3-30-1980

New Jersey Institute of Technology Catalog of Day and Evening Undergraduate Programs, 1980-1982

New Jersey Institute of Technology

Undergraduate 1980-1982 Programs

New Jersey Institute of Technology
1st Century

Directory For Correspondence

Mailing Address: 323 High Street, Newark, N.J. 07102.

Telephone: Area Code (201), 645-5321.

Admissions (Undergraduate):
For undergraduate admissions, including requests for publications, and information on advanced standing, tuition and fees, address the Director of Admissions. Telephone: (201) 645-5140.

Registration:
Address the Registrar. Telephone: (201) 645-5150.

Alumni Activities:
Address Alumni Secretary. Telephone: (201) 645-5441.

Division of Continuing Education:
Address the Director. Telephone: (201) 645-5236.

Division of Technology:
For information concerning certificate programs, address the Assistant Director. Telephone: (201) 654-5231.

Business Matters:
Address the Business Office. Telephone: (201) 645-5106.

Financial Aid and Scholarships:
Address the Director of Financial Aid. Telephone: (201) 645-5183.

Placement of Seniors and Alumni:
Address the Director of Placement. Telephone: (201) 645-5200.

Cooperative Education:
Address the Director. Telephone: (201) 645-5361.

Counseling:
Address the Counseling Center. Telephone: (201) 645-5190.

Transcripts:
For transcripts and student grades, address the Recorder. Telephone: (201) 645-5138.

Veterans:
For information on veteran benefits, address the Registrar. Telephone: (201) 645-5146. For information on other veteran affairs, address the Director of Veterans Affairs. Telephone: (201) 645-5103.

Public Affairs:
Address the Director. Telephone: (201) 645-5195

Foundation at New Jersey Institute of Technology:
Address the Administrator. Telephone: (201) 645-5211.

Plant, Equipment, and Utilities:
Address the Director of Physical Plant. Telephone: (201) 645-5151.

COVER PHOTO *shows historic site where classes began at New Jersey Institute of Technology (then Newark Technical School) on February 9, 1885. Classes opened with 102 students in this rented, three-story building still standing at 21 West Park Street near Military Park in Newark.*

The student population today numbers more than 6,000 and makes use of 14 buildings on a campus of 24 acres.

This issue of the Undergraduate Catalog commemorates the Institute's growth and emergence as the public technological university of New Jersey, and is part of its Centennial celebration which will continue through 1981. The Centennial is represented on the cover by the Institute's official Centennial logo. This design, which incorporates the theme "1st Century" and an abstract of the numerals 1881 and 1981, symbolizes the institution's first 100 years.

We cordially invite you to join us in shaping what we firmly believe will be an even more dynamic 2nd Century

Catalog of Day and Evening Undergraduate Programs 1980-1982

INSTITUTE ACADEMIC CALENDAR
1980 - 1981 Academic Year

Fall Semester 1980

Fall semester classes begin ...	Tuesday, September 2
Thanksgiving recess	Thursday, November 27 through Saturday, November 29
Final examination period	Wednesday, December 17 through Tuesday, December 23
Fall semester ends	Tuesday, December 23

Spring Semester 1981

Spring semester classes begin .	Monday, January 19
Washington's Birthday	No classes, Monday, February 23
Spring recess	Saturday, March 14 through Friday, March 20
Good Friday/Saturday	No classes April 17 & 18
Final examination period	Wednesday, May 13 through Tuesday, May 19
Commencement	(Tentative) Thursday, May 28

INSTITUTE ACADEMIC CALENDAR
1981 -1982 Academic Year

Fall Semester 1981

Fall semester classes begin ...	Tuesday, September 1
Labor Day	No classes, Monday, September 7
Thanksgiving recess	Thursday, November 26 through Saturday, November 28
Final examination period	Thursday, December 17 through Wednesday, December 23
Fall semester ends	Wednesday, December 23

Spring Semester 1982

Spring semester classes begin .	Monday, January 18
Washington's Birthday	No classes Monday, February 22
Spring recess	Saturday, March 13 through Friday, March 19
Good Friday/Saturday	No classes April 9, 10
Final examination period	Wednesday, May 12 through Tuesday, May 18
Spring semester ends	Tuesday, May 18
Commencement	(Tentative) Thursday, May 27

Old Weston Hall (Circa 1910)

Tradition and Change

The traditions of NJIT date back to 1881 when Newark Technical School was founded to provide academic background for the apprentices of a growing industrial center. Keeping pace with a developing urban region, the School began to offer bachelors degrees in engineering in 1919. Subsequently, it adopted the name, Newark College of Engineering.

After the Second World War, the college expanded rapidly to meet the needs of the increasingly sophisticated industry of the State and nation. Graduate programs in engineering were introduced and the college began a program of physical expansion. Doctoral study was initiated in 1960.

In 1968, the institution began to diversify its academic programs into fields other than engineering in order to better serve the needs of the State and beyond. New programs were developed in science, management, and technology. In 1974, the college opened the New Jersey School of Architecture. In 1975, in recognition of its broadening mission, Newark College of Engineering became New Jersey Institute of Technology.

Today, the Institute has emerged as the public technological university of New Jersey. The year, 1981, marks 100 years of continuous history and a renewed dedication on the part of the Institute to continue to provide the kind of diverse academic programs, research and public service required in our technological age.

Education for Careers in a Technological Age

NJIT now offers twelve different undergraduate programs leading to the bachelor's degree. Many of the programs have a variety of elective options, so you can choose a program most suited to your interests and career objectives. All the programs combine a study of technical matters with courses in the liberal arts to provide an education for today's complex technological society.

Bachelor's degree programs are offered in:

- Architecture
- Computer Science
- Engineering
  - Chemical Engineering
  - Civil Engineering
  - Electrical Engineering
  - Industrial Engineering
  - Mechanical Engineering
- Engineering Science
- Engineering Technology
- Industrial Administration
- Man and Technology
- Surveying

You will find full descriptions of these programs beginning on page 33.

Campus and Student Life

The NJIT Campus

Drive north along High Street past the imposing Essex County Court House, or south past the St. Michael's Medical Center, and you will see the usual facade of weathered town houses and store fronts that are typical of major American cities.

Then you will come upon NJIT's "castle," set on a slight rise above its tree-shaded lawn. The oldest building on NJIT's campus, Eberhardt Hall was once an orphanage, later acquired by the Institute and modernized to house administrative offices. Built in 1856, it was designated as a historical landmark in 1973.

The campus is situated close to the Newark business district and to NJIT's sister institutions of Essex County College, the Newark Colleges of Rutgers University, and the College of Medicine and Dentistry of New Jersey. Located a few blocks from Interstate Highway 280, the campus is also easily accessible by public transportation from many points in New Jersey.

Of NJIT's original buildings, the oldest still in use is Colton Hall, built in 1911. Then came Campbell Hall (1926), and an Annex (1930). Rapid growth after World War II led to the construction of Weston Hall and Cullimore Hall in 1958.

Then, in 1966, NJIT's "new campus" was dedicated, an event which saw the Institute's total land area jump from hardly more than two acres to twenty and its number of buildings increase from six to eleven.

Opened simultaneously were an electrical engineering building, a student center, an alumni center, operations building, and a complete physical education plant which includes a large gymnasium, a swimming pool, specialized sports areas, an athletic field, and several tennis courts.

Most recently, the campus has been enlarged to 24 acres, and the addition of a library-humanities center, chemical engineering-chemistry complex, mechanical engineering building and new dormitory brings to fourteen the number of facilities.

The buildings themselves and the handsome, landscaped campus with its Institute Green that holds and unifies them, are both representative of NJIT's long traditions, and are the scene today of a spirited educational and extracurricular life that looks eagerly to the future.

A Look at Student Life

New Jersey Institute of Technology may not be *the* busiest place in the world, but it certainly must be one of them, for over the years the Institute has developed an extracurricular program that is remarkable for its wide interest and diversity.

