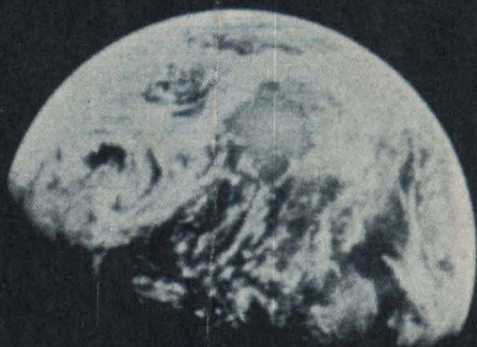


# 1969-70 Graduate Bulletin



STATE UNIVERSITY OF NEW YORK AT  
**STONY BROOK**





STATE UNIVERSITY  
OF NEW YORK  
AT STONY BROOK

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GRADUATE BULLETIN

1969-1970

**Additional Information**

For general information about graduate programs and/or application, please write or phone:

The Graduate School  
State University of New York  
at Stony Brook  
Stony Brook, N.Y. 11790  
(516) 246-5945



## ACADEMIC CALENDAR

1969—1970

*Fall Semester 1969*

FOREIGN STUDENT ORIENTATION	September 10-11
FINAL REGISTRATION FOR GRADUATE STUDENTS	September 11-12
NEW STUDENT ORIENTATION FOR UNDERGRADUATES	September 15-16
FINAL REGISTRATION FOR UNDERGRADUATES	September 15-16
CLASSES BEGIN	September 17
ONE-DAY RECESS	September 22
END OF CHANGE OF REGISTRATION PERIOD FOR UNDERGRADUATES	September 30
LAST DAY FOR GRADUATE STUDENTS TO DROP OR ADD A COURSE WITHOUT PENALTY	October 15
LAST DAY FOR REMOVAL OF INCOMPLETES FROM SPRING SEMESTER FOR GRADUATES AND UNDERGRADUATES	November 1
ADVANCE REGISTRATION FOR SPRING SEMESTER FOR GRADUATES AND UNDERGRADUATES	November 10-14
LAST DAY FOR UNDERGRADUATES TO DROP A COURSE WITHOUT PENALTY	November 18
MID-TERM ADVISORY GRADE REPORTS DUE	November 21
THANKSGIVING HOLIDAY	November 26 (begins at close of classes)
CLASSES RESUME	December 1
WINTER RECESS	December 21
CLASSES RESUME	January 5
READING AND REVIEW DAYS	January 12-13
FINAL EXAMINATIONS BEGIN	January 14
FINAL EXAMINATIONS END	January 24

*Spring Semester 1970*

FINAL REGISTRATION	February 2-3
CLASSES BEGIN	February 4
END OF CHANGE OF REGISTRATION PERIOD FOR UNDERGRADUATES	February 17
LAST DAY FOR GRADUATE STUDENTS TO DROP OR ADD A COURSE WITHOUT PENALTY	March 4
LAST DAY FOR REMOVAL OF INCOMPLETES FROM FALL SEMESTER FOR GRADUATES AND UNDERGRADUATES	March 15
MID-TERM ADVISORY GRADE REPORTS DUE	March 27
SPRING RECESS	March 28 (begins at close of classes)
CLASSES RESUME	April 6
LAST DAY FOR UNDERGRADUATES TO DROP A COURSE WITHOUT PENALTY	April 10
ADVANCE REGISTRATION FOR FALL SEMESTER AND SUMMER SESSION FOR GRADUATES AND UNDERGRADUATES	April 13-17
LAST DAY OF CLASSES	May 16
READING AND REVIEW DAYS	May 18-19
FINAL EXAMINATIONS	May 20-30
MEMORIAL DAY (EXAMS ARE HELD)	May 30
COMMENCEMENT	June 7

*Summer Session 1970*

REGISTRATION	June 22
CLASSES BEGIN	June 23
CLASSES END	July 31



Celebrated visitors to the Stony Brook campus in 1969 have included, from the top, composer Igor Stravinsky, former presidential aide Theodore C. Sorenson, anthropologist Margaret Mead, poet W. H. Auden, Nobel Prize-winning chemist Linus Pauling, and former judge and diplomat Arthur J. Goldberg.



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## AN INTRODUCTION TO STONY BROOK

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State University of New York at Stony Brook is one of four university centers of the State University of New York. The Master Plan of the State University, revised in 1964, calls for the development at Stony Brook of graduate programs leading to the Ph.D. in all departments of the College of Arts and Sciences and the College of Engineering in the near future.

During the 1969-70 academic year, graduate programs leading to the masters and Ph.D. degrees are offered by the Departments of *Anthropology, Biological Sciences, Chemistry, Earth and Space Sciences, Economics, English, History, Mathematics, Physics, Psychology, and Sociology* in the College of Arts and Sciences and by the Departments of *Applied Analysis, Electrical Sciences, Materials Science and Mechanics* in the College of Engineering. Masters degrees are offered by the Departments of *Music and Romance Languages (French)*. Programs in other areas now being developed will be approved as the faculty and facilities necessary to assure high standards become available.

### History and Location

The University was founded in 1957 at Oyster Bay, Long Island, as a center for educating secondary school teachers of mathematics and science. In 1960, however, within the context of a fast-growing state university, it was designated a University Center and given the mandate to develop undergraduate and graduate programs through the Ph.D. in the humanities, sciences, social sciences and engineering. As a comprehensive university, it was also to become a center for research.

In order to realize its larger goals, the University moved in 1962 to a new and larger campus at Stony Brook. Today, there are 39 buildings on the campus with additional buildings under construction or planned for construction during the 1969-70 period.

The academic program continues to expand at both the graduate and undergraduate levels, the aim being a balanced institution with strength in all areas of the arts and sciences and engineering. In addition, a comprehensive Health Sciences Center is being planned for the Stony Brook campus. The Center, which will include schools of medicine, nursing, dentistry, allied health and social work, will admit its first students in 1971 or 1972. However, graduate students will benefit from this pending development almost immediately, since members of the Health Sciences Center planning group will participate in the instructional and research activities of the two existing colleges and will direct some Ph.D. research.

Stony Brook is located in a region of woods and hills and small historic villages on the north shore of Long Island some 50 miles northeast of New York

City. The University 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.

### **Students and Faculty**

As a relatively new University, Stony Brook is experiencing dramatic growth. The 1969-70 full-time enrollment will exceed 7,000 students including about 850 graduate students and a number of post-doctoral fellows. Enrollment will reach 10,000 by the early 1970's. Eventually 40% will be graduate students.

As of September 1969, Stony Brook will have more than 700 faculty members. A complete directory of faculty members participating in current graduate programs can be found elsewhere in this *Bulletin*.

### **The Stony Brook Campus**

The Stony Brook campus is situated minutes away from the coves and beaches of Long Island Sound. The Atlantic shore is about 20 miles to the south. The campus consists of 1,000 acres of rolling, densely wooded terrain, with the central core area largely cleared for the buildings now in use.

There are nine large academic structures which provide classroom, lecture hall, laboratory and office space for the divisions, schools or departments they serve. These include the Humanities Building, the Social Sciences Center, the Lecture Hall, and buildings for Earth and Space Sciences, Chemistry, Biology, and Engineering. The Physics Building houses the Departments of Physics and Mathematics. The Frank Melville, Jr. Memorial Library, in addition to housing the customary books, periodicals, microfilm, music collections, and listening and reading facilities, also provides temporary quarters for the university administration.

Twenty-three two- and three-story residence hall buildings afford living quarters for 4,000 students and contain numerous lounges and dining halls. The Gymnasium, with its swimming pool, basketball and squash courts, and rooms for gymnastics and ballet, serves the curricular, intramural and intercollegiate athletic programs. It also supplies space for the Office of Physical Education and the University Theatre.

### **Libraries**

The Frank Melville, Jr. Memorial Library, a three-story air-conditioned building, is designed for 350,000 volumes and seating for 700 students. It constitutes the first phase of a larger structure to be completed in 1972 that will house a million volumes at its next stage of development. Four science collections are

housed in the science and engineering buildings. In all campus libraries students have free access to the open stacks, with reading areas and bookstacks interspersed. During regular semesters the Melville Library is open until midnight except on Saturday.

A special area houses the files of microfilms, microcards, microprint and microfiche, with reading equipment. Copying machines are available for student use.

As a selective government depository, the University Library receives large numbers of publications issued by the United States and New York State governmental agencies. About 5,800 periodicals are currently received and books are being added at the rate of over 100,000 volumes per year. The total library collection now numbers 430,000 volumes and over 100,000 documents.

The library furnishes students with recordings of speeches, poetry and drama, as well as music in the Music Library, which occupies a portion of the first floor of the Melville Library.



**Computing Center**

The Computing Center houses an IBM 360 Model 67 computing system with 524,288 bytes of core storage. The IBM 360/67 operates in a multi-programming environment, processing several jobs concurrently. An additional 233.4 million bytes of direct access storage is realized through the IBM 2314 disk storage facility. Seven magnetic tape drives provide data access for low speed-high volume transmissions. During the 1969-70 academic year, additional direct access storage facilities with a total capacity of 554 million bytes of storage will be added in support of a remote terminal system. This system will permit instantaneous communication with the central computer, thereby allowing users and experiments facilitated access to the computer.

The Computing Center Building, completed in 1968, is located in the Engineering Quadrangle.

**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 on the first floor of the Social Sciences Center, aids students who are interested in renting rooms, apartments or houses in the Suffolk County area.

An expanded program of faculty involvement with the students exists in the form of "residential colleges." Graduate students are invited to participate as graduate associates in this program, which is designed to expand cultural and intellectual opportunities in the residences as well as to foster student identity within the University and improve interpersonal relationships. Individual colleges will range in size from 200 to 400 students each, and each college and its students and faculty associates will have the opportunity to develop in individual program, style, and tradition.

**Summer Program**

Though the six-week summer session offers formal course work primarily for undergraduates, 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.

**FINANCIAL  
INFORMATION**

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**Tuition**

The tuition rate for graduate students is \$300 per semester. There is no tuition charge for graduate assistants, research assistants and certain fellows, but they must pay other fees listed below. Tuition rate for a special graduate student part-time 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

Individual: \$33 (payable at Fall registration for 12 months—September to September, pro rata premium available for February admits).

Student & Spouse: \$72

Student, Spouse and Dependent Child or Children: \$120

General University Deposit

Commuting Student: \$20

Resident Student: \$35

Graduation Fee: \$15 (payable upon completion of all degree requirements and prior to the award of the degree).

Identification Card: \$2

Late Registration Fee: \$15 (paid by students registering after the close of the official registration period).

Transcript Fee: \$1 for each transcript (A student who obtains a degree may receive two transcripts without charge. Account with the University must be clear.)

**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.



Seated together are University Chancellor Samuel B. Gould (left) and three of Stony Brook's Distinguished Professors: Nobel Laureate C. N. Yang in physics, Bentley Glass in biology and Alfred Kazin in English.

### **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.

### **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 research assistantships carry stipends of \$2,627 for the academic year and tuition exemption. For advanced students the stipend is \$2,754.

University Fellowships are also available, with stipends of about \$2,500 and higher for the academic year and tuition exemption.

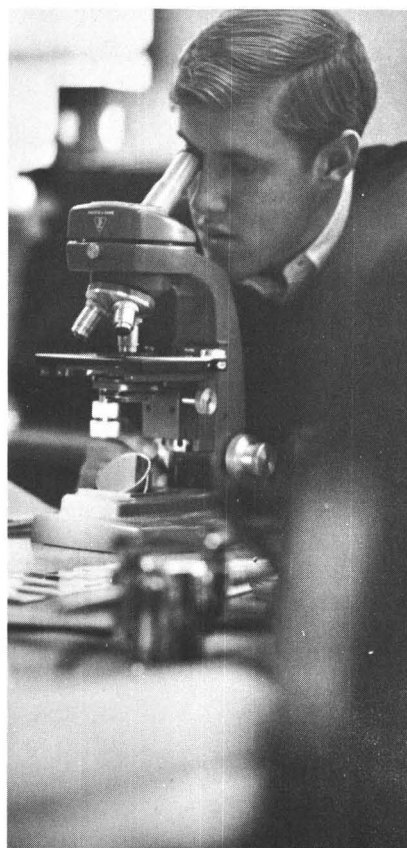
Teaching assistantships, research assistantships, and fellowships are awarded on a competitive basis by the Graduate School on recommendation of the department.

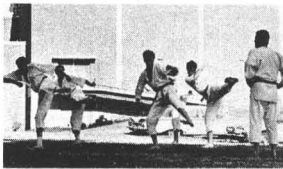
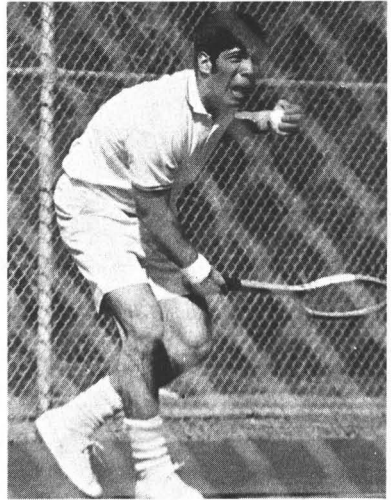
State University of New York at Stony Brook participates in such fellowship and traineeship programs as: NDEA Fellowships, NSF Traineeships and Fellowships, NASA Traineeships, and New York State Regents' Fellowships. The stipends of University fellowships and graduate assistantships are subject to adjustment 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 \$3,500 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 applications for this program is January 31 for those wishing to start their studies in the fall, and July 31 for those who wish to enter the University in the spring semester.

During the 1968-69 academic year, approximately 90% of the graduate students at Stony Brook held fellowships or assistantships.









## ADMISSION REQUIREMENTS

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Applicants may be admitted to the Graduate School to pursue the M.A., M.S., 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: *The 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 Status and Special Student Status**

Normally part-time study is carried out in the Center for Continuing Education, where the degree sought is the M.A. (L.S.) degree. Part-time students may be accepted into a Ph.D. program upon request of the program chairman to the graduate dean. Part-time students who do not seek a degree enroll as special students (non-matriculated) in the Center for Continuing Education. Special students and part-time students may enroll for no more than eight credit hours and no more than two courses per semester.

Part-time and special students may enroll in any courses offered in the Center for Continuing Education (courses designated CED). If such students wish to enroll in regular departmental graduate courses they must supply the documents required of applicants for regular admission to the Graduate School, including letters of recommendation from former teachers or from professional superiors.

### **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 graduate dean, 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.

### **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; July 31 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.

**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 graduate dean of the student's institution. It should then be sent to the graduate dean 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.

**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.

## **DEGREE REQUIREMENTS**

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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.
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.
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 graduate dean 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 graduate dean 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 graduate dean. 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 require 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 graduate dean and recommend that the degree be awarded. Degrees are awarded at the annual Commencement following the completion of requirements. Prior to Commencement a certificate in lieu of the degree may be requested.

#### **Waiver of Regulations**

Specified requirements may be waived by the Graduate Council 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

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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.

### I. General Instructions

- A. **MASTERS THESIS.** Two copies of the thesis must be deposited with the University Library, and one copy with the candidate's department or, in the case of engineering, his college. The two library copies shall be the original typewritten copy, and either the first carbon or a Xerox copy. A department or the College of Engineering may, as it sees fit, require additional copies beyond the three 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 library copies will be done by the library for a stated fee (presently \$4.50 per copy).

