Planned



DIRECTIONS TO STONY BROOK

By automobile from west: Long Island Expressway to Exit 56. Left on Route 111 two miles to Nesconset-Port Jefferson Road (Smithtown By-pass). Right six miles to Nicoll Road. Left two miles to campus entrance.

By automobile from east: Nesconset Road or Route 25A to Nicoll Road. Right or left, respectively, to campus entrance.

By Long Island Railroad: Take Port Jefferson line from Pennsylvania Station (Manhattan) or Flatbush Avenue Station (Brooklyn). Change at Jamaica for remainder of trip to Stony Brook Station.

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.

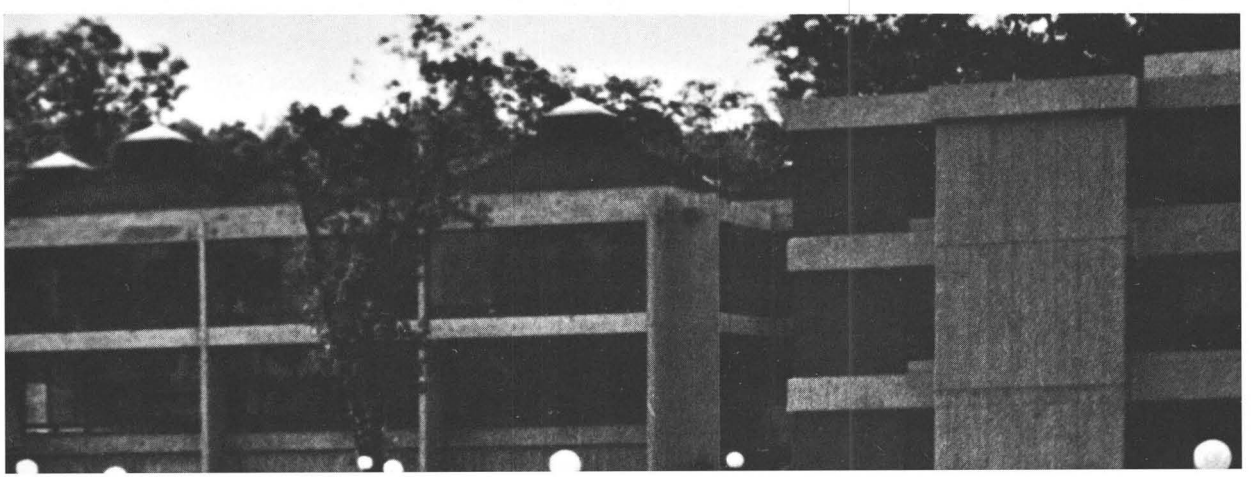
Four-year programs strongly emphasize the liberal arts and science and also include specializations in teacher education, business, forestry, maritime service, ceramics and the fine and performing arts.

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.

Governed by a Board of Trustees appointed by the Governor, State University of New York comprises all State-supported institutions of higher education, with the exceptions of the senior colleges of City University of New York. Each college and center of State University is locally administered. Although separated geographically, all are united in the purpose of improving and extending numerous opportunities to the youth of New York State.

The State University motto is: "Let Each Become All He Is Capable of Being."



CAMPUSES

Office of the Chancellor
8 Thurlow Terrace, Albany, N.Y. 12201

UNIVERSITY CENTERS

State University at Albany
State University at Binghamton
State University at Buffalo
State University at Stony Brook

MEDICAL CENTERS

Downstate Medical Center at Brooklyn
Upstate Medical Center at Syracuse

COLLEGES OF ARTS AND SCIENCE

College at Brockport
College at Buffalo
College at Cortland
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

COMMUNITY COLLEGES

(Locally-sponsored, two-year colleges under the program of State University)
Adirondack Community College at Glens Falls
Auburn Community College at Auburn
Borough of Manhattan Community College
Bronx Community College
Broome 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.)

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STATE UNIVERSITY OF NEW YORK
LET EACH BECOME ALL HE IS CAPABLE OF BEING
1948