Intercollegiate sports include baseball, basketball, bowling, fencing, gymnastics, ice hockey, soccer, judo, karate, wrestling, pistol, rifle, skiing, swimming, tennis, volleyball, weight lifting, and team handball.

Considerable emphasis is placed upon an intramural program which includes all sports also available at the varsity team level, plus sailing, track and field, paddleball, flag football, innertube water polo, badminton, softball, archery, and two man basketball. Women may participate in varsity and intramural activities.

Fraternity sports, many students say, are among the most exciting of all "since they are played with an intense spirit of brotherhood." There are thirteen social fraternities on campus to help prove their point.

There are nine honor societies and twelve recognition societies represented by the Honor Societies Council. These include Tau Alpha Pi, Tau Beta Pi, Phi Eta Sigma, and Omicron Delta Kappa as well as professional societies such as the American Chemical Society, the American Institute of Aeronautics and Astronautics, the American Institute of Chemical Engineers, the Society for Technology, the Society for the Advancement of Management, Society of Manufacturing Engineers, to name just a few. In other words, there is an active professional society for every major field of study offered by the Institute.

NJIT's student activities are presided over by a Student Senate which administers a wide range of programs through an Activities Council, Publications Council, the Class Councils, and Interclub Council, Honor Societies Council, and the Professional Societies Council. Women students, numbering about 400, take an active part in all phases of the extracurricular life of the Institute, including scuba diving, mountain climbing, ham radio, photography, theatre, chess, and radio broadcasting.

Because of NJIT's close proximity to New York City (less than an hour to Times Square), students take full advantage of the recreational and cultural life of the City and engage in a constant distribution of tickets to shows and museums, concerts, and sports events. Members and guests of the Motorsports Club, the Outing Club, Ski Club, and Ten Fathoms Club spend frequent weekends following their various interests at the shore, in Vermont, and at other places throughout the northeastern United States.

And always, there's the Center, where students gather to eat, plan programs and activities, socialize, work on publications, bowl, shoot pool, or just relax. In addition, the fraternity members can drop over "to the house" for fellowship and relaxation.

Freshman students "read all about it" each fall in the latest edition of NJIT's Student Survival Handbook, written for and by students to help them get the most out of their college years.

NJIT's students have a full, busy, and interesting life in which academic and non-academic values go hand in hand to produce graduates who are well educated and self-assured. As NJIT's alumni, they have and will continue to make a significant contribution to the economic, social, and intellectual life of the nation.

How to Apply

If you would like to apply for admission to any of the undergraduate programs at NJIT you will want to read the detailed requirements and procedures that are described beginning on page 13. What you need for admission depends on which undergraduate program you plan to pursue. For example, admission requirements for Industrial Administration are quite different from those for Engineering.

Most NJIT students enroll as freshmen after graduating from high school, but applications are also welcome from transfer students who have completed some college work. The Institute works closely with New Jersey county colleges to facilitate transfer of students completing the Associate degree.

Admissions counselors are available to help you define your college plans. They will give you further information about any of the undergraduate programs, and they can explain the admission requirements for each program. If you are uncertain about which program to take, an admissions counselor will help you make a decision.

Feel free to visit the NJIT campus to learn more about what is available. You may arrange a tour, if you would like. For admission forms, further information, or tours contact:

Office of Admissions
New Jersey Institute of Technology
323 High Street
Newark, New Jersey 07102
(201) 645-5140

Admissions

Admissions

FRESHMAN ADMISSIONS

High school graduates who have not previously attended college may apply for admission as a freshman. In lieu of a certificate of graduation from an approved secondary school, you may offer a high school equivalency certificate, as issued by the New Jersey State Board of Education or similar State agency. To become a candidate for admission, you must complete an Application for Admission and pay a nonrefundable $10.00 application fee. Your application will be considered on the basis of your high school record, your performance on College Board examinations and other pertinent information.

HIGH SCHOOL REQUIREMENTS

All applicants for admission to programs leading to the bachelor's degree are required to complete 16 high school units in a college preparatory program. This work must include 4 units of English and 2 units of laboratory science. Applicants for Engineering, Engineering Science, Computer Science or Surveying are encouraged to take physics and chemistry as their laboratory sciences.

Applicants for the Pre-Professional Program in Architecture are encouraged to take biology and physics as their laboratory sciences.

Mathematics requirements vary depending on the bachelor's degree you plan to pursue. Engineering, Engineering Science, Computer Science, Surveying, and Architecture require 3½ units of mathematics, including trigonometry. Industrial Administration and Man and Technology require 2 units of mathematics. Applicants for the Man and Technology program are encouraged to take 3 units of mathematics.

If your credentials are strong enough for you to be admitted but you have not completed all the specific required units, you may be admitted and a special program worked out so that you can complete your bachelor's degree in the normal length of time.

The Institute recognizes that individuals may make decisions to pursue careers in the technical professions well after completion of high school, or even college. Admissions counseling is available to help you plan a program of study. You are encouraged to make contact with the Office of Admissions.

ADMISSIONS EXAMINATIONS

All applicants for an undergraduate program must complete the Scholastic Aptitude Test. In addition, applicants for admission to Engineering, Engineering Science, Computer Science, and Surveying must complete the Mathematics (Level I or II) Achievement Test.

You should plan to take the tests required for your program preferably in the fall of your senior year in high school. Applications and information on fees and dates of examinations can be obtained from most high schools or from the College Board, Box 592, Princeton, New Jersey 08540.

COURSE PLACEMENT

Students enter at many levels of achievement. The credentials of all accepted students are reviewed before specific courses are assigned. The range of coursework available is from review courses (for those who would benefit from some "brush up") to honors courses which provide more challenge for the student who is ready for it.

Students for whom review is suggested or required may do such work during summer school or in a slightly modified program during the academic year. Foreign students and others whose native language is not English may be required to submit their results from the Test of English As A Foreign Language (TOEFL) examination and may also be required to take a course in English as a Second Language.

COLLEGE LEVEL EXAMINATION PROGRAM (CLEP)

Applicants may be granted course credit for non-traditional college education such as independent studies or job-related experiences by successfully passing appropriate CLEP Subject Examinations. Interested candidates should contact the Counseling Center for additional information.

EARLY ADMITTANCE

Exceptional students who can meet the appropriate testing and course requirements for a particular program of a freshman year may qualify to begin as a freshman without completing the senior year of high school or receiving a high school diploma.

ADVANCED PLACEMENT

Applicants may be awarded credit for freshman coursework in a number of areas by taking the proper courses in secondary school and attaining satisfactory scores on appropriate Advanced Placement Examinations. It is possible in some cases for an applicant to receive credit for two semesters in a course and begin studies in that subject at the sophomore level. Interested candidates should contact the Counseling Center at 645-5190 for additional information.

DEPARTMENT EXAMINATIONS

Accepted candidates may be granted credit for advanced departmental courses by successfully passing a departmental examination to demonstrate proficiency in a subject area. Interested candidates should contact the Counseling Center for further information.

ADMISSION AS SOPHOMORE

A limited number of outstanding incoming students will be granted credit for the freshman year and will be placed in the sophomore year of study. Such actions will take place based on outstanding secondary school records, test scores, interviews, and college testing.

FOREIGN STUDENT ADMISSIONS

All students who will maintain F-1 (student) visa status while attending New Jersey Institute of Technology must submit a Confidential Statement and Confirmation of Finances form as part of their application. This form is included with the application sent to such students.

No Form I-20 will be issued to students who have gained F-1 (student) status via another institution until one year of study has been completed at that institution. An exception to this requirement is a program designed solely to increase a student's proficiency in the English language.

NON-MATRICULATED STUDENTS

Permission to enroll as a non-matriculated student will be granted to students who can fulfill admissions requirements or who have completed the prerequisites for the courses they wish to pursue.