- B. **DOCTORAL DISSERTATION.** Each candidate will deposit with the Graduate School the first or ribbon copy of his dissertation, the first carbon or duplicate copy for the University Library and the second carbon for the use of his department, or in the case of engineering, his college. The ribbon copy will be listed and indexed in University Abstracts. This will constitute publication. The publication fee is \$30, and the binding fee for the copies is, at present, \$4.50 per copy. 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.

### 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

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### ANTHROPOLOGY

*Professors:* ARMILLAS, P. BROWN, CARRASCO, FARON (*Chairman*)

*Associate Professor:* STEVENSON

*Assistant Professor:* REGELSON

#### **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.



### **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.

**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.

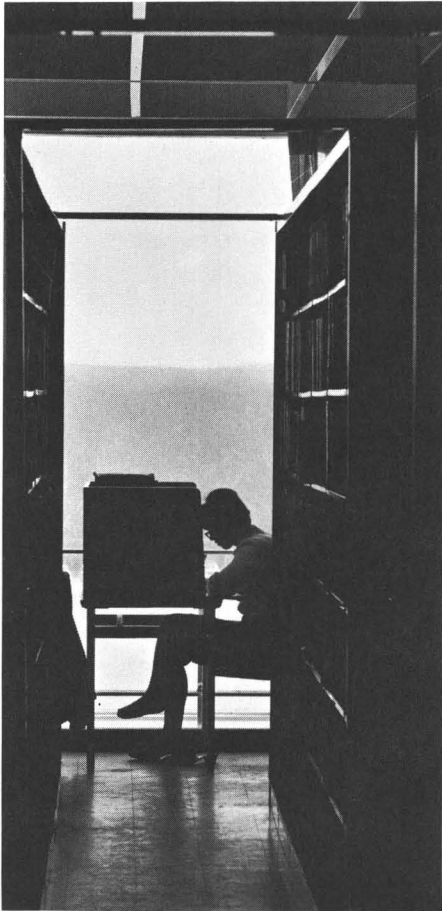
All courses in the 600 range will be conducted as guided independent research and presuppose a full year of advanced study.

**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 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, po-



litical 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 processes and culture history.

*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 600 Practicum in Teaching**

*Variable and repetitive credit*

**ANT 601, 602 Research Seminar in Anthropological Theory****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

*Professors:* <sup>a</sup>E. BAYLOR, CAIRNS, E. CARLSON, CIRILLO, ERK, GLASS, <sup>a</sup>GOREAU, JONES (Chairman), SANDERS (Adjunct), M. SIMPSON, SLOBODKIN, SOKAL, <sup>b</sup>SQUIRES, <sup>a</sup>G. WILLIAMS

*Associate Professors:* BATTLE, FREUNDLICH, LYMAN, MERRIAM, MOOS, RILEY, ROHLF, SMOLKER, TUNIK, WALCOTT

*Assistant Professors:* ARNHEIM, A. CARLSON, DUDOCK, EDMUNDS, EMLER, J. FARRIS, FOGG, J. FOWLER, GAUDET, GESTELAND, HECHTEL, KERNAGHAN, KRICKORIAN, LEICHTLING, STERNGLANZ, VANDERMEER, WURSTER

*Instructor:* J. HARRIS

*Lecturer:* V. FARRIS

(*Professors in Health Sciences:* KNUDSON, LEFEVRE, PELLEGRINO) <sup>c</sup>

(*Independent Investigator:* M. BAYLOR) <sup>c</sup>

### 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 Department 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.

<sup>a</sup> Member, Marine Sciences Research Center.

<sup>b</sup> Director, Marine Sciences Research Center.

<sup>c</sup> Other scientists who may supervise graduate research in biological sciences.

- C. Formal course requirements: Successful completion of an approved course of study of at least 24 semester credits, including two semesters of Interarea Seminar.
- D. Thesis: Independent laboratory, field or theoretical research under the supervision of a staff member of the department.
- 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 Graduate Studies Committee 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 department'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.

## Graduate Programs in Biology

Graduate studies in the Department of Biological Sciences are primarily focused at the Ph.D. level in the following four programs: Molecular and Cellular Biology, Developmental Biology, Ecology and Evolution, and Psychobiology. Each program offers a sequence of basic courses taught by its own staff, a series of seminar courses and early participation by graduate students in research. The programs are briefly described below.

### *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 bases 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 and of learning, metabolic control mechanisms, contractile systems and ultrastructure. Besides members of this department, the program includes faculty from the Department of Chemistry and the Health Sciences Center.

### *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 presently doing 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. The staff includes persons working in population dynamics from a behavioral, mathematical and experimental approach as well as from the study of field populations.

In addition, certain aspects of taxonomy, physiology, genetics, statistics and systems analysis are being studied insofar as they are related to ecological and evolutionary problems.

### *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 and animal behavior. Detailed information about admission to the program and degree requirements is available from A. Carlson in Biology and John Garcia in Psychology.

### **Teaching Responsibilities**

All graduate students are expected to serve as teaching assistants for the equivalent of one year (one laboratory section each semester for two years). In certain cases, e.g., fellowship holders, this teaching requirement may be reduced.

### **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 Biochemistry**

A survey of the structure of the major chemical constituents of the cell including carbohydrates, lipids, nucleic acids, and proteins. Emphasis will be placed on enzyme structure, enzyme kinetics, reaction mechanisms including the role of coenzymes; metabolic pathways of biosynthesis and degradation involved in cellular activity.

*Fall, 4 credits*

##### **BIO 503 Mechanisms 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 504 Nucleic Acids and Protein Biosynthesis**

This course considers the biochemical aspects of nucleic acids and their involvement in protein biosynthesis. Emphasis is placed upon macromolecular structure and the biochemical mechanisms of the reactions involved.

*Spring, 2 credits*



### **BIO 505 Microbial Regulatory Mechanisms**

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

*Fall, 3 credits*

### **BIO 507 Chemistry and Enzymology of Nucleic Acids**

This is primarily a course in the methodology of nucleic acids with emphasis on the determination of their structure as well as their structure chemistry and enzymology.

*Fall, 2 credits*

### **BIO 509 Experimental Biochemistry I**

An introduction to modern methods of biochemical analyses. Students will spend various periods of time working in close association with members of the staff engaged in biochemical research.

*Fall, 2 credits*

### **BIO 510 Experimental Biochemistry II**

A continuation of Bio 509.

*Spring, 2 credits*

### **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. Laboratory work will give instruction in the critical use of some tools and methods of investigation at the cellular level. Each student will undertake a limited project in which he will do independent work in the laboratory. One hour lecture, one hour discussion and four hours of regularly scheduled laboratory.

*Spring, 4 credits. Not offered 1969-70*

### **BIO 513, 514 Graduate Seminar in Molecular and Cellular Biology**

Seminars are given by graduate students on current research in the field of molecular and cellular biology.

*Each semester, 1 credit*

### **BIO 515, 516 Molecular and Cellular Biology Workshop**

Progress reports are given each week by members of the faculty and advanced graduate students on recent, but as yet, unpublished research.

*Each semester, 1 credit*

### **BIO 520 Molecular Biology of Viruses**

This course covers the principal aspects of the replication of animal and bacterial 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 oögenesis, embryogenesis and tissue and organ differentiation.

*Fall, 3 credits*



**BIO 524 Cellular Aspects of Development**

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

**BIO 536 Physiology and Development of Lower Plants**

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

*Spring, 3 credits*

**BIO 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.

*Spring, 3 credits*

**BIO 550 Practicum in Ecology**

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

*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*

### **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 semesters of registration for BIO 600 is required for all candidates for graduate degrees in biological sciences, 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 members of the staff and visiting scientists in which current research and thinking in various aspects of molecular and cellular biology will be presented.

*Each semester, 1 credit*

### **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:* <sup>a</sup>ALEXANDER, BONNER (*Chairman*), CHU, FRIEDMAN, HAIM, KOSOWER,  
<sup>a</sup>LAUTERBUR, LE NOBLE, OKAYA, RAMIREZ, SUJISHI  
OKAYA, RAMIREZ, SUJISHI

*Associate Professors:* GOLDFARB, HIROTA, PORTER, SCHNEIDER, <sup>b</sup>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 the 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.

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<sup>a</sup> On leave, Academic Year 1969-70.

<sup>b</sup> Director of the Center for Curriculum Development.

### 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.

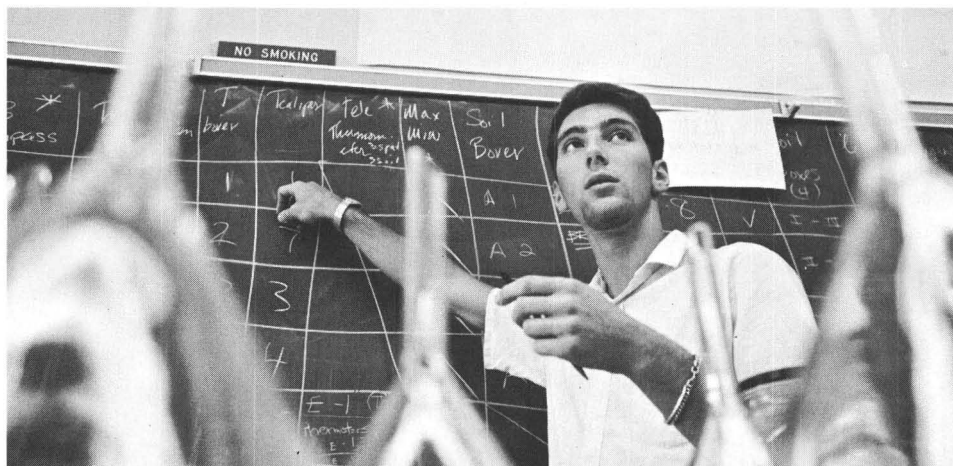
In addition to the above, all graduate students are expected to attend the department's regularly scheduled colloquia. These colloquia are presented by outstanding chemists invited from outside the University.

### 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 Departments 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. Normally a student will be advised to take the first four courses below in the fall semester and two required courses and one optional course in the spring semester. Qualification to candidacy is based on achievement in these first year courses as described under degree requirements.

Organic Chemistry <sup>a</sup>	(CHE 501 or 502 or 503)	3 credits each
Inorganic Chemistry I	(CHE 511)	3 credits
Quantum Chemistry I	(CHE 521)	3 credits
Chemical Thermodynamics	(CHE 523)	3 credits

—and at least two of the following:

Organic Chemistry <sup>a</sup>	(CHE 501, 502 or 503)	3 credits each
Inorganic Chemistry II	(CHE 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

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.

<sup>a</sup> Any one of the organic chemistry courses (501, 502 or 503) or their equivalent is required for all students. A student planning to specialize in organic chemistry is required to take all three of these courses during his first year.

**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<sup>a</sup> 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<sup>a</sup>) of an approved course of study.
- E. Cumulative examinations 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 examinations will be offered at eight stated

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<sup>a</sup> 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.

dates each year in the three major areas of physical, inorganic and organic chemistry. 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.

#### **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 (with the consent of his department chairman) the chemical physics course program. 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<sup>a</sup>; 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.

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<sup>a</sup> A student who is admitted to physics should consult the physics section of this catalog.



### QUALIFICATION

The usual procedure for qualification in the Chemistry Department will be followed (qualifying examinations and adequate performance in required courses). The course evaluation will be based on the required courses below; the student must have taken at least six of these courses at the time of evaluation.

### REQUIRED COURSES

Twenty-seven hours of graduate courses including the following: (CHE 523) Chemical Thermodynamics; (PHY 343 or 503) Methods of Mathematical Physics; (PHY 501) Mechanics; (PHY 502) Electrodynamics; (CHE 521, 522 or PHY 511, 512) Quantum Mechanics; (CHE 528 or PHY 540) Statistical Mechanics.

A sample course plan for chemistry graduate students is given below:

#### I

CHE 523 Thermodynamics  
 PHY 343 or 503 Mathematical Physics  
 PHY 501 Mechanics  
 CHE 521 Quantum Mechanics

#### II

CHE 528 Statistical Mechanics  
 PHY 502 Electrodynamics  
 CHE 522 Quantum Mechanics

#### III

#### Optional 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, 3 credits*

**CHE 526 Chemical Kinetics**

An intensive study of rates of chemical reactions and in particular the relationship of kinetic studies to the determination of reaction mechanisms. Experimental methods will be discussed with emphasis on the determination of rate laws. The theoretical treatment will include discussions of the kinetic theory and the transition-state theory approaches to chemical kinetics. Topics will include gas

reactions, chain reactions and the new approaches to the study of very rapid chemical reactions.

*Spring, 3 credits*

### **CHE 528 Statistical Mechanics**

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 599 Research**

*Variable and repetitive 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**

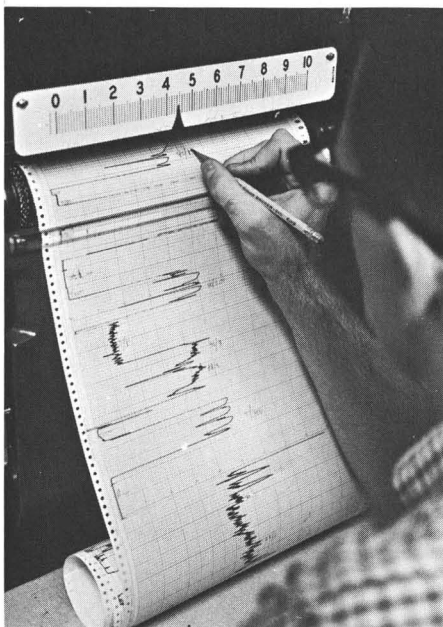
The application of physical-organic chemistry to biochemical reactions, including a survey of intermediary metabolism and mechanistic analysis of such reactions as decarboxylations, hydration, hydrolysis, electron-transfer reactions, hydrogen-transfer reactions and reactions of phosphates.

*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:* <sup>a</sup>LINDSLEY, <sup>b</sup>MILFORD, A. PALMER, SCHAEFFER (*Chairman*), <sup>c</sup>SQUIRES,  
<sup>d</sup>STROMGREN, <sup>e</sup>WEYL

*Associate Professors:* <sup>f</sup>H.-Y. CHIU, DODD, <sup>e</sup>GROSS, HARDORP, PAPIKE, PREWITT,  
STROM

*Assistant Professors:* BENCE, GEBEL, G. HANSON, SHU, 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: Two consecutive semesters of full-time study.
- 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.

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<sup>a</sup> Not in residence 1969-70.

<sup>b</sup> Head of Geostrophysics Research, Grumman Aircraft Engineering Corp., part-time at Stony Brook.

<sup>c</sup> Director of the Marine Sciences Research Center.

<sup>d</sup> Distinguished Professor of Astronomy, Royal Danish Observatory, Copenhagen; adjunct at Stony Brook.

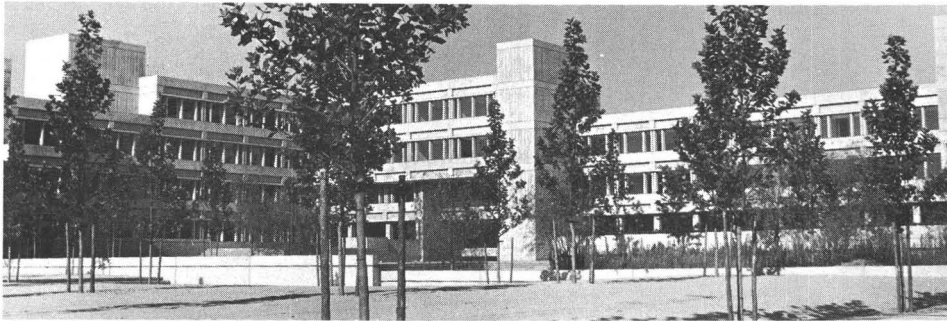
<sup>e</sup> Member of the Marine Sciences Research Center.