Official transcripts for non-matriculated students will list subjects completed, grades earned, and the credits which will be granted if the student matriculates. If the courses pursued were as an auditor, no

grade or academic credit will be awarded. Auditors may, however, receive a statement of their attendance in the course.

Non-matriculated students who are approved for enrollment will be permitted to register for courses in which there is room available after all degree candidates have completed their registration. Contact the Office of Admissions for more information.

READMITTANCE

Students who have matriculated at New Jersey Institute of Technology, and discontinued their program, and now wish to rejoin the Institute should address their inquiries to the Office of the Dean of Student Services.

VISITS

It is generally a good idea for you to visit any college in which you are interested. You are encouraged to contact the Office of Admissions to arrange for a student-guided tour of the Institute; we will be pleased to be your host.

INTERVIEWS

An interview may be required as we attempt to evaluate your capability to complete a program at NJIT. If an interview is required, the date and time will be arranged by the Office of Admissions.

TRANSFER ADMISSIONS

If you have pursued a course of study at another institution and wish to transfer to NJIT, you are encouraged to read all of the following sections which apply to your situation.

Credit may be given for completed courses which are equivalent to those in the NJIT curriculum to which you have been accepted, and in which you have earned final grades higher than the lowest passing grade. In some cases exceptions can be made and courses in which the lowest passing grade has been earned may be transferred.

APPLICATION AND RECORDS

In order to be considered for admission as a transfer student you must submit the Application for Admission, the $10.00 non-refundable application fee, and official records of all post-secondary school work you have attempted.

Generally, a transfer applicant who has earned an Associate degree or its equivalent in an appropriate field is not required to submit secondary school records or College Board results. The Admissions Office reserves the right, however, to require such credentials if the student's admissibility would otherwise be jeopardized.

ENGINEERING, ENGINEERING SCIENCE, COMPUTER SCIENCE, SURVEYING, INDUSTRIAL ADMINISTRATION, PRE-PROFESSIONAL ARCHITECTURE, AND MAN AND TECHNOLOGY

In addition to the items mentioned above, the following are required:

Transcripts of secondary and post-secondary school work
Results of the Scholastic Aptitude Test
Results of the Mathematic (Level I) Achievement Test (Engineering, Engineering Science, Computer Science, and Surveying applicants only)

Students applying to an Engineering, Engineering Science, Computer Science or Surveying program who have successfully completed two or more semesters of college level calculus are exempt from submitting Mathematics (Level I) Test scores.

ENGINEERING TECHNOLOGY

Candidates for admission to the program leading to the Bachelor of Science degree in Engineering Technology must hold an associate degree in engineering technology (A.A.S.) or in the physical or life science technologies. The Institute will consider you if you are well-qualified and if you have an educational background equivalent to an appropriate associate degree, but do not actually have the degree. Transfer students from engineering programs may be required to complete a minimum number of technology courses in addition to the junior and senior year Bachelor of Technology program. A knowledge of elementary applied calculus is desirable for all options and required for the Electrical and Mechanical Systems options.

If you are applying to the Construction and Contracting option you may have an associate degree in a variety of technologies — civil, construction, drafting and design, mechanical, architectural, or others.

If you are applying to the Electrical Systems option you must have completed a two-year program in electrical or electronics engineering technology.

If you are applying to the Environmental option you may have an associate degree in a variety of technical specialties including biology, chemistry, and engineering technologies.

If you are applying to the Manufacturing option you may have completed a two-year program in any field of engineering technology.

If you are applying to the Mechanical systems option you must have completed a two-year program in mechanical technology.

The Scholastic Aptitude Test and the Achievement tests of the College Entrance Examination Board are *not required* of Engineering Technology applicants.

NEW JERSEY SCHOOL OF ARCHITECTURE

The five-year architecture curriculum has a two components: two years of broad-based general studies (introductory program) followed by the concentrated professional Architecture Program. Candidates interested in admission to introductory program study at NJIT should refer to admissions information for freshmen. The introductory program years may also be completed at another two or four year college or university. Specific introductory program course requirements include a year of English composition, a year of general physics, a semester of freehand drawing, a semester of computer science and two years of general environmental design courses. The first math course requirement may be met by completing terminal courses in college algebra and trigonometry, introductory calculus or statistics. A second course in math, Mathematics of the Environment, is also required. Students intending to transfer should pursue elective course programs which are similar to the NJIT introductory program — that is, courses in general studies.

A summer school program is available to those students who are unable to take environmental design course work equivalent to the School of Architecture's Arch 101, 102, 201 and 202. An accepted student graduating from a county college or completing two years at another college or university, but lacking environmental design background can enter the professional Architecture Program by successfully completing the summer school program.

There are special guideline instructions and forms for transfer application to the Architecture Program. Persons interested in applying should specifically request these instructions and forms from the NJIT Office of Admissions. The forms are available early in the fall.

As a candidate for admission to the Architecture Program you must submit college records showing your two years of introductory architecture study (a minimum of 60 semester credits). In addition, you will be expected to submit examples of the work which best characterizes your intellectual and creative interests, aptitudes, and personal development. The guidelines and instructions specify in detail the many types of material which you may submit.

Deadlines for application to the Architecture Program are earlier than for many other programs; final deadlines are stated in the application guidelines.

The Architecture Program begins with the fall semester only. Students initially enrolling during a spring semester can be accepted only as introductory architecture students.

Expenses

TUITION AND FEES (Note: Full-time = 12 or more credits. Part-time = less than 12 credits. Block rates apply to 12-18 credits. Above 18 credits — each credit is paid for in addition to the block rate.)

As of June 1980, the current charges per semester for tuition and regular fees for undergraduate programs are as follows:

TUITION

Resident	**Tuition**
Full-Time Undergraduate (12-18 credits)	$416/semester
Part-Time Undergraduate	$ 28/credit
Non-Resident	
Full-Time Undergraduate (12-18 credits)	$832/semester
Part-Time Undergraduate	$ 56/credit

FEES

Resident	**General Fee**	**Student Service Fee**
Full-Time Undergraduate	$40.00 per semester	$35.00 per semester
Part-Time Undergraduate	$20.00 per semester	$ 4.00 per semester
Non-Resident		
Full-Time Undergraduate	$40.00 per semester*	$35.00 per semester
Part-Time Undergraduate	$20.00 per semester	$ 4.00 per semester

*$50.00 for students on F-1 visas.

New Jersey Institute of Technology reserves the right to revise its charges for tuition and fees and to establish fees as may be required by increased educational costs.

Tuition includes charges for services other than instruction, such as library, publications, counseling, placement, etc., but does not cover the breakage or loss of Institute property. The General Fee provides funds for the operation of health services, related benefits, and other non-academic facilities and services. It also includes the registration fee, a prorated portion of the matriculation fee, and graduation fee.

The Student Service Fee provides funds for various student activities and inter-collegiate athletics.

Requirements for residency are defined in NJAC 9:14-1.1 et seq. Applications for New Jersey resident status are available in the Office of the Registrar.

Application, Matriculation and Special Fees

ADMISSION APPLICATION FEE Each candidate for admission to the Institute must pay an APPLICATIONS FEE of $10.00 at the time the application for admission is submitted. The fee is not returnable, regardless of whether or not the applicant is admitted to the Institute. This fee covers service which is necessary to evaluate applications for admission. See information on Freshman Admissions on page 13.

READMISSION APPLICATION FEE Any applicant for readmission to New Jersey Institute of Technology must pay a READMISSION APPLICATION FEE of $10.00 at the time the Application for Readmission form is submitted. See section "Readmission," page 21. This fee is not returnable, regardless of

whether or not the student is readmitted to the Institute. This fee covers service which is necessary to evaluate applications for readmission.

MAINTAINING REGISTRATION FEE

Students enrolled in degree programs who find it necessary to temporarily discontinue their studies may maintain their registration by paying a $10.00 fee. Students maintaining their registrations will not be required to reapply for admission and will be allowed to register in advance for the following semester.