<sup>f</sup> NASA/Goddard Space Studies Institute, part-time at Stony Brook.

- 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.
- 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: Two years 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 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 graduate dean. 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 and X-ray Mineralogy
- ESS 306 Igneous and Metamorphic Petrology
- ESS 308 Advanced Topics in Geology
- ESS 309 Structural Geology
- ESS 312 Stratigraphy
- ESS 322 Introductory Geochemistry
- ESS 341 Astrophysical Processes I
- ESS 342 Astrophysical Processes II
- ESS 343 Lab Course in Astronomical Techniques
- ESS 345 Physics of the Interstellar Medium
- ESS 346 Galactic Structure
- ESS 363 Sediments and Sedimentary Processes
- ESS 364 Marine Geology

### *Graduate Courses*

#### **ESS 501-502 The Earth and the Cosmos**

A one-year introductory graduate course integrating the areas of astronomy and earth sciences. Topics include stellar evolution, nucleosynthesis, origin of the solar system, geotectonics, physics of the solid earth, origin of life and evolution of environmental conditions of the earth.

*Fall and Spring, 3 credits each semester*

#### **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 diagenetic 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 505 Precambrian Geology**

The succession of Precambrian rocks as exemplified in the Lake Superior district. Precambrian history, as interpreted with the aid of radiometric age determinations.

*Spring, 3 credits*

#### **ESS 506 Theoretical Petrology**

Theory of phase diagrams, Schreinemaker's Rules, heterogeneous equilibria, experimental systems of petrologic interest. Laboratory: problems, experimental petrology.

Prerequisites: Metamorphic and Igneous Petrography, 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 511 Advanced Paleontology**

Lecture sessions emphasizing selected examples of imaginatively resolved paleontologic 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, cono-

donts 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.

Prerequisite: 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 study of the solid materials which strike the earth and their relation to earth and 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 and Crystal Chemistry I**

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 Crystallography and Crystal Chemistry II**

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 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  $3^{\circ}$  K thermal radiation.

*Spring, 3 credits*

**ESS 561 Climatic Change During Pleistocene and Recent Times**

The historical and geologic record of climatic changes during the last two million years is examined. The mechanisms responsible for climatic change are evaluated.

*Spring, 3 credits*

**ESS 598 Seminar in Earth Sciences**

A series of seminars discussing problems of current interest.

*Fall, 2 credits*

**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 3 credits, with repetitive credit permitted.

**ESS 601 Topics in Astronomy-Astrophysics****ESS 602 Topics in Environmental Sciences****ESS 603 Topics in Geology****ESS 604 Topics in Geo-Cosmochemistry****ESS 605 Topics in Paleontology-Stratigraphy****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, H. KRAMER, L. MILLER, NORDELL, SAKBANI, SALPIETRO, SCHOEPFLE, VAN ROY, 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 pre-determined number of courses. The following areas of proficiency are required for all students:
  - A. One foreign language.
  - B. 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.
  - C. 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. 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.
3. Degree candidacy. Successful completion of two years of full-time graduate study, language and mathematics proficiency and the five

field examinations are necessary for admission to candidacy for the Ph.D. degree.

4. **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, an associate in an intrauniversity program such as the Economic Research Bureau, the Health Sciences Center, the 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 Course 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 non-quantitative 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 of 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 1969-70.*

**ECO 542 Urban Economics**

*Not offered 1969-70.*

**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*

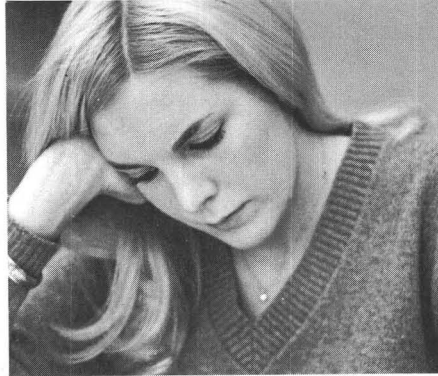
**ECO 560 Comparative Economic Systems**

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, <sup>a</sup>KAZIN, KRANIDAS, LEVIN, LUDWIG, RIBNER (*Chairman*), L. SIMPSON, STAMPFER, STEVENS, THOMPSON, WEISINGER

*Associate Professors:* FIESS, FRY, GOLDBERG, R. A. LEVINE, MARESCA, R. MILLER, NEUMEYER, PEQUIGNEY, ROGERS, ZIMBARDO

*Assistant Professors:* ABRAMS, ANSHEN, BENNETT, CARPENTER, DOLAN, 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 \$2,626 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 English the following are required:

- A. A bachelors degree from a recognized institution.
- B. An average of at least B in undergraduate literature courses.

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<sup>a</sup> Not in residence, Academic Year 1969-70.



- 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 during the student's first semester of work toward the masters degree. EGL 599 may be elected during the second semester only if the student has a B+ average the first semester and only if he 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 on 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.

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\* 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 re-examination at the discretion of the Graduate Program Committee of the department.

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

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

Both the director and the second reader of the dissertation must recommend acceptance of the dissertation before it can be approved by the Graduate Program Committee of the department. In cases in which the director and the second reader disagree, the Graduate Program Committee will appoint a third reader.

- 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 Advisory 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 Advisory 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 Advisory Committee to serve as its chairman. The student's advisor or the chairman of his Advisory Committee must sign the student's course card during registration. On occasion the advisor or Advisory 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:** 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. The student will be required to write a full account of his reasons for requesting an Incomplete and the course instructor will have to approve of these reasons after the Graduate Program Committee has given its approval. The Graduate Program Committee will not automatically grant a request for an Incomplete.

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 Seventeenth 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 Nineteenth Century British Literature***Variable and repetitive credit***EGL 550 Studies in Twentieth Century British Literature***Variable and repetitive credit***EGL 560 Studies in Early American Literature***Variable and repetitive credit***EGL 565 Studies in Nineteenth Century American Literature***Variable and repetitive credit***EGL 570 Studies in Twentieth 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*

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*Special Advanced Courses*

**EGL 690 Thesis Research**

*Variable and repetitive credit*

**EGL 697 Practicum in the Teaching of English Composition**

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

*Variable and repetitive credit*

**EGL 698 Practicum in the Teaching of Literature**

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

*Variable and repetitive credit*

**EGL 699 Directed Reading for Doctoral Candidates**

*Variable and repetitive credit*

## HISTORY

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

*Associate Professors:* <sup>b</sup>ANGRESS, <sup>a</sup>BURNER, CLELAND, LEBOVICS, <sup>b</sup>PRATT, J. T. ROSEN-  
THAL, STAUDENRAUS, F. WEINSTEIN, WELTSCH, <sup>b</sup>WILDMAN, J. WILLIAMS

*Assistant Professors:* ALIN, BOTTIGHEIMER, HAMNETT, KNIGHT, LAM, R. H. G. LEE,  
<sup>b</sup>R. M. LEVINE, <sup>c</sup>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 Graduate Record Examination, though not mandatory, are desirable to help in the selection process for admission. Applicants are strongly urged to submit them.
- D. A baccalaureate degree in history, or its equivalent.
- E. A minimum grade-point average of 2.75 (B-) in all undergraduate course work, and 3.00 (B) in history courses.
- F. Acceptance by the Department of History and the Graduate School.

In special cases, students not meeting requirements D and E may be admitted on a provisional basis.

With the approval of the dean of the Graduate School and the History Department, a student holding an M.A. degree from another accredited institution may be admitted directly to the Ph.D. program at Stony Brook.

### Foreign Languages

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

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<sup>a</sup> Not in residence, Fall 1969.

<sup>b</sup> Not in residence, Academic Year 1969-70.

<sup>c</sup> Not in residence, Spring 1970.

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 per 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.

### **The 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.

The 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 Russia since 1600.

Latin America before Independence.

Latin America since Independence, with emphasis on Brazil, Argentina, and Mexico.

### 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:

- One reading-research seminar sequence in the exam field (6 units).
- At least one additional reading seminar with a different instructor (3 units).
- Electives chosen among further reading seminars, 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.

### The 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.).

### **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-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 seminar) 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.

### **The 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 graduate dean. Fields in related disciplines will 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 graduate dean. It will 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 lapse 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 graduate dean 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 U.S., 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 graduate dean. 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 further details see Item #6 of the Ph.D. Degree Requirements.

### Courses

Advanced undergraduate history courses, numbered from 300-499, will often be part of a beginning graduate student's program. A list of these courses can be found in the History section of the *Undergraduate Bulletin*.

Graduate Courses in the 500 series, unless otherwise indicated, are reading seminars, those in the 600 series are research seminars in the fields listed. Seminars normally carry three credits.

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

HIS 501	Reading Seminar in Ancient History	HIS 516	Reading Seminar in Modern Europe: Imperialism
HIS 502	Reading Seminar in Medieval History	HIS 517	Reading Seminar in Modern Germany
HIS 503	Reading Seminar in Renaissance and Reformation	HIS 521	Reading Seminar in American Colonial History
HIS 504	Reading Seminar in Western Europe, 1500-1789	HIS 522	Reading Seminar in The American Revolution, 1760-1789
HIS 505	Reading Seminar in Western Europe since 1789	HIS 523	Reading Seminar in American Constitutional Origins and Development
HIS 506	Reading Seminar in Central Europe, 1500-1789	HIS 524	Reading Seminar in The Age of Jefferson and Jackson
HIS 507	Reading Seminar in Central Europe since 1789	HIS 525	Reading Seminar in Civil War and Reconstruction
HIS 508	Reading Seminar in Eastern Europe, 1505-1801	HIS 526	Reading Seminar in United States History, 1877-1929
HIS 509	Reading Seminar in Eastern Europe since 1801	HIS 527	Reading Seminar in United States History 1929-Present
HIS 510	Reading Seminar in Intellectual European History	HIS 528	Reading Seminar in American Industrial Society to 1900
HIS 515	Reading Seminar in Modern France	HIS 529	Reading Seminar in American Industrial Society since 1900



- |           |   |         |   |
|-----------|---|---------|---|
| HIS 530   | Reading Seminar in Social and Intellectual U.S. History to 1865         | HIS 553 | Reading Seminar in Tudor and Stuart England       |
| HIS 531   | Reading Seminar in Social and Intellectual U.S. History since 1865      | HIS 554 | Reading Seminar in Modern British History         |
| HIS 532   | Reading Seminar in U.S. Diplomatic History                              | HIS 555 | Reading Seminar in British Empire History         |
| HIS 533   | Reading Seminar in American Cultural History                            | HIS 561 | Reading Seminar in East Asian History             |
| HIS 534   | Reading Seminar in Urbanization   | HIS 581 | Supervised Teaching                               |
| HIS 541   | Reading Seminar in Latin America and the Outside World                  |         | <i>Variable and repetitive credit:</i>            |
| HIS 542   | Reading Seminar in Modern Mexico  | HIS 582 | Directed Reading for M.A. Candidates I            |
| HIS 543   | Reading Seminar in Colonial Latin America                               | HIS 584 | Directed Reading for M.A. Candidates II           |
| HIS 544   | Reading Seminar in Latin America since Independence                     | HIS 585 | Directed Reading for M.A. Candidates III          |
| HIS 545   | Reading Seminar in Brazilian History                                    | HIS 586 | Directed Reading for M.A. Candidates IV           |
| HIS 552   | Reading Seminar in Social and Economic History of England, 1785-Present |         |   |
| * * * * * |   |         |   |
| HIS 601   | Research Seminar in Ancient History                                     | HIS 606 | Research Seminar in Central Europe, 1500-1789     |
| HIS 602   | Research Seminar in Medieval History                                    | HIS 607 | Research Seminar in Central Europe since 1789     |
| HIS 603   | Research Seminar in Renaissance and Reformation                         | HIS 608 | Research Seminar in Eastern Europe, 1505-1801     |
| HIS 604   | Research Seminar in Western Europe, 1500-1789                           | HIS 609 | Research Seminar in Eastern Europe since 1801     |
| HIS 605   | Research Seminar in Western Europe since 1789                           | HIS 610 | Research Seminar in Intellectual European History |

- |         |   |         |  |
|---------|---|---------|--|
| HIS 621 | Research Seminar in American Colonial History                       | HIS 642 | Research Seminar in Modern Mexico  |
| HIS 622 | Research Seminar in the American Revolution, 1760-1789              | HIS 643 | Research Seminar in Colonial Latin America                               |
| HIS 623 | Research Seminar in American Constitutional Origins and Development | HIS 644 | Research Seminar in Latin America since Independence                     |
| HIS 624 | Research Seminar in the Age of Jefferson and Jackson                | HIS 652 | Research Seminar in Social and Economic History of England, 1785-Present |
| HIS 625 | Research Seminar in Civil War and Reconstruction                    | HIS 653 | Research Seminar in Tudor and Stuart England                             |
| HIS 626 | Research Seminar in United States History, 1877-1929                | HIS 654 | Research Seminar in Modern British History                               |
| HIS 627 | Research Seminar in United States History, 1929-Present             | HIS 655 | Research Seminar in British Empire History                               |
| HIS 628 | Research Seminar in American Industrial Society to 1900             | HIS 661 | Research Seminar in East Asian History                                   |
| HIS 629 | Research Seminar in American Industrial Society since 1900          |         |  |
| HIS 630 | Research Seminar in Social and Intellectual U.S. History to 1865    |         | <i>Variable and repetitive credit:</i>                                   |
| HIS 631 | Research Seminar in Social and Intellectual U.S. History since 1865 | HIS 682 | Directed Reading for Ph.D. Candidates I                                  |
| HIS 632 | Research Seminar in United States Diplomatic History                | HIS 684 | Directed Reading for Ph.D. Candidates II                                 |
| HIS 633 | Research Seminar in American Cultural History                       | HIS 685 | Directed Reading for Ph.D. Candidates III                                |
| HIS 634 | Research Seminar in Urbanization                                    | HIS 686 | Directed Reading for Ph.D. Candidates IV                                 |
| HIS 641 | Research Seminar in Latin America and the Outside World             | HIS 699 | Research for Ph.D. Candidates  |

## MATHEMATICS

*Professors:* ADLER, AX, BARCUS, DOSS, DOUGLAS, GROMOLL, LISTER, PINCUS, RAPAPORT, SIMONS (*Chairman*), SZUSZ

*Visiting Lecturer:* MEYER

*Associate Professors:* CHARLAP (*Director of Graduate Studies*), CHEEGER, EBIN, FARKAS, W. FOX, SCHANUEL, THORPE, ZAUSTINSKY

*Assistant Professors:* BACHELIS, D'ALARCAO, FEINER, FRIED, HELTON, HOWE, KRA, KUMPEL, OH, PHILLIPS, ROITBERG, J. ROSENTHAL, SCHROER, SHANTARAM, TRAMER

### 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. Either of the following:
  1. Passing of the Masters Comprehensive Examination, or
  2. Grade of at least B in six one semester courses at the 500 level or above, and a performance on the Ph.D. oral qualifying exam deemed acceptable for the granting of a masters degree.

### Masters Comprehensive Examination

The examination will cover basic material in real analysis, complex analysis, algebra and a fourth topic to be selected by the student. The material is normally covered in advanced undergraduate and first year graduate courses. The examin-

ation will be given twice each year. No student will be permitted to take the examination more than twice.

#### **Requirements for the Ph.D.**

- A. Demonstration of proficiency in two languages chosen from French, German and Russian.
- B. Either of the following:
  - 1. Passing of the Masters Comprehensive Examination, or
  - 2. Grade of at least B in six one semester courses at the 500 level or above.
- 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**

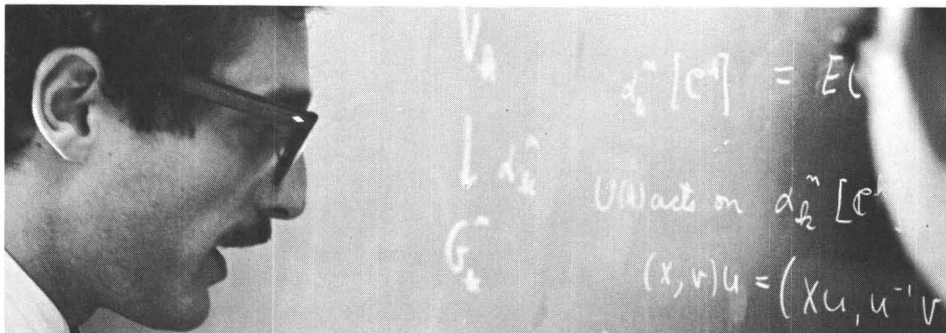
The examination will be based on material at the second year graduate level selected from two areas of mathematics. The areas will be selected by the student subject to the approval of the Committee on Graduate Studies.

The examination will be given by a committee of three faculty members, two of whom are to be selected by the student at the beginning of his preparation period, and the other of whom is to be appointed by the Committee on Graduate Studies. The material covered in the examination is to be chosen by the two student-selected members of the examining committee at the beginning of the preparation period in discussion with the student and subject to approval by the Committee on Graduate Studies.

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

#### **Time Limitations**

All students are urged to satisfy Ph.D. requirement B by the end of one year's study, and Ph.D. requirement C by the end of two year's study. Students will not be encouraged to continue if they have not completed Ph.D. requirement B by the end of their second year, and if they have not completed Ph.D. requirement C by the end of their third year.



## Courses

### MAT 502, 503 Algebra

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.

Second semester will treat the structure and use of algebras, including tensor and exterior algebras, semi-simple algebras, theorems of Wedderburn and Brauer.

*4 credits each semester*

### 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  $\text{Ext}^1$  and  $\text{Tor}_1$  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, 513 Real Analysis

The real number system and Euclidean spaces, general topology, measures and associated integrals particularly Lebesgue measure and the Lebesgue integral, the Riesz representation theorem, linear functions on  $L_p$ , absolute continuity, functions of bounded variation, Lebesgue decomposition theorem, derivative of measure, Banach space, Hahn-Banach and uniform boundedness theorems, vector valued integration theory.

*4 credits each semester*

**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  $\mathbb{R}^n$ , 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, 523 Complex Analysis**

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 expan-

sions. Geometric properties of holomorphic functions. Moebius transformations. Riemann's mapping theorem for simply connected domains.

The contents of the second term vary. Topics are selected from the following: Dirichlet problem. Green's function. Conformal mapping. Introduction to Riemann surfaces. Uniformization of simply connected Riemann surfaces. Elliptic and automorphic functions. Prime number theorem. Picard's theorem. Nevanlinna theory. Introduction to several complex variables. Hardy spaces.

*4 credits each semester*

**MAT 524, 525 Riemann Surfaces and Automorphic Functions**

Analytic continuation, the complete analytic function and analytic configuration. Covering manifolds, monodromy theorem and covering transformations. Algebraic topology of manifolds. Harmonic and analytic differentials. Function theory on compact Riemann surfaces: Weierstrass points, Riemann-Roch theorem, Abel's theorem and the Jacobi inversion problem. The relation of compact Riemann surfaces to algebraic functions. Discontinuous groups, functions automorphic with respect to groups, automorphic forms. Function theory on open Riemann surfaces.

*4 credits each semester*

**MAT 532, 533 Algebraic Topology**

The homology and cohomology of a chain complex; simplicial, singular, and cell complexes; the Eilenberg-Steenrod axioms; homotopy groups and the Hurewicz theorem. Further topics such as fiber spaces, spectral sequences, Poincaré duality.

*4 credits each semester*

**MAT 534 Differential Topology**

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

*4 credits*

**MAT 542, 543 Differential Geometry**

Basic theory of smooth manifolds and submanifolds. Affine connections, exponential

map, geodesics, and curvature. Riemannian metrics; the Riemannian connection and Riemannian curvature. Additional topics selected from: spaces of constant curvature, holonomy, variations of arc length, Gauss-Bonnet theorem.

*4 credits each semester*

#### **MAT 544, 545 Riemannian Geometry**

The Hodge theorem, the Weil homomorphism, characteristic classes, pinching and comparison theorems, theorems relating curvature to topology, minimal varieties, isometric immersion and imbedding theorems, infinite dimensional Riemannian manifolds and global analysis. The choice of material will vary from year to year depending on the interest of students and faculty.

*4 credits each semester*

#### **MAT 546, 547 Lie Groups and Lie Algebras**

Introductory theory of Lie groups and algebras, classification of semi-simple Lie algebras, representation theory, the geometry of Lie groups, introduction to symmetric spaces, additional topics depending on the interest of students and faculty.

*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 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 alge-

braic 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 642, 643 Topics in Geometry**

One or two subjects treated at a research level. These may be selected for example from Riemann geometry, Finsler geometry, Kaehler geometry, complex manifold theory, homogeneous spaces, symmetric spaces.

*4 credits each semester*

#### **MAT 652, 653 Topics in Logic**

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

*4 credits each semester*

## MUSIC

*Professors:* LAYTON (*Chairman*), NEMIROFF

*Associate Professors:* <sup>a</sup>LESSARD, LEWIN

*Assistant Professors:* BONVALOT, FULLER

*Instructors:* R. KRAMER, LAWTON

*Director of Choral Music:* G. SMITH

*Director of the University Band:* KARASICK

*Performing Artists in Residence:* ADDISON, BARON, CANIN, <sup>b</sup>FROELICH, <sup>b</sup>GLAZER,  
GREENHOUSE, KREISELMAN, <sup>b</sup>ROSEMAN, ROSEN, <sup>b</sup>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 twentieth 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 their 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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<sup>a</sup> On leave, Academic Year 1969-70.

<sup>b</sup> Member of The New York Woodwind Quintet.





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 eighteenth and nineteenth 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 sixteenth century style.
  - b. A fugue in four voices in eighteenth century style.
  - c. A sonata or chamber work movement in the homophonic style of the eighteenth 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.
- 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.
- 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 Mus.M. Program**

The following are required for admission to the Mus.M. 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 recommendations from the principal teacher and at least one other person familiar with the student's work.

#### **Requirements for the Mus.M. Degree**

- A. Courses: Twenty-four credits, chosen in consultation with the student's advisor, of which no more than twelve may be in individual study of an instrument or voice. Of the remaining twelve credits, up to six may be in advanced undergraduate courses.
- 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 Twentieth 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 521 Seminar in Composition**

Individual projects in composition, discussed and criticized in class.

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: Twentieth 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 exemplars 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 at-



tained 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 Eighteenth Century Music**

#### **MUS 553 Topics in Nineteenth Century Music**

#### **MUS 555 Topics in Twentieth 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 two hours 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 twentieth 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 Twentieth 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 Hotterre 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.

*Variable credit*

#### **MUS 599 Independent Studies**

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

*Variable credit*

## PHYSICS

*Professors:* BALAZS, <sup>c</sup>G. BROWN, <sup>a</sup><sup>c</sup>COURANT, <sup>c</sup>DRESDEN, EISENBUD, FEINGOLD, FINOCCHIARO (*Visiting*), D. FOX, <sup>c</sup>M. GOLDBERGER (*Adjunct*), M. GOOD, HAMERMESH (*Chairman*), LAMBE, <sup>c</sup>B. W. LEE, L. L. LEE, JR., MUETHER, NATHANS, POND, SILSBEE, STRASSENBURG, SWARTZ, TOLL, WILCOX, <sup>c</sup>C. N. YANG

*Associate Professors:* O. AMES, <sup>b</sup>CHIU, <sup>a</sup>CRAIG, DEZAFRA, FOSSAN, KAHN, KAO, KIRZ, KUO, LEE-FRANZINI, MOULD, SKOLNICK, <sup>b</sup>THADDEUS (*Adjunct*)

*Assistant Professors:* J. COLE, FOSTER, <sup>c</sup>FREEDMAN, <sup>c</sup>A. GOLDBERGER, GRAF, GRANNIS, <sup>c</sup>GROENEVELD, <sup>c</sup>HWA, INGBER, A. JACKSON, Y. Y. LEE, <sup>c</sup>MCCOY, MCGRATH, <sup>c</sup>NIEH, PAUL, <sup>c</sup>J. SMITH, SPROUSE, TAKAHASHI (*Visiting*), <sup>c</sup>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 requirements 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.

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<sup>a</sup> Physicist, Brookhaven National Laboratory, on part-time appointment at Stony Brook.

<sup>b</sup> Member, NASA Goddard, on part-time appointment at Stony Brook.

<sup>c</sup> Member, Institute for Theoretical Physics.

**Requirements for the M.A. Degree**

- A. One year of residence, with registration in a program of courses approved by the advisor.
- B. An average grade of at least B (3.0), and no grade of F, in the following graduate courses: Analytical Mechanics, Electrodynamics, Mathematical Physics I, Quantum Mechanics I and II.
- C. Passing of the Masters Examination.

**Requirements for the Ph.D.**

- 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: Analytical Mechanics, Electrodynamics, Quantum Mechanics I, II, Mathematical Physics I, Statistical Mechanics. (With permission of the Graduate Committee, a student may satisfy this requirement in any of the above-listed courses by taking the course examination and receiving a grade of A or B. A student who does not receive an A or B in a course or examination may, with permission repeat the 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 consists of the defense of an original proposition developed by the student.
- 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

#### *Advanced Undergraduate Courses*

PHY 341, 342 Quantum Mechanics and  
Modern Physics

PHY 345, 346 Senior Laboratory

*Graduate 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 Mathematical Methods of Physics I, II**

Treatment of the mathematical equipment useful to physicists. Topics: Hilbert space, complex analysis, calculus of variations, Green's function, differential equations, special functions, boundary value problems, integral transforms, integral equations, groups.

*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 nonequilibrium phenomena.

*3 credits*

**PHY 551 Nuclear Physics I**

Basic properties of nuclei, radioactivity, and electromagnetic properties; experimental techniques, accelerators, and nuclear detectors; the two-body problem and nuclear forces.

*3 credits*

**PHY 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 557 Elementary Particle Physics I**

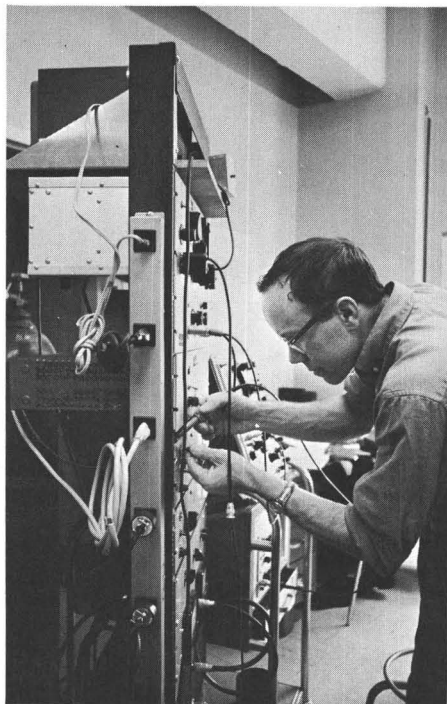
Introduction to elementary particle characteristics and phenomena, symmetry and invariance principles, partial wave analysis and resonance phenomena, models for strong interaction, weak interactions, accelerator and detector development.

*3 credits*

### **PHY 562 Solid State Physics II**

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

*3 credits*



### **PHY 564 Nuclear Physics II**

Nuclear models and their relations to properties of nuclei, theory of nuclear reactions, nuclear beta decay.

*3 credits*

### **PHY 566 Elementary Particle Physics II**

Fundamental particle systematics, 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**

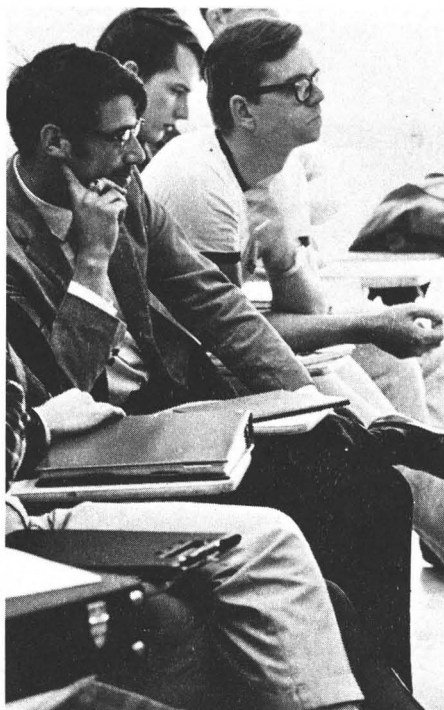
General theory of relativity; cosmology.

*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 the permission of the faculty seminar leader. Seminars for 1969-70 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 686 Special Topics in Elementary Particle Theory**

**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 preliminary examination.

*Each semester, variable and repetitive credit*

## PSYCHOLOGY

*Professors:* GARCIA, KALISH (*Chairman*), <sup>a</sup>KRASNER, M. LEVINE, <sup>g</sup>F. PALMER, ROSS, STAMM, WYERS

*Associate Professors:* BRAMEL, <sup>b</sup>DAVISON, GEER, GOLDFRIED, <sup>c</sup>MORRISON, <sup>f</sup>POMERANZ, RACHLIN, SINGER, VALINS

*Assistant Professors:* <sup>d</sup>DOLL, D'ZURILLA, EMMERICH, FEHMI, FRIEND, <sup>e</sup>GHOLSON, KESTENBAUM, F. LEVINE, NEALE, O'LEARY, SCHVANEVELDT, M. SMITH, WEINTRAUB, YOUNG

### 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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<sup>a</sup> Director of Clinical Training.

<sup>b</sup> Not in residence, Academic Year 1969-70.

<sup>c</sup> Associate in Instructional Resources.

<sup>d</sup> Member, Institute for Research in Learning.

<sup>e</sup> Visiting part-time.

<sup>f</sup> Director of Psychological Services.

<sup>g</sup> Provost for Educational Research and Development.

*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.

*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.

*Language Proficiency*

Proficiency in translating one foreign language must be demonstrated before the student is admitted to the Specialty Examination. Ability to translate technical literature in either French, German, Spanish or Russian is the criterion for satisfaction of the requirement. Substitution of any other language requires special departmental permission.

*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.