LATE REGISTRATION FEE

Registration is required for each semester. A LATE REGISTRATION FEE is required of those who register late.

LABORATORY FEE

Students registering for the professional work of any semester in the Chemical Engineering Department are charged a special LABORATORY FEE of $10.00 a semester if residents of New Jersey, or $20.00 a semester if non-residents.

SCHEDULE CHANGE FEE

A SCHEDULE CHANGE FEE is charged when a student requests a schedule change for reasons other than those beyond his control.

SPECIAL EXAMINATION FEE

For special examinations, taken at times other than those regularly scheduled, a fee of $5.00 is charged.

INSURANCE

The Institute has compulsory accident insurance for all full-time day undergraduate students and compulsory accident, sickness and major medical insurance for all foreign students. The cost of this is included in the full-time general fee. Non-mandatory insurance is available to all those who wish to purchase it.

Miscellaneous Expenses

BOOKS AND SUPPLIES — DAY

For the first semester of the freshman year, books cost approximately $175.00 with an additional $100.00 covering the cost of a calculator, drawing instruments and general supplies, including gym clothing. Books and supplies for the second semester of the freshman year cost approximately $125.00.

BOOKS AND SUPPLIES — EVENING

For the first semester of the first year, books cost approximately $100.00 with an additional $85.00 covering the cost of a calculator and general supplies for that semester. Books and supplies for the second semester of the first year cost approximately $85.00.

EXPENDITURES FOR BOOKS

Students are advised to defer expenditures for books until the official list of text books has been posted at the Institute Bookstore.

PROPERTY LOSS

The Institute is not responsible for loss of property by fire or theft in its buildings and grounds.

Academic Policies and Procedures

REGISTRATION Prospective students will be informed of registration procedures by the Registrar, after the latter has received certification of acceptance from the Director of Admissions.

Students entering the Institute for the first time are required to submit a completed physical examination form prior to August 1 for September admissions and January 1 for January admissions. The form will be furnished by the Registrar. Each examination form will be reviewed by the Institute physician.

Currently enrolled students will be informed of advance registration procedures by the Registrar.

Former students (not currently enrolled), after being readmitted by the Dean of Student Services, will be informed of registration procedures by the Registrar.

Failure to complete registration by the close of the registration period will make the student subject to payment of a late fee and the certainty of closed courses.

The Institute requires a student to carry 12 or more credits to be classified as a full-time student.

Courses for which less than 15 students are enrolled may be cancelled.

Registration by an undergraduate student is not considered complete until all financial obligations to the Institute have been met, or arrangements satisfactory to the Institute have been made.

CROSS REGISTRATION PROCEDURE Full-time students may take courses at one of the participating schools (Essex County College, the College of Medicine and Dentistry of New Jersey and Rutgers-NCAS) at no additional cost provided that the following criteria are met:

1. The course must be used toward a degree.
2. The course is not offered at NJIT, or in the case of a conflict in schedule, cannot be taken at NJIT.

Steps to follow:

1. Permission must be obtained from a departmental representative:
   a. In the case of a Humanities or Social Science Elective, the representative of the respective department;
   b. In the case of a Technical Elective, the representative of the degree-granting department;
   c. In the case of an Engineering Science student, either the student's adviser or the head of the Engineering Science Program;
   d. In the case of a Man & Technology student, the student must see the representative in the Humanities Department;
   e. In the case of an Architecture student, permission is given through the School of Architecture.

2. Forms are obtained from the Office of the Assistant Dean of Academic Affairs or the School of Architecture. Once approval is received, as outlined above, the form must be signed by the appropriate Dean. The green copy is removed, and the student then takes the form to the host school for registration there.
3. This procedure applies only for day undergraduate courses. If the course is to be taken during the summer or in the evening, the green form entitled "Permission to Take Courses at Other Colleges" is processed through the Registrar's Office, and the student must pay the applicable tuition to the host school.

REGISTRATION (TAKING COURSES AT ANOTHER COLLEGE)*

1. Obtain "Approval for courses at other colleges" form in Registrar's Office.
2. Obtain approval from NJIT department giving comparable course. Be prepared to show the department chairman a catalog description of the course/s you intend to take.
3. Have form countersigned by the Registrar, who will give you one copy. Registrar will retain original and send one copy to the NJIT department involved.
4. Take copy to host college and follow through with their registration procedure.
5. Upon completion of the course/s, arrange to have an official transcript sent to NJIT, *Att: Office of the Registrar.* When the transcript arrives, your NJIT grade record will be updated accordingly, provided that you earn a grade one level higher than the lowest passing grade at the host college.

*Exclusive of cross-registration at Rutgers, NCAS; Essex County College; College of Medicine and Dentistry of N.J.

READMISSION

To initiate readmission, students must obtain an application for readmission at the offices of either the Dean of Student Services or Registrar and then complete and submit this form with the required readmission application fee of $10.00 to the Dean of Student Services. Deadline dates for the receipt of an application for readmission are as follows:

For the Fall Semester ..... July 1
For the Spring Semester ..... December 1
For the Summer Session ..... May 1

Applicants will be informed of their readmission status by the Dean of Student Services. Those who are advised of acceptance for readmission will be sent registration instructions by the Registrar.

CHANGE OF PROGRAM

A student who adds a course, or courses, to his/her program will be charged the full tuition and fee for the course or courses added, regardless of the date on which the addition takes place. If, *within the first five class days of the semester,* a student changes his/her schedule, he/she must fill out the authorized schedule change form and see to it that it is properly authorized and pay the appropriate schedule change fee. The tuition will then be recalculated and, if there is a refund or financial credit, such refund or credit will be made.

After the first five class days of the semester any change of program will be considered a withdrawal from a course (or from the Institute) and the student should follow the procedures stipulated. **Courses cannot be added after the fifth class day of the semester.**

WITHDRAWALS If a student wishes to withdraw from one or more courses, he/she must do so by completing and submitting the *Schedule Change Form* to the Dean of Student Services by the end of the ninth week of the semester. This form requires both the signature of the instructor(s) and the Dean. It is available at the Dean of Students Office, the Counseling Center, and the Registrar's Office. Failure to submit this form to the Dean by the deadline will result in a final grade other than "W."

If a student wishes to withdraw entirely from the Institute, he/she has until the end of the twelfth week of the semester to do so. Again, the *Schedule Change Form* must be completed and submitted to the Dean by the deadline. Failure to do so will result in grades other than "W."

MAINTAINING REGISTRATION Students enrolled in degree programs who find it necessary to temporarily discontinue their studies may maintain registration. Students maintaining their registration will automatically be mailed registration material for the following semester. These students will not be required to reapply for admission. To maintain registration a registration form must be completed and "MR" written under the course I.D. heading.

REFUNDS An official withdrawal from the Institute will be eligible for a refund based upon the following schedule. Fees are not refundable.

During the first week of the semester	80%
second	80%
third	60%
fourth	40%
fifth	20%
remainder of semester	0%

GRADES Grades used in the undergraduate program and their general significance are listed below:

Grade	*Significance*
4	Superior
3	Above average
2	Satisfactory
1	Minimum for credit
0	No credit
Aud	Audit
INC	"Grade deferred" — given in rare instances for students who would normally have completed the course work, but who could not because of special circumstances. If this grade is not removed within the next regular semester, a grade of 0 will result.
W	Withdrawn
S	Satisfactory
U	Unsatisfactory

TRANSCRIPT OF GRADES

A semester grade record is issued to the student by the Registrar at the end of each semester. Students who wish to have a transcript issued on their behalf must submit a request in writing to the Recorder. (Only unofficial copies will be supplied to either current or former students.) Transcript requests must be accompanied by a payment fee of $1.00 for each copy.