*Advancement to Candidacy*

Upon successful completion of the language requirement and the Preliminary Examination, 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 processes 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 newly formed 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 322 Advanced Statistics
- PSY 341 Introduction to the Nervous System
- PSY 342 Seminar in Synaptic Processes
- PSY 362 Sensation-Perception
- PSY 372 Tests and Measurements
- PSY 381, 382 Introduction to Mathematical Psychology

### *Graduate Courses*

#### **PSY 501 Quantitative Methods I**

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

*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 theo-

retical 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 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, 3 credits*

**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 interest 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 698 Research**

*Variable and repetitive credit each semester*

**PSY 699 Doctoral Research**

*Variable and repetitive credit each semester*



## ROMANCE LANGUAGES

### FRENCH

*Professors:* BIEBER, BRUGMANS, HAAC, LAIDLAW (*Chairman*)

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

*Assistant Professors:* ALLENTUCH, PETREY

#### 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**

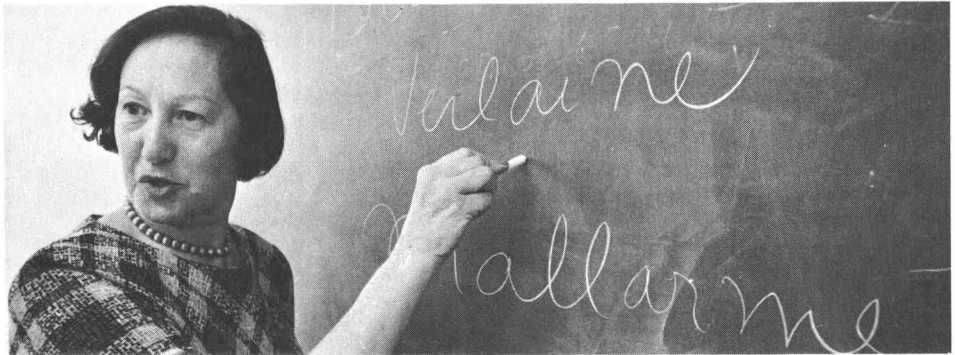
A study of the historical development of the French language from its origin.

*Fall, 3 credits*

##### **FRN 514 Seminar in Medieval Literature**

Topic for the first offering: The theme of love in the works of major French, Italian and English writers of the Middle Ages.

*Spring, 3 credits*



**FRN 530 Studies in Poetry from the Pleiade to Baudelaire**

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

*Spring, 3 credits*

**FRN 531 Studies in the Classical Theater**

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

*Fall, 3 credits*

**FRN 532 Studies in Classical Prose**

Analysis of the works of the *Ecrivains mondains*, with special emphasis on La Rochefoucauld, Mme de Lafayette and Mme de Sévigné.

*Spring, 3 credits*

**FRN 541 Studies in the Enlightenment**

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

*Fall, 3 credits*

**FRN 542 Studies in Eighteenth 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 Valéry 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, LANG, SELVIN (*Chairman*), E. WEINSTEIN

*Associate Professors:* COLLVER, FELDMAN, GAGNON, GOODMAN, POLSKY

*Assistant Professors:* BERGER, S. COLE, FARBERMAN, GOODE, HERRICK, HUDSON,  
TUCHMAN, <sup>a</sup>WEITMAN

*Lecturers:* MAURICE, TANUR

### Admission to Graduate Study

Requirements for admission will normally include:

- A. An average of 3.00 in undergraduate course work.
- B. Five courses in sociology.
- C. A one-semester course in statistics.
- D. Proficiency in a foreign language (preferably French or German) equivalent to two years of college work.
- E. Results from the Graduate Record Examination.
- F. Acceptance by the Department of Sociology and by the Graduate School.

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

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

<sup>a</sup> On leave, Academic Year 1969-70.

- 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. Language proficiency: Passing of an examination demonstrating competence in dealing with literature in a modern foreign language will satisfy this requirement.
- 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.
- 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

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

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. 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. 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. 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.

Prerequisite: SOC 103.

*Fall, 3 credits*

#### **SOC 363 Sociology Today**

Recent advances in research, theory, and method in the field of sociology.

Mr. 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. 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. 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. Weinstein

Prerequisite: SOC 501.

*Fall, 3 credits*

**SOC 505 Modern Social Theories**

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

Mr. Coser

*3 credits*

**SOC 508 Experimental Methods**

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

Mr. Weinstein

*3 credits*

**SOC 509 Field Work**

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

Mr. 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. Collver

Prerequisite: One course in statistics.

*Fall, 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.

Messrs. Feldman, Goodman

*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.

Messrs. Feldman, 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. 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. Hudson

*3 credits*

**SOC 541 Conflict and Violence**

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

Messrs. Coser, 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. Messrs. Gagnon, Polsky

*3 credits*

**SOC 561 Sociology of Intellectual Life**

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

Mr. Coser

*3 credits*

**SOC 562 Sociology of the Arts**

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

Mr. 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. Cole

*3 credits*

**SOC 564 Communications**

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

Mr. 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. 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. 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. Berger

*3 credits*

**SOC 606 Sociological Theory**

Modes of conceptualization and theory construction. Problems in developing a theory.

Mr. 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**

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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 graduate programs, each under the direction of a chairman. The graduate program chairmen and the dean of engineering comprise the Graduate Executive Committee which reviews all student applications and approves the enrollment of the graduate student in one of the programs best suited to his background and interests.

### **Admission to Graduate Study**

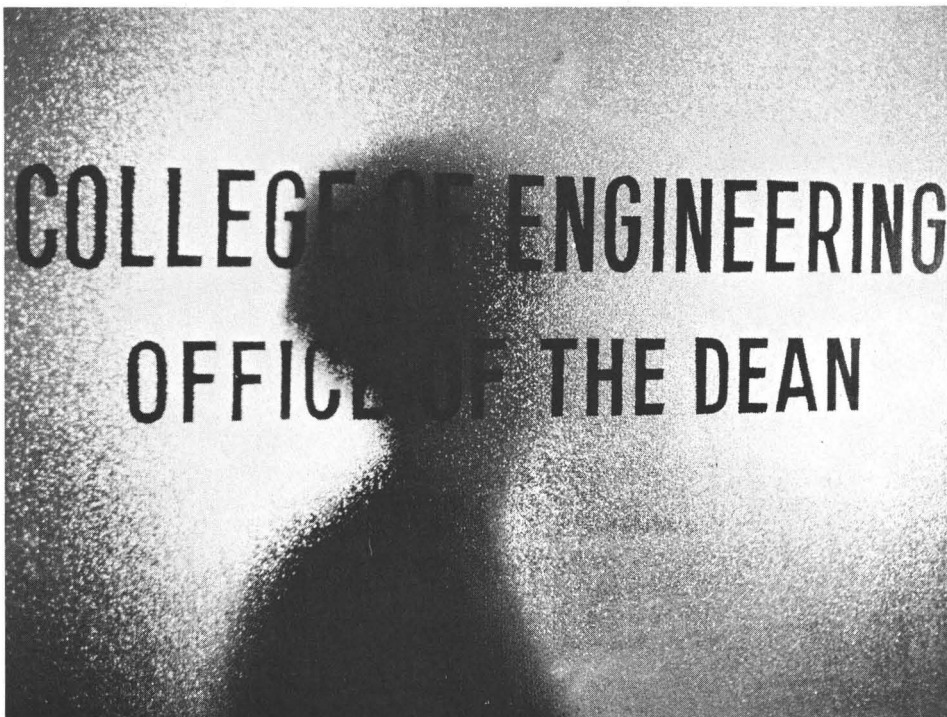
For admission to graduate study in engineering, the minimum requirements are as follows:

- 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 Graduate Executive Committee and the Graduate School.

### **Requirements for the M.S. Degree**

- A. Residence: Two consecutive semesters of full-time study.
- B. 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 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.

- C. 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.
- D. Final recommendation: Upon the fulfillment of the above requirements the faculty of the graduate program will recommend to the dean of the Graduate School through the Graduate Executive Committee, that the Master of Science degree be conferred, or will stipulate further requirements that the student must fulfill.
- E. 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. Residence: Four semesters of full-time study beyond the baccalaureate including at least two consecutive semesters.
- B. Language requirement: A reading ability in at least one foreign language relevant to the student's field of interest is required. The student's choice of language must be approved by his research advisor.
- C. Qualifying examination: A student must satisfactorily pass a qualifying examination to ascertain his ability to study for the Ph.D. degree.
- D. 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.
- E. Preliminary Examination: Upon completion of the course work and language requirements, a comprehensive oral examination, which may be supplemented by a written examination, will be given to the student.
- F. 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.
- G. 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.
- H. The student must defend his dissertation before an examining committee. On the basis of the recommendation of this committee, the Graduate Executive Committee 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.
- I. Time limit: All requirements for the doctor of philosophy degree must be completed within four years after advancement to candidacy.

**APPLIED ANALYSIS**

*Professors:* <sup>a</sup>DICKER, DOLEZAL (*Visiting*), FINERMAN, GELERNTER, GERST (*Chairman*), TEWARSON, ZEMANIAN

*Associate Professors:* BELTRAMI, Y. CHEN, LEIBOWITZ, D. LEVINE, SRIVASTAV, THAMPURAN, TYCKO

*Assistant Professors:* JOSEPH, KIM

<sup>a</sup> Not in residence, Academic Year 1969-70.

**Admission to Graduate Study**

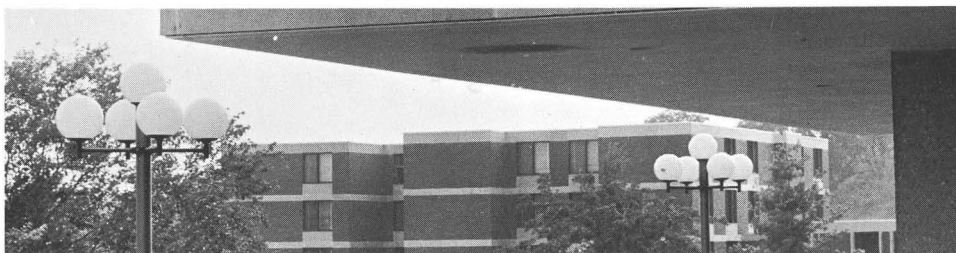
In addition to the requirements for admission given on page 111, the department requires a course in advanced calculus or equivalent material.

Requirements for the M.S. and Ph.D. degrees are listed on pages 111-113.

The graduate program of this department provides a course of study in modern applied mathematics with a view to their utilization in the engineering or scientific disciplines. 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 co-operative 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 101.

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, and optimization.



**Courses***Advanced Undergraduate Courses***ESA 316 Special Functions of Applied Mathematics***3 credits***ESA 335 Computer Organization and Programming***3 credits***ESA 340 Introduction to the Theory and Applications of Computers***3 credits**Graduate Courses***ESA 501 Analysis of Linear Systems I**

Propagation problems in discrete systems, integral transform techniques, system functions, convolution, applications of complex variables, stability.

*3 credits***ESA 502 Analysis of Linear Systems II**

Propagation problems in continuous systems, solution of partial differential equations by transform techniques, asymptotic relations, iterative structures, sampled-data systems, z-transform, systems with memory.

*3 credits***ESA 503 Principles of Applied Mathematics I**

Equilibrium and characteristic value problems in discrete systems. Development and application of pertinent material from the following subjects: matrix calculus, linear vector spaces, transformation theory and spectral decomposition, extremum principles, numerical methods.

*3 credits***ESA 504 Principles of Applied Mathematics II**

Equilibrium and characteristic value problems in continuous systems. Development and application of pertinent techniques from the following subjects: Sturm-Liouville theory, orthogonal functions, special functions, variational principles, integral equations, Green's function, conformal mapping, theory of characteristics, analytical and numerical methods of solution.

*3 credits***ESA 507 Stochastic Processes I**

Processes with mutually independent, uncorrelated or orthogonal random variables. Markov processes. Martingales. Processes with independent or orthogonal increments. Stationary processes. Prediction. Applications to biology, quantum theory, numerical analysis, statistical physics, nuclear fission, astronomy and astrophysics, chemical reactions. Prerequisite: ESA 320, or the equivalent.

*3 credits***ESA 508 Stochastic Processes II**

Problems in the filtering of noise and criteria for signal detection. Study of prediction theory and the Wiener-Hopf equation. Prediction in state space and the use of iterative filters. Connection with least squares and maximum likelihood estimates. Introduction to information theory. The notion of entropy; proof of the Shannon theorems for a noisy channel.

Prerequisite: ESA 507, or the equivalent.

*3 credits***ESA 510 Introduction to 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. Topics germane to the applications are selected from the fields of topology, real variables, integration theory, Hilbert and Banach spaces. Students intending to take ESA 605, 623 or 628 are advised to take this course first.

*3 credits*

**ESA 511 Complex Variable Theory with Applications**

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 513 Linear Algebra, with Applications**

Topics in linear algebra and matrix theory including matrix inequalities, systems of linear differential equations, and stability matrices. The Perron-Frobenius theorem with application to Markov chains and to economic models. Introduction to Hilbert space and to self-adjoint boundary value problems.

*3 credits*

**ESA 514 Abstract Algebra and Applications**

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 513 or equivalent.

*3 credits*

**ESA 515 Non-Linear Systems**

Basic non-linear differential equation theory. Analytical, graphical and approximation techniques for studying the behavior of non-linear systems. Application of phase plane and describing function techniques.

*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 531 Tensor and Group Methods in Applied Analysis**

This course provides an introduction to the powerful methods of tensor and group theory with applications to engineering and physics. Commencing with a review of linear vector spaces, the course then proceeds to tensor algebra, tensor calculus with applications to dynamics, elasticity, electromagnetic theory and relativity, group properties of transformations and group representation with physical applications.

Prerequisite: Elementary matrix algebra.

*3 credits*

**ESA 537 Methods of Operations Research I**

A study of the methods of operations research and of their application to the design of complex systems. Model testing. Analysis of data. Linear and dynamic programming. Theory of games and decisions. Flow charting. The digital computer as a research tool and system component. Simulation, applied statistical technique.

*3 credits*

### **ESA 538 Methods of Operations Research II**

Non-linear programming and programming under uncertainty; introduction to statistical decision theory and game theory. Monte Carlo techniques. Applications such as inventory theory or traffic theory according to the interest of the class.

Prerequisite: ESA 537, or the equivalent.

*3 credits*

### **ESA 541 Network Theory—Analysis**

Fundamental properties of electrical networks are examined, such as linearity, time-invariance, passivity, causality, and stability. Their relationship to the concept of positive-reality and its generalizations is developed. Quadratic forms, energy functions, and Lagrange's equations are discussed.

The time-domain implications of these results are next considered. The Bochner-Schwartz theorem on positive-definiteness and Bernstein's theorem on complete-monotonicity are derived and applied to obtain realizability criteria for impulse response matrices. The transfer functions corresponding to non-decreasing step functions are also analyzed.

Finally, the scattering matrix is developed and applied to an analysis of various types of degenerate networks.

*3 credits*

### **ESA 542 Network Theory—Synthesis**

General properties of network functions in the complex frequency plane and at real frequencies, Hurwitz polynomials and positive-real functions. Equivalent and reciprocal networks. Synthesis of passive one-ports; two-element kind networks, RLC networks. Realizability criteria for passive two-ports. Synthesis of transfer immittances. Transfer function synthesis. Image-parameter techniques. Lattice, ladder and other unbalanced configurations. N-port realizability theory. Realization techniques using active elements.

*3 credits*

### **ESA 543 Optimum Design of Feedback Control Systems I**

This course is identical with ESE 543.

*3 credits*

### **ESA 544 Optimum Design of Feedback Control Systems II**

This course is identical with ESE 544.

*3 credits*

### **ESA 545 Graph Theory and its Applications**

A development of the concepts and techniques applied in the study of those aspects of systems which may be represented by flow-graphs. Connectivity. Capacity. Input-output relationships. Single commodity flow. Max-min theorem. Multi-commodity flow. Reciprocity connection with linear programming. Probabilistic nets. Application to communication systems, electrical networks, transportation systems, traffic flow, fluid mechanics.

*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. Intended as either a single course or as preparation for ESA 543, 544.

Prerequisite: ESA 501, or the equivalent.

*3 credits*

### **ESA 555 Mixed Boundary Value Problems in the Mathematical Theory of Elasticity**

Occurrence of mixed boundary value problems, preliminary mathematics, the problem of a disc, dual integral equations, Peter's solution, Titchmarsh's solution, Noble's so-

lution, a distributional approach, dual series equations, dual equations involving Fourier-Bessel series, Dini series and trigonometric series. Tranter's solution, method of fractional integration, methods based on integral representation, applications to axisymmetric and plane problems of elastostatics.

3 credits

#### **ESA 557, 558 Elasticity I and II**

This course is identical with ESC 541, 542.

3 credits per semester

#### **ESA 561 Vibrations**

Principal modes and natural frequencies of discrete and continuous systems. Forced vibrations, dissipative continua. Stability analysis. Introduction to non-linear vibrations.

3 credits

#### **ESA 563 Hydrodynamics**

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

3 credits

#### **ESA 564 Cavity Flows**

A brief review of the hydrodynamics of free-streamline flows. The Helmholtz and Riabouchinsky cavity flow models are studied and applied to physical problems. Unsteady cavity flows are solved by means of perturbation methods. Existence and uniqueness of solutions are discussed.

Prerequisites: ESA 563—ESA 605 or their equivalent.

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 567 Wave Propagation in Plasma**

This course is identical with ESE 522.

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 335, 340, or permission of instructor.

3 credits per semester

#### **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. Analogue 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 catalogues. 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 to be treated are the decomposition theory of Hartmanis and Stearns which is based on lattice theory rather than semigroups and Zeiger's results on covers and decomposition into permutation-reset machines.

Prerequisite: Permission of instructor.

*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 320 and a knowledge of measure theory and integration, or the equivalent.

*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 321 and a knowledge of Lebesgue integration, or the equivalent.

*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, 612 Theory of Partial Differential Equations and Their Applications I and II**

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 504.

*3 credits per semester*

**ESA 621 Advanced Operational Methods in Applied Mathematics**

An advanced course in the application of operator techniques to the analysis of systems. Topics covered include: the general integral transform, Hilbert, Hankel and Mellin transforms, finite transforms, Wiener-Hopf technique, generating functions, asymptotics, Mikusinski operational calculus.

*3 credits*

**ESA 623 Distribution Theory and its Applications I**

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.

*3 credits*

**ESA 624 Distribution Theory and its Applications II**

Heaviside operators defined on the system of distributions vanishing on the negative semi-axis. Systems of integro-differential equations with constant coefficients; the classical and distributional solution. Generalized Volterra's operators. Systems of integro-differential equations with variable coefficients; properties of the solutions.

*3 credits*

**ESA 625 Advanced Boundary Value Problems in Applied Mathematics**

Linear operators on a Hilbert space and their spectra; applications to self-adjoint boundary value problems and Fredholm theory. The boundary behavior of Cauchy integrals in the usual and distributional sense is studied to provide a unified approach to certain problems in engineering analysis: Plemelj formulas, singular integral equations, and the Wiener-Hopf and Hilbert problems; Hilbert transforms.

*3 credits*

**ESA 627 Theory of Integral Equations and their Applications**

Integral equations with degenerate kernels, equations of the second kind, iterative solutions, contraction mapping principle, Fredholm theory, spectral theory for symmetric kernels, Volterra equations of the first and second kind, equations with weakly singular kernels, simultaneous systems, applications. Prerequisites: ESA 503, ESA 510 or permission of instructor.

*3 credits*

**ESA 628 Functional Analysis I**

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.

Prerequisite or corequisite: ESA 503

*3 credits*

**ESA 629 Functional Analysis II**

Hilbert space, orthogonality, orthonormal expansions, Riesz-Fischer theorem, self-adjoint operators. Topological linear spaces, seminorms, continuous linear functionals, dual spaces, weak and strong topology. Applications to the foundations of physical system theory and generalized networks.

Prerequisite: ESA 628.

*3 credits*

**ESA 631, 632 Approximate Methods in the Boundary Value Problems of Applied Mathematics I and II**

A survey of boundary value problems arising in the applications for which analytical solutions either are not available or are of little practical value, followed by an intensive study of various techniques for the approximate solution of these problems. Topics covered include numerical solutions by means of finite differences; approximate analytical solutions such as Galerkin's method, collocation, Ritz method, and the method of least squares. Applications are drawn from the areas of fluid mechanics, elasticity, heat transfer and potential theory.

*3 credits per semester*

**ESA 635 Realizability Theory in Hilbert Space**

Banach-space-valued distributions and their convolution. Banach systems and Hilbert ports. The postulational foundations of linear systems. Passivity and positivity. The scattering formalism. Synthesis of Hilbert ports. Prerequisite: Advanced calculus; or Corequisite: Functional analysis.

*3 credits*

**ESA 641 Geometric Programming**

Basic concepts and techniques of geometric programming. Relevant results from linear and convex programming. Duality and its refinements. Extended geometric programming. Applications to non-linear optimization problems in engineering design.

Prerequisite: Permission of instructor.

*3 credits*

**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 503.

*3 credits*

**ESA 680 Selected Topics in Computer Sciences**

Selected topics in proof theory, heuristic programming, computability and recursive function theory, recent and current research in the computer sciences.

Prerequisite: Permission of instructor.

*3 credits, repetitive*

**ESA 690 Topics in Applied Mathematics**

Selected topics from various fields of applied mathematics which require specialized development of subjects in the fields of analysis and algebra.

*3 credits, repetitive*

**ESA 691 Seminar in Applied Mathematics**

Supervised reading and discussion of current journal publications in applied mathematics.

*3 credits*

**ESA 695 Seminar in Numerical Methods**

Discussion of recent and current research in numerical analysis. This course may be taken for repetitive credit with permission of the instructor.

Prerequisites: ESA 526, ESA 527, or permission of instructor.

*3 credits*

**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 Department of Applied Analysis or in the Department of Electrical Sciences may elect to participate in a joint program sponsored by both these departments leading to an advanced degree in applied analysis or electrical sciences with a designated option in computing science. The computing science program faculty consists of members of the parent departments whose major research and teaching interests center in the computer-related sciences. This joint faculty includes Professors Chang, Kieburz, Rappaport and Smith of electrical sciences and Professors Finerman, Gelernter, Levine, Tewarson and Tycko of applied analysis. Professors Smith and Tycko are co-chairmen of the program.

A student participating in this program follows the Ph.D. qualifying procedures of his own department, but selects his course of study from the offerings of both departments. His thesis research may be pursued under the direction of any member of the computing science program faculty, regardless of parent department.

Suggested core sequence for the M.S. degree in computing science:

	<i>Credits</i>
ESA 335 Computer Organization and Programming	3
ESE 317 Digital Logic and Systems	3
ESA 526 Numerical Analysis I	3
ESA 579 Algorithmic Languages and Compilers I	3
ESA 587 Theoretical Foundations of Computing I	3
ESE 550 Combinational Switching Theory	3
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If a student's background is sufficiently strong, he does not take ESA 335 and/or ESE 317.

The remainder of the required 24 credits are selected from the following elective courses:

	<i>Credits</i>
ESA 340 Introduction to the Theory and Applications of Computers	3
ESE 316 Digital Devices and Circuits	3
ESA 527 Numerical Analysis II	3
ESA 580 Algorithmic Languages and Compilers II	3
ESA 583 Simulation and Modelling	3
ESA 584 Information Organization and Retrieval	3
ESA 588 Theoretical Foundations of Computing II	3



ESA 589, ESE 589 Automata Theory I	3
ESA 590, ESE 590 Automata Theory II	3
ESE 531 Theory of Digital Communications I	3
ESE 532 Theory of Digital Communications II	3
ESE 535 Information Theory and Coding	3
ESE 541 Feedback Control Systems I	3
ESE 542 Feedback Control Systems II	3
ESE 551 Sequential Machines	3

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 is augmented. Presently, research is being conducted in the following subdisciplines of computing science:

- Abstract Languages and Machines
- Biomedical Computer Applications Research
- Digital Communications
- Digital Control
- Graphic Information Processing
- Information Organization and Retrieval
- Numerical Analysis
- Pattern Recognition
- Simulation and Modelling
- Simulation of Intelligent Behavior by Machine
- Switching Theory and Digital Circuits

## ELECTRICAL SCIENCES

*Professors:* <sup>a</sup>CHANG, CHUANG (*Visiting*), KIEBURTZ, MARSOCCI (*Acting Chairman*),  
STROKE

*Associate Professors:* C. CHEN, DOLLARD, D. SMITH, TRAUTMAN, TUAN

*Assistant Professors:* CARROLL, RAPPAPORT, THOMAS

The Department of Electrical Sciences offers graduate work leading to the Master of Science and Doctor of Philosophy degrees. These programs are designed to provide the student with a firm background in fundamental principles of analysis and synthesis on which to base further independent study. Ample opportunities exist for students to become involved in both experimental and theoretical research.

In addition, the department sponsors a joint interdepartmental graduate program in computing science with the Department of Applied Analysis, as described on pages 122-123.

Some of the research areas currently being investigated by faculty members and graduate students include: optimal control theory, systems theory, digital communications techniques, pattern recognition by computers, synthesis of logic networks, electronic transport phenomena in solids, frequency-independent antennas, wave propagation in random media, and electromagnetic waves in gaseous plasmas, quantum electronics, coherent optics, holography.

### Requirements for Graduate Degrees

The faculty of electrical sciences has set the following regulations, which are in addition to the College of Engineering requirements listed on pages 111-113:

Immediately upon arrival, every graduate student entering the department is assigned by the graduate administrator 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 administrator. Any subsequent changes of advisor or courses should also be reported to the graduate administrator.

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.

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<sup>a</sup> On leave, Academic Year 1969-70.

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 con-

sequences 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

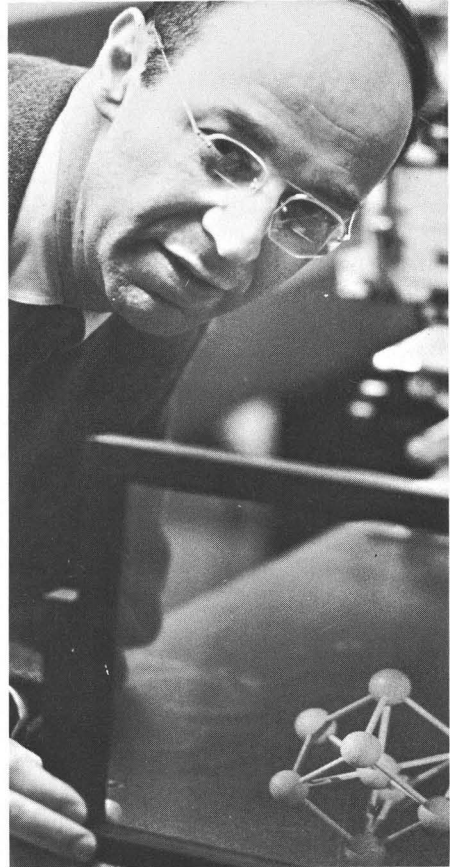
### **ESE 523 Antenna Theory**

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 530 Introduction to Communications Principles**

The basic model of communications systems. Modulation and detection. AM, FM, PM; DSB, SSB and vestigial sideband modulation. FM with feedback. Gaussian noise, signal to noise ratio, and threshold effects in continuous wave systems. The sampling theorem. PAM, PPM, and PCM systems. Quantization noise. Statistical properties of signals. Companders, vocoders and TASI. Space-, time- and frequency-division multiplexing. Interference. Distortion. Subjective versus objective criteria of quality. The course emphasizes the underlying theory of the various communications techniques, rather than specific implementation. A major objective is to



establish the relative importance of digital techniques in current communications practice, and to indicate some of the reasons why direct application of the more sophisticated theory has been most successful in digital systems.

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. ESE 530 and/or ESA 507 are 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 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 and classes of combinational functions and their complexity: symmetry classes, monotone functions, and their detection. Complete algorithm for two level synthesis. Functional decomposition and multilevel synthesis with simple gates. Linearly separable functions—methods of testing and synthesis. Adaptive linear logic: comparison of set theoretic and statistical approaches, single unit adaption theorems. Non-linearly separable functions synthesis with non-linear elements, networks of linear and adaptive elements. Probabilistic logic, synthesis of reliable networks from unreliable components. Special applications: pattern recognition, property filters, etc.

*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**

Introduction of field of modern optics and electro-optical science. Review of properties of light (quantum, electromagnetic, relativistic) and of basic geometrical and physical optics; coherence properties of light and coherent light generation, amplification and control with optical masers; operational Fourier-transform and convolution theory, etc.

Prerequisite: A bachelors degree or equivalent in the physical sciences, mathematics, or engineering. Mathematics training through calculus and differential equations.

*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 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, <sup>b</sup>S. LEVINE, NATHANS, SEIGLE, THOMPSON (*Chairman*)

*Associate Professors:* CARLETON, HERMAN, <sup>a</sup>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 will be 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 will be given at the beginning of each semester, and will be a comprehensive examination covering undergraduate work in materials science, physics, chemistry and applied mathematics. The Qualifying Examination will be 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 will then be allowed, if required). An M.S. degree is not a prerequisite to admission to the Ph.D. degree program in materials science.

### Courses

#### *Advanced Undergraduate Courses*

**ESM 302 Techniques of Materials Science**

**ESM 325 Diffraction Techniques and the Structure of Solids**

**ESM 336 Modern Theory of Solids**

#### *Graduate Courses*

**ESM 509 Thermodynamics of Solids**

The basic laws and thermodynamic relationships are briefly reviewed, with emphasis on the computation of standard free energy changes of reactions, and application to equilibrium calculations. Current knowledge re-

<sup>a</sup> Not in residence, Academic Year 1969-70.

<sup>b</sup> Not in residence, Fall Semester 1969-70.

garding the thermodynamic properties of condensed phases is discussed, including the thermodynamics of first and higher order phase transitions in solids. The thermodynamic treatment of ideal, regular, and real solutions is reviewed. Use of the foregoing in the estimation of reaction free energies and equilibria in condensed phase reactions such as diffusion, oxidation, and phase transformations is emphasized. Finally, the thermodynamic analysis of phase equilibrium diagrams is considered.

*3 credits*

### **ESM 511 Imperfections in Crystals**

The course provides an introduction to point and extended imperfections in crystalline solids. The characteristics of point defects in metals, semiconductors and ionic solids are described, and the thermodynamics of point defects is developed in detail. Elementary dislocation theory is introduced. The energetics of dislocations are treated using elasticity theory, and important dislocation reactions are described. In addition, the structures of internal boundaries are presented. Finally, interactions between lattice imperfections are discussed, with emphasis on the generation and annihilation of imperfections, dislocation climb, clustering and segregation.