ACADEMIC HONORS

To qualify for academic honors in the Day Division, matriculated students must be taking a minimum of 13 credits included in a regular program of study and maintain a weighted average of "3" and have no grade lower than "2."

To qualify for academic honors in the Evening Division, matriculated students must be taking a minimum of 6.5 credits included in a regular program of study and maintain a weighted average of "3" and have no grade lower than "2."

ACADEMIC STANDING

Students are expected to maintain a GPA of 2.00. A student who earns a GPA of less than 2.00 in his/her most recent semester shall be assigned the academic status termed "probation."

The academic record of a student will be reviewed by the Committee on Academic Standing, and the student will be subject to suspension from the Institute whenever the student:

1. has been assigned probationary status for two successive semesters, or
2. earns a GPA of less than 1.50 in his/her most recent semester.

A student's probationary status will be removed when the student:

1. earns a semester GPA of 2.00 or better in twelve or more credit hours in the Day Division, and his/her cumulative GPA is raised to 2.00, or
2. earns a GPA of 2.00 or better in a total of twelve or more credit hours in two consecutive semesters in the Evening Division, and his/her cumulative GPA is raised to 2.00.

When the record of a student has been reviewed, the Committee on Academic Standing may:

1. assign the academic status of "probation."
2. suspend the student from the Institute.
3. stipulate specified requirements which the student will be obliged to fulfill in order to retain the privilege of initiating or maintaining registration in any following semester.

APPEALS

1. An appeal should not be entered into lightly inasmuch as decisions affecting students' status in the Institute are made in accordance with the principles and regulations laid down by the Faculty as being in the best interests of the students. To appeal such action is tantamount to asking that these regulations and the opinion of those interpreting them be set aside in the light of unusual and extenuating circumstances. Therefore, before instituting an appeal, the student should consult with the Secretary of the Faculty, Professor Warren H. Crater, within five days of receiving notice of the decision being appealed.

2. If an appeal is decided upon, the student should then prepare a letter stating accurately and completely the decision being appealed, noting when it was taken, by whom, etc., and clearly but succinctly stating the reasons for feeling that justice has not been fully served. Transcripts, test scores, and other information which form part of the student's record will also be distributed to the Committee members for their consideration.
3. The decision of the Committee on Student Appeals is final and irrevocable and will be announced by the Secretary. (Generally, the student will be telephoned immediately following the meeting *if* there is any change in the student's status. In any event, a letter will be sent.)

EXTENUATING CIRCUMSTANCES

It is the responsibility of the student to bring to the attention of the Office of the Dean of Student Services Committee on Academic Standing or the Associate Chairperson of the student's professional department, either directly or through the students' adviser, any extenuating circumstances which are beyond the student's power to control and which may have an adverse effect upon his/her academic standing. This action should be taken immediately upon the development of such circumstances and not be postponed until the end of the semester.

REINSTATEMENT IF DISMISSED

After a lapse of at least one (1) semester (not including summer) a student may apply for reinstatement on an application form obtained from the Office of the Dean of Student Services.

Such applications must be in the hands of the Dean of Student Services not later than four weeks prior to the opening of the semester for which the student desires readmission. This includes summer school.

GRADUATION

New Jersey Institute of Technology receives the authority to grant degrees from the New Jersey State Board of Higher Education.

Each degree is certified by a diploma bearing the seal and the signatures of officers of this institution.

Candidates for graduation who satisfactorily complete a regular undergraduate program receive the Bachelor's Degree in the program pursued.

Each prospective candidate for any degree must file an Application for Candidacy on or before the deadline dates as set by the Institute.

To be eligible for graduation, a student must attain a grade point average of 2.00 in all the courses listed in this catalog as being required in the third and fourth years of the curriculum in which he/she desires to earn a Bachelor's Degree. In Architecture, the grade point average is determined for the third, fourth, and fifth years.

Candidates for any degree granted by the Institute shall appear in person upon the appointed commencement day to receive the degree, unless excused by the Faculty.

The academic honors of cum laude, magna cum laude, and summa cum laude are awarded to qualified students at graduation. The honors are given for outstanding academic achievement, as determined by standards set by the Institute.

RESIDENCE REQUIREMENT

A student transferring into New Jersey Institute of Technology must take at least 33 credits approved by the department of his/her major study to be eligible for graduation.

ENGLISH AS A SECOND LANGUAGE

All students whose native language is not English will be required to take an examination for undergraduate English as a second language. Any such student who is unable to meet the minimum standard of the examination will be required, in his/her first semester at the Institute, to take Eng 101. Until the student has shown satisfactory achievement in that course, he/she will not be permitted to register for Eng 111 or Hum 112. See page 100 for further details.

CORRECTIVE WRITING PROGRAM

The Humanities Department conducts a special non-credit tutorial program for any student whose writing has been judged deficient by the instructor of any of his/her courses within the Department and by a departmental committee. Each such student, while continuing in the departmental course, will be required to follow a corrective program for his/her writing. The student will be referred by his/her instructor to a member of the faculty for English, who will hold tutorial conferences with him/her during whatever portion of the semester he/she needs for sufficient improvement.

CREDIT BY EXAMINATION

Examinations to earn credit are available in certain courses. Students who believe they have the background covered in a given course should consult with the chairman of the department offering the course to see whether an examination is offered. To receive credit by examination, a student must perform at a level equivalent to a grade of 2 in the course. *Students who have failed a course may not take an examination for credit in that course.* A fee of $25.00 will be charged for the examination, an additional fee for granting credit will be required.

THE FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT

The Family Educational Rights and Privacy Act of 1974 is a federal law which provides each student with the right to inspect educational records maintained about him/her by the Institute, the right to a hearing to challenge the contents and to make explanation for challenged information. The law also provides that the Institute will maintain confidentiality of student records except with respect to special cases noted in the legislation.

The Registrar at New Jersey Institute of Technology is responsible for student records. Educational records include transcripts, admission files and registration records. Students wishing to review their files must make a written request to the Registrar listing the items of interest. Student health records are maintained by the Director of Health Services and may be examined by a professional of the student's choice. Files covered by the Act will be made available within 45 days of the request. Students may have copies made of their records at their own expense at reasonable rates to be determined by the record custodian. A catalog of educational records maintained by the Institute is attached to this document. Exceptions to the right of inspection include financial aid records and records of institutional, supervisory and administrative personnel and educational personnel ancillary thereto which are the sole possession of the maker or his/her substitute.

Within the Institute community, only those members acting in the student's interest, individually or collectively, are allowed to have access to student files. These include personnel in the Registrar's, Admissions, Student Services and Finance Offices and academic personnel within the limitations of their need to know.

With the exceptions stated in the Act, no one outside the Institute shall have access to a particular student's educational records without the written consent of the student, except in extraordinary circumstances such as emergencies, by the accrediting agencies carrying out their accrediting function or by certain state and federal officials. A record of access and reasons for granting will be kept by the Institute and be accessible to the student.

The Institute at its discretion may provide directory information in accordance with the provisions of the Act to include: the student's name, address, telephone listing, date and place of birth, major field of study, participation in officially recognized activities and sports, weight and height of members of athletic teams, dates of attendance, degrees and awards received, and the most recent previous educational agency or institution attended by the student. Students wanting directory information withheld should notify the Registrar in writing within the first two weeks of the initial registration and annually thereafter.

Requests for non-disclosure will be honored by the Institute for ONLY ONE academic year. Therefore, authorization to withhold directory information must be filed annually in the Office of the Registrar.

In case the student disagrees with an entry, he/she should attempt to resolve the question with the Office of the Registrar. Failing this either the school or the student may request a formal hearing. The hearing, in accordance with the Act's requirements, will be held within 30 days after the request, and will be conducted by a school official or other person without a direct interest in the outcome. The student will be given a full and fair opportunity to present relevant evidence and provide his/her own counsel. In the event that the decision is unfavorable to the student, the student, at his/her option, may include a written statement in his/her file explaining the disputed entry. A written decision will be rendered within 15 working days after the hearing.