*3 credits*

### **ESM 512 Strength and Plasticity of Solids**

This course provides a broad treatment of the strength and plasticity of solids from both the macroscopic and microscopic viewpoints. Subjects included are analysis of stresses and strains in solids, mechanical tests and properties, macroscopic criteria for yielding and fracture in homogeneous solids, modes of fracture, ductile and brittle behavior; dislocation theory and the strength of materials, generation and multiplication of dislocations, dislocation interactions and theories of yielding and fracture, influence of impurities, solutes, and dispersed phases upon dislocation movement, theories of fatigue, creep, and rupture at elevated temperatures.

*3 credits*

### **ESM 515 Reactions in Solids I**

This course provides a comprehensive treat-

ment of solid state reactions and transformations. Diffusion in solids is considered in detail, including solution of the transport equations for volume, grain boundary, and surface diffusion, Kirkendall effect and other diffusion phenomena, atomic mechanisms of diffusion, correlation effects, etc. Next, the theory of processes in which diffusion plays an important role is considered, such as ionic conduction, oxidation of metals, and the sintering of solids.

*3 credits*

### **ESM 516 Reactions in Solids II**

Continuation of ESM 515. The theory of phase transformations in solids is considered. Kinetics and mechanisms of nucleation and growth and martensitic transformations. Melting and solidification, precipitation from solid solution, polymorphic transformations, eutectic and eutectoid reactions, second order transitions, recrystallization, and other transformations in solids.

Prerequisite: ESM 515.

*3 credits*

### **ESM 520 Structure of Solids**

This course offers a broad treatment of the structure of solids, beginning with the principles of geometrical and mathematical crystallography, symmetry and groups, the reciprocal lattice, and Brillouin zone construction. The structures of real crystals are discussed and rationalized in terms of atom and molecular geometry and bonding. Next the structure of non-crystalline solids is considered. The atom distribution function is introduced and applied to liquids and glasses. Structural factors influencing the formation of amorphous phases are discussed. Finally the structure of heterogeneous solids is considered, including the topology of crystallite assemblies and domains in polycrystalline and multiphase systems.

*3 credits*

### **ESM 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 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, chemisorption 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*

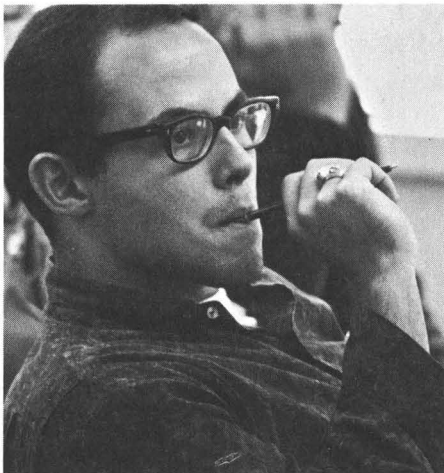
#### **ESM 616 Advanced Topics in Solids**

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 mag-



netic susceptibilities; piezoelectricity, ferroelectrics and antiferroelectrics; thermodynamical theory of ferroelectricity; ferroelectricity and lattice dynamics; ferro- and ferrimagnetics and anti-ferromagnetics; theories of ferromagnetic anisotropy; magnetic metals and alloys; garnets and ferrites; domain theories and micromagnetics.

*3 credits*

#### **ESM 619 Electric and Magnetic Polarization of Materials II**

This course is a continuation of ESM 618 concentrating on the physical principles of dielectric and magnetic materials in technical applications. The course covers the semi-classical 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 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 discussion by visitors, local faculty and students presenting current research results.

*1 credit*

#### **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

Requirements for the M.S. and Ph.D. degrees are listed on pages 111-113.

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.

### Courses

#### ESC 501, 502 Advanced Heat Transfer I and II

Thermal boundary layers in forced and free convection, heat transfer in internal flows, two-phase boundary layer flows. Thermal radiation, formulation of radiation problems in terms of integral equations, radiant transfer with absorbing-emitting gases.

*3 credits per semester*

#### ESC 511, 512 Advanced Fluid Mechanics I and II

Lagrangian and Eulerian frames, Rayleigh transport theorem and kinematic surface conditions, elementary kinetic theory, dynamical equations of motion, energy and momentum transfer, classes of constitutive relations. Fluid statics, including self-gravitation stability of floating bodies, surface tension effects and statics of the earth's atmosphere. Significant features of fluid dynamics of incompressible and barotropic perfect fluids and of the compressible perfect gas. Characteristic surfaces and shock waves. Internal and surface waves. Constitutive equations of viscous fluids. Some exact solutions of the

Navier-Stokes equations. The nature of laminar instabilities.

*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 multi-component 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 Energy Transfer in Gases**

Energy transfer among the internal and translational modes of molecular motion. Spectroscopic states, interactions, lifetimes and populations. Relaxation dynamics. Sound propagation in compressible fluids. Shock wave structure. Irreversible processes and the approach to equilibrium. Nonequilibrium radiative and chemical pumping of internal modes. Applications to gasdynamic systems.

*3 credits*

**ESC 522 Experimental Methods in Radiative Transfer**

Quantitative spectroscopic measurements of absolute intensities of chemically stable and unstable species; radiative transfer measurements in isothermal and nonisothermal gas systems; radiative heat transfer studies in flow systems; determination of surface pressures on planets; effects of radiative fields on dissociation and recombination of chemical species; use of lasers for gas velocity and absorption measurements.

*3 credits*

**ESC 541, 542 Elasticity I and II**

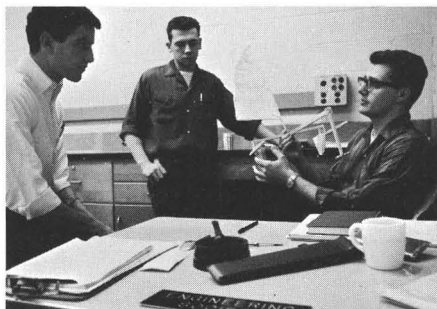
Derivation of linear equations of elasticity. Stress equations of motion. Displacement and strain. Stress-strain relations for crystalline solids. Compatibility equations. Uniqueness theorem. Reciprocity theorem. Applications to static three-dimensional problems. Contact theory. Two-dimensional problems. 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 will be such topics as Pfaff differentials and Caratheodory's 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-solid 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 Radiative Energy Transfer**

The physics of absorption, emission and scattering of thermal radiation in gaseous media. Basic equations relating to energy transfer in absorbing, emitting and scattering media. Formulation and solution of the integro-differential equations describing conservation of energy for radiative equilibrium, combined conduction and convection, and convective phenomena involving radiating media.

*3 credits*

**ESC 621 Combustion**

Experimental methods and results. Fundamentals of theory. Existence, structure, initiation, propagation and extinction of deflagrations and detonations. Radiative and thermophysical properties of combustion gases. Premixed and unpremixed combustible gases. Heterogeneous combustion. Flames in non-laminar flow fields. Combustion instability.

*3 credits*

**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 626 Kinetic Theory of Radiating Media**

Spectral line profiles, Lambert's law of extinction, band models, infrared gas emissivities. Equation of radiative transfer, radiative equilibrium problems and Milne's integral equation, integral equation of radiative equilibrium in infrared radiating gases. Introduc-

tion to methods of solutions, eigenvalues and eigenfunctions and their determination by approximate methods, thermal radiation diffusivities, luminescence radiation diffusivities. Singular perturbation methods and the radiation predominant problems.

*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 will be considered.

*3 credits*

### **ESC 641 Dynamics of High-Temperature Gases**

Studies of phenomena involving mutual interaction between fluid mechanics, heat transfer, physical kinetics due to high-temperature thermodynamic effects: dissociation, ionization, and radiation.

*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*

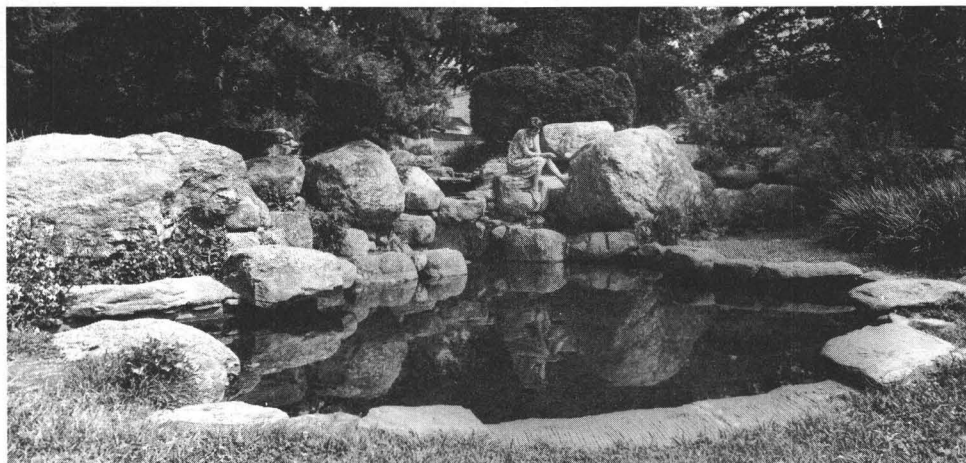
### **ESC 698 Practicum in Teaching**

*3 credits, repetitive*

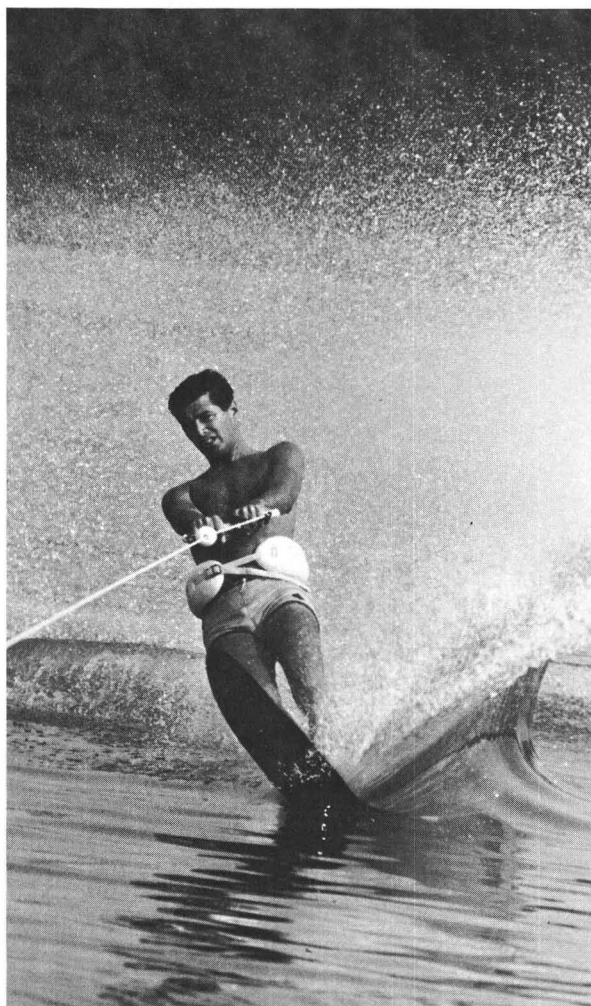
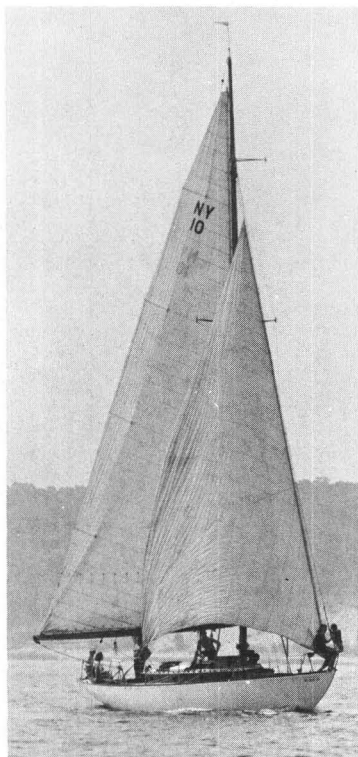
### **ESC 699 Research**

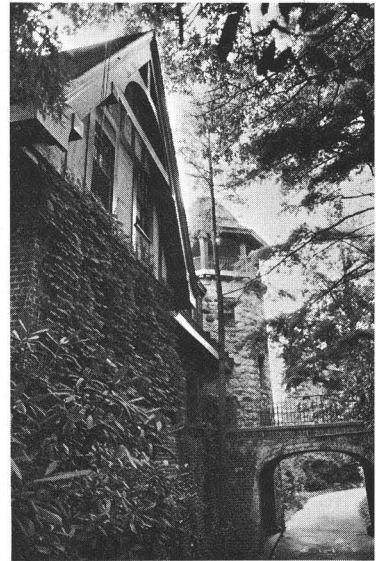
*Variable and repetitive credit*

Within a few miles of the Stony Brook campus are the refreshing beaches of Long Island Sound, quiet parks and wooded estates, small historic villages distinctly akin to those of New England—and all the scenes pictured on this and the following pages.









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DIRECTIONS TO STONY BROOK	
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M.D., Cornell University; M.P.H., Colum-  
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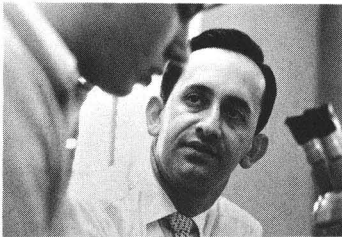
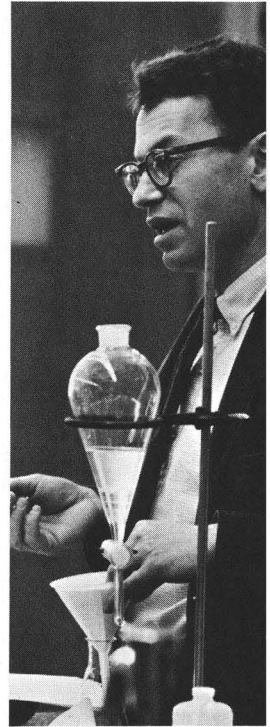
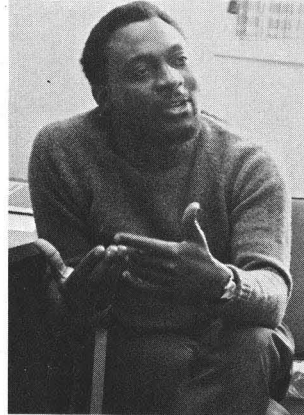
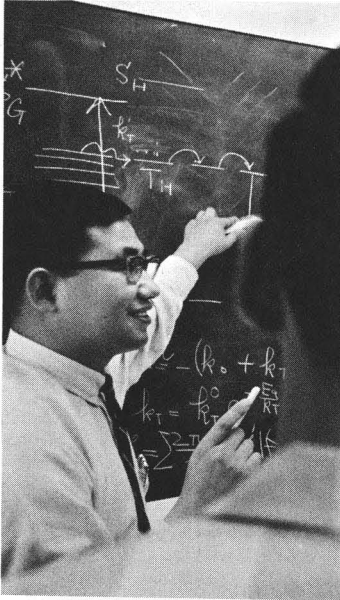
MELVIN V. SIMPSON  
Professor of Biochemistry  
Ph.D., University of California, Berkeley