Students who believe that the adjudications of their challenges were unfair, or not in keeping with the provisions of the Act may request in writing, assistance from the President of the Institute. Further, students who believe that their rights have been abridged, may file complaints with The Family Educational Rights and Privacy Act Office (FERPA), Department of Health, Education, and Welfare, Washington, D.C. 20201, concerning the alleged failures of New Jersey Institute of Technology to comply with the Act.

Student Services

The following important supportive services are made available to students. Detailed information may be obtained by contacting the respective Directors.

ACADEMIC ADVISEMENT

The advising services of the Institute are coordinated by the Dean of Student Services and are made available to all students by the professional departments, the Counseling Center, and the office of the Dean of Student Services.

COMPUTERS

In keeping with the emphasis upon science, technology, and mathematics, the Institute provides students and faculty with training and access to a full range of computers.

COUNSELING CENTER

A Counseling Center with a staff of professional counselors is available to all students who wish either personal counseling, academic advisement, or career counseling. In addition to the professional staff, a counseling psychiatrist is available for evaluation and treatment recommendation of individual cases. The Counseling Center administers supportive testing as needed as well as SAT tests and CLEP examinations. Community service to high schools and industry is also offered.

STOP-IN CENTER

The Stop-In Center, staffed by trained student counselors, can provide on-the-spot information and assistance to NJIT students. The Center's peer counselors are prepared to help students with any questions or problems — academic, personal, or general information; if they cannot resolve a problem directly, they have been trained to investigate fully and refer students to an individual or office that can help them. No appointment is necessary. The office is located off the second floor lounge of the Center.

FINANCIAL AID

Financing a college education presents a serious problem to many students and their families. The office of Financial Aid provides counseling and administers loans, scholarships, grants, and part-time employment to qualified students. Federal and State programs, private, industrial, and college resources are utilized to support the Institute Financial Aid programs. Approximately 75% of the full-time students receive some sort of financial assistance.

A pamphlet giving complete information on financial aid is available at the Financial Aid office. The pamphlet describes the various forms of aid available and lists the donors and other sources of scholarship funds.

HOUSING

For the Fall, 1979 semester, NJIT opened its first residence hall. It houses 210 students. For other students who wish to live nearby, the Dean of Student Services Office maintains a list of available housing which includes hotels, the YM/WCA, and private homes. An up-to-date listing can be acquired before the start of any given semester. Throughout the semester additional postings are made available in the Dean of Student Services Office.

HEALTH SERVICES

Each weekday from 8:30 a.m. to 4:30 p.m. a registered nurse is available in the Health Services Office. Several times a week the services of a licensed physician are also available. All medical emergencies, day and evening, are referred to St. Michael's Hospital on High Street, Newark, NJ.

HEALTH AND ACCIDENT INSURANCE

All full time undergraduate day session students are required to subscribe to the Institute Accident Insurance policy. Costs are low, the

coverage is extremely comprehensive, and for twelve months. Accident insurance coverage shall be required for any student participating in Institute extra-curricular activities.

PHYSICAL EDUCATION AND ATHLETICS

The primary objective of the Department of Physical Education and Athletics is to encourage undergraduates to develop individual physical skills that can be continued throughout adult life. To assist in the achievement of this goal, an intramural and intercollegiate athletic program is conducted by the staff with emphasis upon individual student participation. Students, faculty, staff, and alumni are encouraged to use the gym facilities for personal recreation.

Two semesters of Physical Education are required of all fulltime undergraduates except Veterans with over six months of active duty and students who transfer to NJIT at the age of 21 or older or who transfer to NJIT with junior standing or higher.

LIBRARY

The Institute Library makes available to students and faculty a collection of books, periodicals, pamphlets, government documents, records, tapes, and art slides for use in course work and as supplemental reading. Borrowing privileges are arranged with the Newark Public Library and Rutgers-NCAS.

PLACEMENT

The Placement Office is designed to assist students and alumni who are concerned about employment. Among the services offered are: providing extensive information and counseling concerning career planning, job opportunities, employer characteristics, and employment trends; scheduling of interviews with employers visiting the campus; maintaining an active list of full-time employment opportunities for evening students and alumni; compiling a continuous listing of summer and part-time jobs; and conducting appropriate surveys of alumni career progress. It is the function of the Placement Office to help the student formalize his/her plans as indicated by his/her interest, initiative, and ability.

EVENING DIVISION

Information regarding student services available to evening students is available at the Center Desk, Monday through Friday, from 5 to 8 p.m. A newsletter highlighting special events, programs and services is prepared several times a year and is mailed directly to evening students.

TUTORING

A tutoring program is available, both day and evening to help students understand basic concepts and develop those skills necessary for academic success. The program is designed principally to assist freshmen in their Math, Physics, and Chemistry courses, but some help can be found for sophomore and junior level courses.

Students who wish to receive tutoring should contact the Tutoring Office (645-5167) or Dean of Student Services (645-5182).

Academic Programs

Academic Programs

A broad spectrum of programs leading to the Bachelor's degree includes twelve fields, ranging from a professional education in Architecture or Engineering to a general education in the Man and Technology program. These programs provide diverse career opportunities. The specific degree requirements shown on the following pages are the latest revisions, generally applicable to freshmen entering in September 1980. More detailed information on course requirements for each degree can be found in the annually-published curriculum pamphlets available for each field. Because programs are continually being revised, each student is advised to consult the appropriate curriculum pamphlet to determine degree requirements for the class with which he/she intends to graduate.

Each program is shown in a sequence as taken by a full-time day student expecting to complete the degree in the standard period of time. If a student wishes to carry less than a full course-load, he/she may do so by extending his/her program over a longer period of time. Other alternative patterns of education can be developed to meet individual student interests.

On the following pages, the numbers following the course title represent in order, lecture-recitation hours per week, laboratory hours per week, and credits for the semester. Course descriptions are found at the end of the catalog.

COOPERATIVE EDUCATION

The Cooperative Education Program was started at the Institute in 1976 and has increased in scope so that at the present time students in engineering, computer science, and industrial administration programs can become involved. The Cooperative Education Program enhances the education of the student with the introduction of two six-month work experience periods in cooperating businesses, industries, and government agencies. Such experience enables the student to examine the variety of areas available within a major professional field. The salary earned during the work experience periods helps defray college and other expenses.

Both work experiences are scheduled during the junior year of the curriculum which extends the time required to complete a degree program to five years.

Basic requirements for admission into the program include a good academic standing with a grade point average of at least 2.2. Students must apply for admission to the Cooperative Education Program at the beginning of the second semester of their sophomore year. Additional information is available from the Director of Cooperative Education.

EVENING STUDY

All undergraduate degree programs are also available for part-time evening study, except for the professional architecture program. Evening students typically carry about half of the full-time course load, and hence require longer to complete a degree. For example, a program that can be completed in four years of fulltime study usually extends to eight years of part-time evening study.

Degree requirements for evening students are essentially the same as those shown for full-time day students. Where differences exist, they are noted. In general, Physical Education in the freshman year is not required of evening students. To learn specific degree requirements for the year in which he/she plans to graduate, the evening student should consult with an adviser in his/her major field.

Not all courses required for a degree are offered every year in the evening, and the selection of electives is limited. An evening student should consult the Schedule of Evening Courses to plan his/her program of study a year in advance. Careful planning and consultation with an advisor will avoid unnecessary delays.

HONORS COURSES

A variety of special honors courses is offered in the day schedule to well-qualified students. An honors course typically covers in greater depth, the content of the regular course it replaces. In the first two years, honors courses are available in chemistry, computer science, humanities, mathematics and physics. Students are invited to participate on the basis of their high school records and aptitude test scores.

In the junior and senior years, students with outstanding college performance may elect a variety of honors courses. In certain cases, qualified students may elect to substitute graduate courses for courses in the regular undergraduate program.

Honors courses are listed in Courses of Instruction later in this catalog. Interested students should consult with the department offering the honors course.

EDUCATIONAL OPPORTUNITY PROGRAM

The Educational Opportunity Program provides special academic and financial assistance for students who come from economically and educationally disadvantaged backgrounds. Originally focused on the special needs of engineering students, EOP now provides assistance to students in all undergraduate academic programs. EOP begins with an intensive summer of study preceding the freshman year to prepare students for any of the various programs offered in the day schedule. It also provides scholarship support and tutorial and counseling services. Further information may be obtained from the Director of the Educational Opportunity Program.

AEROSPACE STUDIES A commission as a second lieutenant in the United States Air Force is available to any student who completes the Aerospace Studies option through the Air Force ROTC program on campus. Students in any undergraduate program may pursue this optional program in conjunction with their normal academic studies. In a typical program, a student takes AS 111, 112 in the first year; AS 221, 222 in the second; AS 333, 334 in the third; and AS 443, 444 in the fourth year. A compressed option for students with three remaining years is available to students with the approval of the Professor of Aerospace Studies. A special program for junior students is also available beginning with the summer prior to their junior year. It is possible to complete any of the options without delaying graduation from any bachelor or other advanced degree program. All students on an Air Force ROTC scholarship while enrolled in the AS 111, 112 and AS 221, 222 courses (typically freshman and sophomore years) are required to successfully complete a course in English composition within the first two years. All students in the last two years of the Air Force ROTC program must successfully complete a course in mathematical reasoning, as approved by the Professor of Aerospace Studies, prior to commissioning.

AEROSPACE STUDIES OPTION Students taking the Aerospace Studies Option will take Aerospace Studies Courses in addition to their regular courses in three of the four years of their campus academic program. AS 333 may be used in lieu of the following: for CE, ME, EE, and CIS students, OS 471; for Eng.Sci. students, OS 472; for IE students, OS 474. AS 334 may be used by all engineering and engineering science students in lieu of the Hum/SS/OSS elective.

Architecture

The practice of architecture is a design and decision-making process aimed at solving an environmental problem; it is the thoughtful making of spaces which serve people.

The architecture program at NJIT considers a wide variety of environmental problems — certainly more than just buildings. The solution to a human environmental problem might be to build no buildings at all. The primary solution to the problem might be in choosing a site, or opening undeveloped land to its best and most appropriate uses, or in keeping that land in its natural state. The scope of a problem might be that of a piece of furniture, a room, an entire neighborhood, a central business district, or an entire community or city. The designer's solution might be a long-range management plan or other guidelines for future growth. The key might be in preserving or adaptively using existing elements of the built environment which are currently misused or discarded. The design professions have never faced a greater challenge.

The total time needed to earn a Bachelor of Architecture degree (the first professional degree) at NJIT is five years. The curriculum consists of two separate and independent parts: the broadbased, two-year Introductory Program which emphasizes general studies, followed by the three-year Architecture Program.

INTRODUCTORY PROGRAM

FIRST YEAR

1st Semester		2nd Semester	
Arch 101 —	Intro. to Man & the Environment 1 2-3-3	Arch 102 —	Intro. to Man & the Environment II 2-3-3
Eng 111 —	English Composition . . . 3-0-3	Eng 238 —	Advanced Composition . 2-3-3
Math 106 —	Basic College Math 4-0-4		or Eng. 342, Technical Communication 3-0-3
or		or	
Math 111 —	Calculus 1 4-0-4	Eng 339 —	Practical Journalism
or		Math 116 —	Math of the Environ. . . . 3-0-3
Math 115 —	Finite Mathematics 3-0-3		Physical Education 0-1-0
or			Electives*
Math 138 —	General Calculus 1 3-0-3		
	Physical Education 0-1-0		
	Orientation 1-0-0		
	Electives*		

SECOND YEAR

Arch 201 —	Environment Design I . . 2-6-3	Arch 202 —	Environment Design II . . 2-6-3
Phys 102 —	Physical Concepts I 3-2-4	Phys 103 —	Physical Concepts II . . . 3-2-4
	Electives†		Electives†

*A course in freehand drawing (such as Rutgers-NCAS 080:133) is required in the first year. This can be taken in either the fall or spring semester.

†An introductory survey course in computer science is required in the second year. This can be taken in either the fall or spring semester.

In the first two years, students are encouraged to elect a variety of introductory courses in general studies — humanities, social sciences, verbal and visual communication, natural and physical sciences or engineering sciences. Technical "skills" courses should be avoided.

The starting point for the math sequence will depend upon the student's high school math record.

A minimum of 60 semester credits is required for transfer into the third year.

ARCHITECTURE PROGRAM

THIRD YEAR

1st Semester		2nd Semester	
Arch 350 —	Architecture Topics I . . . 9-0-9	Arch 351 —	Architecture Topics 9-0-9
Arch 360 —	Architecture Studio I . . 0-15-5	Arch 361 —	Architecture Studio . . . 0-15-5
	Electives		Electives

FOURTH YEAR

Arch 450 —	Architecture Topics III . . 9-0-9	Arch 451 —	Architecture Topics IV . . 9-0-9
Arch 460 —	Architecture Studio III . 0-15-5	Arch 461 —	Architecture Studio IV . 0-15-5
	Electives		Electives

FIFTH YEAR

Arch 550 —	Architecture Topics V . . 6-0-6	Arch 551 —	Architecture Topics VI . . 6-0-6
Arch 560 —	Architecture Studio V . 0-15-5	Arch 561 —	Architecture Studio VI . 0-15-5
	Electives		Electives

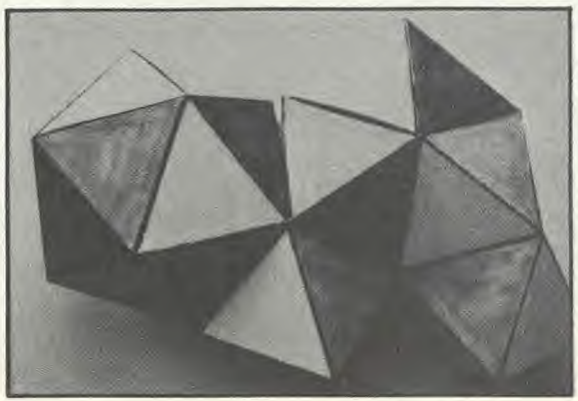
A total of 160 semester credits is required for the Bachelor of Architecture degree.

Besides architecture program electives offered by the New Jersey School of Architecture faculty, students may choose courses from other NJIT programs and from the other institutions (the Newark Colleges of Rutgers University, Essex County College, and the College of Medicine and Dentistry of New Jersey).

AREAS OF CONCENTRATION

Within their total elective program, students must include a series of courses in an "area of concentration" that will best reflect their personal potential and interest. These elective series will normally vary from 18 to 24 semester credits. Some architecture courses may be applicable to areas of concentration.

An area of concentration may be completely made up of non-architecture courses (in ecological studies, psychology, sociology, urban geography, urban law, history or civil engineering, for instance). Or the concentration may be comprised of outside courses from a number of disciplines together with architecture program electives. Such combined programs might be in housing, building economics, urban design, computer systems, research, industrialized building, historic preservation or man/environment relations.



Computer Science

Computer Science is the study of information: its structure, its representation and its utilization. This includes the analysis, design, implementation and application of computer programs (software) and computer equipment (hardware) for developing computerized information processing systems in response to users' needs.

The use of computers can be characterized as augmenting a person's mental skills and intelligence. This is in contrast to other machines which are characterized as augmenting a person's physical skills and strength. The dramatic uses of computers in problem solving and in support of human cognitive processes has resulted in a change in the thinking of professionals in every discipline. Modern enterprises also are dependent on computers for automating their industrial and office procedures and practices. In order to keep pace with these sophisticated technological uses of computers, professionals in the computer field must understand and employ advanced scientific concepts in their work.