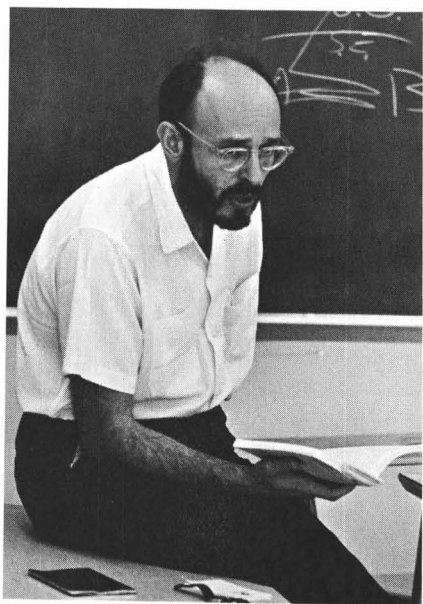
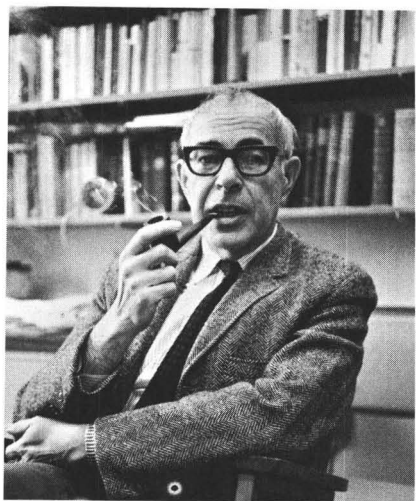
DANIEL N. SLATKIN  
Instructor in Pathology  
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Professor of Engineering and Medical Bio-  
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Ph.D., Johns Hopkins University
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Ph.D., University of Oregon
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Ph.D., University of Amsterdam
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Ph.D., Princeton University
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*Independent Investigator in Biological  
Sciences*  
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*Associate Professor of Engineering*  
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*Assistant Professor of Petrology*  
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Marine Sciences Research Center*  
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Ph.D., Georgia Institute of Technology

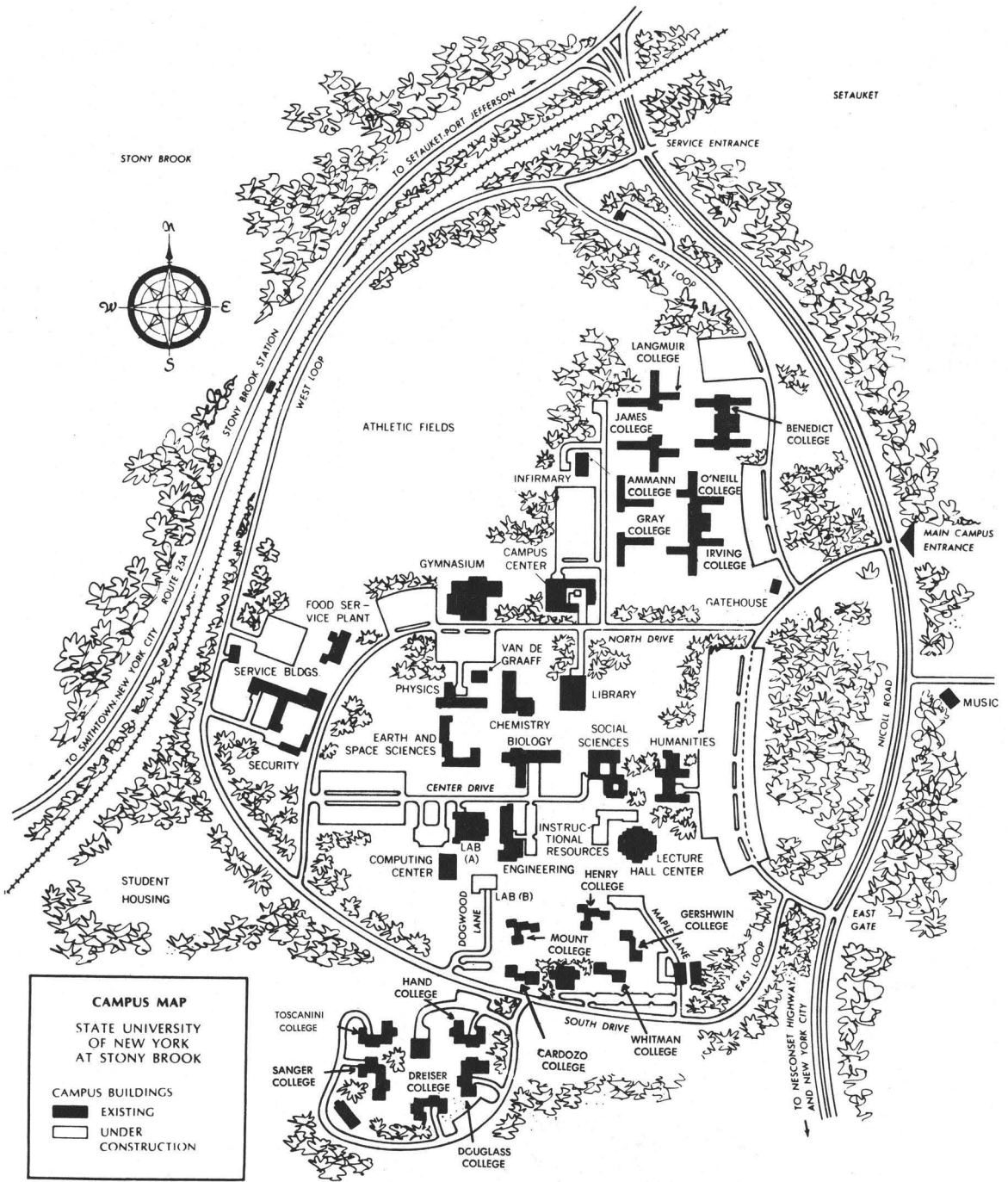
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<sup>a</sup> Not in residence, Academic Year 1969-70.

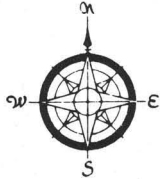
<sup>b</sup> Not in residence, Fall 1969.

<sup>c</sup> Physicist, Brookhaven National Labs, on part-time appointment at Stony Brook.

<sup>d</sup> Member, NASA Goddard, on part-time appointment at Stony Brook.



STONY BROOK



SETAUKET

STUDENT HOUSING

**CAMPUS MAP**

STATE UNIVERSITY OF NEW YORK AT STONY BROOK

CAMPUS BUILDINGS

- EXISTING
- UNDER CONSTRUCTION

TOSCANINI COLLEGE

SANGER COLLEGE

HAND COLLEGE

DREISER COLLEGE

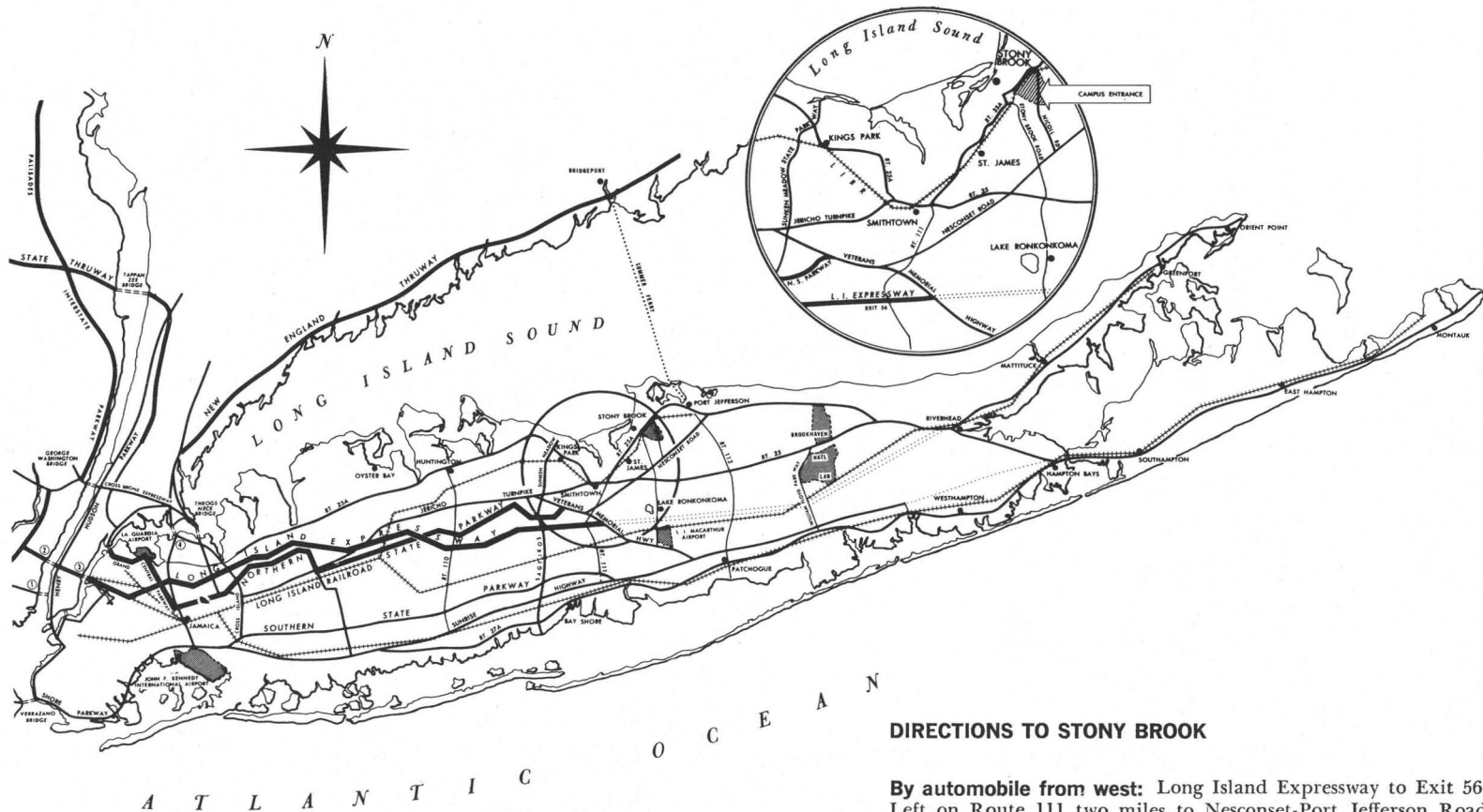
DOUGLASS COLLEGE

CARDOZO COLLEGE

WHITMAN COLLEGE

TO NEECONSET HIGHWAY 25B AND NEW YORK CITY

- EXISTING
- UNDER CONSTRUCTION



### 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

State University of New York, established by the State Legislature in 1948, comprises 70 colleges and centers. At present, 63 conduct classes: four university centers, two medical centers, 11 colleges of arts and science, two specialized colleges, six two-year agricultural and technical colleges, five statutory colleges and 33 locally-sponsored, two-year community colleges.

Two colleges of arts and science are in varying stages of development. Two four-year campuses, in Westchester County at Purchase and in Nassau County at Old Westbury are under construction. Old Westbury admitted a limited number of students in September 1968, in temporary quarters at Oyster Bay, Long Island. The third campus will be upper-divisional (junior-senior years) in concept and located in the Utica-Rome-Herkimer area. Masters level programs will be offered at all three campuses.

The University's trustees also have approved the establishment of five additional community colleges. In varying stages of development, they are sponsored by Clinton, Columbia-Greene, and Schenectady Counties and two by New York City's Board of Higher Education.

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 four urban centers administered by community colleges.

University-wide research programs include the Atmospheric Sciences Research Center with campus headquarters at Albany, the Institute for Theoretical Physics and the Marine Sciences Research Center at Stony Brook, and the 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 the 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 advance 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, radio and television, forestry, maritime service, ceramics, pre-law, 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 exception 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."

## STATE UNIVERSITY OF NEW YORK

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 SCIENCES

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

### SPECIALIZED COLLEGES

College of Forestry at Syracuse University  
Maritime College at Fort Schuyler (Bronx)

### AGRICULTURAL AND TECHNICAL

#### COLLEGES (Two-year)

Alfred	Cobleskill	Farmingdale
Canton	Delhi	Morrisville

### STATUTORY COLLEGES

College of Ceramics at Alfred University  
College of Agriculture at Cornell University  
College of Home Economics at Cornell  
School of Industrial and Labor Relations at Cornell  
Veterinary College at Cornell University

\*(Three additional Colleges of Arts and Science are in varying stages of development. Two four-year campuses, in Westchester County at Purchase and in Nassau County at Old Westbury are under construction. Old Westbury admitted its first students in limited numbers at temporary quarters in Oyster Bay in September, 1968. The third campus will be upper-division (junior-senior years) in concept and located in the Utica-Rome-Herkimer area. Master's level programs will be offered at all three campuses.)

### 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 at Binghamton  
Broome Technical Community College  
Community College of the Finger Lakes at Canandaigua  
Corning Community College at Corning  
Dutchess Community College at Poughkeepsie  
Erie County Technical Institute 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  
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 of Applied Arts and Sciences  
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  
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

(Five additional community colleges have been approved by the Board of Trustees and are in varying stages of development. They are sponsored by Clinton, Columbia-Greene and Schenectady Counties and two by the New York City Board of Higher Education.)

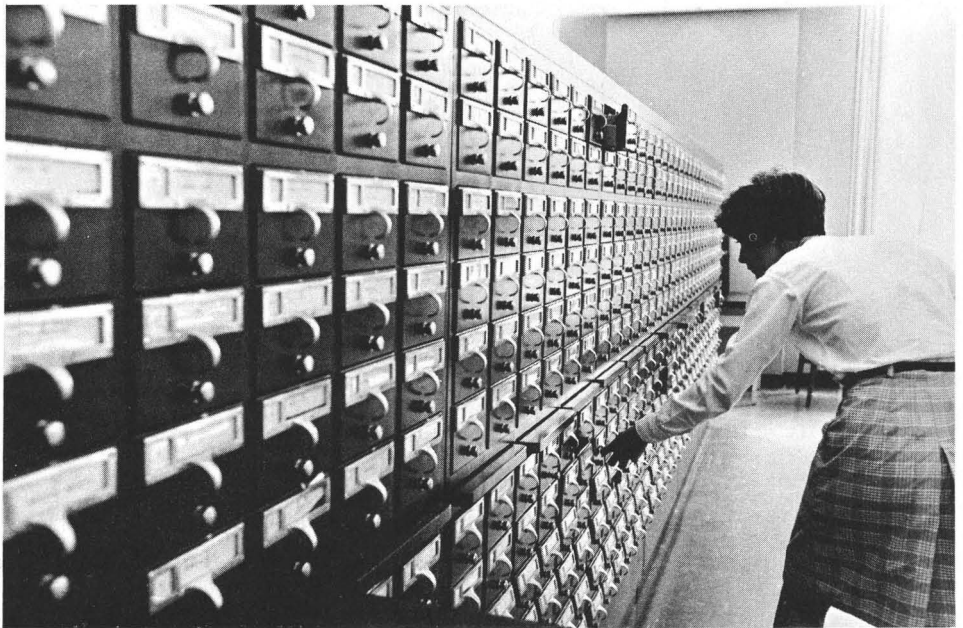


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### **About the Cover**

As man reached the moon, the quest for knowledge that is the very idea of a university received new affirmation. At Stony Brook there was very special interest in the Apollo 11 project. Dr. Oliver A. Schaeffer, Chairman of Stony Brook's Earth and Space Sciences Department, was in Houston with an 11-man team when the first lunar samples were returned, waiting to conduct experiments designed to detect evidence of a lunar atmosphere.

*NASA photograph*