The Computer Science curriculum is designed to give students a directed education for a meaningful career in this new scientific discipline. Building on a solid foundation in mathematics, science and programming acquired by the student in the first two years, the computer science courses lead to understanding the potentialities of information systems and applications of computers in management, science and engineering. An emphasis is placed in the curriculum upon fundamental concepts so that the student may direct and adapt to the rapid technological advances in this developing field. The student may structure a program from a large selection of options, depending on individual specialized interests and career objectives.

Graduates of the program are prepared for careers in a wide variety of positions. Their work ranges from planning and developing computer systems for the information needs of an organization to using computer technology in business, industry and government. Students who qualify may also elect to continue their studies with graduate work leading to an advanced degree.

COMPUTER SCIENCE CURRICULUM

FIRST YEAR

1st Semester		2nd Semester	
Math 111 —	Calculus I 4-0-4	Math 112—	Calculus II 4-0-4
Phys 111 —	Physics I 3-2-4	Phys 121—	Physics II 3-2-4
Chem 115—	Chemistry & Materials I† 4-2-5	Chem 116—	Chemistry & Materials II† 3-2-4
Eng 111 —	English Composition . . . 3-0-3	Hum 112—	Man & Culture I 3-0-3
CIS 101 —	Computer Programming 2-1-2	EG 101 —	Engineering Graphics* . 1-2-2
	Physical Education 0-1-0		Physical Education 0-1-0
	Orientation		

SECOND YEAR

Math 221 —	Calculus III 4-0-4	Math 222—	Differential Equations . . 4-0-4
EE 210 —	Electrical Engr. 3-2-4	Phys 231—	Physics III 4-2-5
CIS 213 —	Intro. to Computer Sci. . 3-0-3	Hum 231 —	Man & Culture II 3-0-3
SS 201 —	Economics 3-0-3		Elective (Soc. Sci.) # . . 3-0-3
	Elective (Technical)• . . . 3-0-3		Elective (Technical)• . . . 3-0-3

THIRD YEAR

CIS 331 —	Machine Assembly Prog. 2-2-3	CIS 332 —	Princ. of Operating Syst. 2-2-3
Math 333 —	Probability & Statistics . 3-0-3		Elective (Applications)§ 3-0-3
	Elective (Application)§ . 3-0-3	CIS 436 —	Princ. of Algorithms . . . 3-0-3
	Elective (CIS) 3-0-3		Elective (CIS) 3-0-3
	Humanities‡ 3-0-3		Humanities‡ 3-0-3

FOURTH YEAR

CIS 490 —	Guided Des. Soft. Eng. . 3-0-3	CIS 491 —	Computer Sci. Project . . 3-0-3
OS 471 —	Management Practices . 3-0-3		Elective (OSS or Hum.) . 3-0-3
	Elective (Technical) 3-0-3		Elective (Application)§ . 3-0-3
	Elective (Technical) 3-0-3		Elective (Mathematics) . 3-0-3
	Elective (Free) 3-0-3		Elective (Free) 3-0-3

†Transfer students may substitute natural science such as Biology or Geology
•Chosen from fields of Computer Science, Engineering, Physics, Chemistry or Mathematics
#Basic Social Science requirement (SS202, SS 210, SS221, or SS231)
§Coherent set of courses in an application area from Engineering, Mathematics, Chemistry or Physics
‡Choice of one course each from Literature, History or Philosophy
*May substitute technical elective including computer programming.

Aerospace Studies option is same as for Engineering programs (See page 32).

Engineering

Engineering programs are offered in the five major professional fields: Chemical, Civil, Electrical, Industrial and Mechanical, as summarized on the following pages. Each curriculum is sufficiently broad to permit a graduate to enter the engineering profession immediately, or to continue his studies in graduate school in engineering, management, or other fields. While most graduates do remain in the engineering profession, a significant number use their engineering background as a foundation for professional careers in law, medicine, business, education, science, and other fields.

Because the engineer applies scientific principles and practical judgement to the economic solution of many problems concerned with human welfare, his/her education includes courses in the basic sciences, and in the humanities and social sciences, in addition to courses in engineering analysis and design. Thus, the total program provides each student with a liberal education, designed to permit him/her to make important contributions not only toward the solution of specific technical problems, such as those found in automobile engine or computer circuit design, but also toward the solution of such compelling problems of society as are evidenced in energy conservation, urban redevelopment, and pollution control.

Students enrolled in Engineering, Engineering Science, and Computer Science pursue a common First Year, as outlined below. Much of the Second Year is common, but two or three courses differ for each curriculum. As a result, a student may change his/her objectives among these curriculums during the First or Second Year with little or no lost time. The regular day mathematics sequence (Math 111, 112, 221, 222) is extended over six semesters for evening students (Math 109, 110, 219, 220, 329, 330).

FIRST YEAR

1st Semester			2nd Semester		
Chem 115	Chemistry & Materials I	4-2-5	Chem 116	Chemistry & Materials II	3-2-4
EG 101	Engr. Graphics*	1-2-2	CIS 101	Computer Prog.*	2-1-2
Eng 111	English Composition	3-0-3	Hum 112	Man & Culture in Hist. Per. I	3-0-3
Math 111	Calculus I	4-0-4	Math 112	Calculus II	4-0-4
Phys 111	Physics I	3-2-4	Phys 121	Physics II	3-2-4
	Physical Education	0-1-0		Physical Education	0-1-0
	Orientation	1-0-0			

*Paired courses. Half of the students will take these in reverse order.

HUMANITIES REQUIREMENTS

All engineering programs include a minimum of five humanities courses and a sixth shared with the OSS Department (student's elective option). All first-year students complete English 111 and Humanities 112. (Students judged deficient in writing skills may be required to take English 110 prior to English 111.) All sophomores take Humanities 231. Once this sequence is completed, students in their junior and senior years select two electives. These must be chosen from *two* of the following fields: Literature, History, Philosophy. The additional elective may be chosen from any 400-level course, including Arts, or from any of the 300-level courses *except* Eng. 342 (Technical Writing); or an OSS elective may be chosen instead. Humanities course listings begin on page 100.

SOCIAL SCIENCE REQUIREMENTS

Courses in the social and organizational sciences examine human behavior, the principles and forces that underlie and give direction to modern society, and the effects of science and technology on current social issues such as urban planning and development, rapid population growth, and deterioration of the environment.

Students in all curriculums will be required to complete SS 201, Economics, and one other basic social science courses from among the following four: SS 202, Labor Relations, SS 210, General Psychology, SS 221, Sociology, SS 231, Political Science. All students will be required to complete one or two more courses in the organizational and social sciences, as specified in the following pages.

CHEMICAL ENGINEERING

The chemical engineer is involved in the design and operation of plants that manufacture a wide variety of chemicals, including plastics, textile fibers, gasoline, and pharmaceuticals. The work of the chemical engineer can be very diverse, ranging from research to reduce air pollution to sales of a new detergent.

The Chemical Engineering curriculum is designed to give the student a thorough background in the fundamental sciences and in engineering subjects. It prepares the student for a professional career in chemical engineering or for graduate study in chemical engineering and other fields.

The chemical engineering student acquires a strong foundation in chemistry, physics, and mathematics, with the emphasis gradually shifting toward chemical engineering courses in the junior and senior years. The senior course in process and plant design coordinates and brings into focus the technical aspects of the chemical engineering curriculum.

Chemical engineers will play an important role in resolving the energy crisis, because of their expertise in oil refining, recovery of oil from oil shale, the manufacture of synthetic fuels from coal, and the preparation and recovery of nuclear fuels.

CHEMICAL ENGINEERING CURRICULUM

FIRST YEAR **(See page 37.)**

SECOND YEAR

1st Semester		2nd Semester	
ChE 227	— Chem. Proc. Princ. 1 . . . 3-0-3	Chem 232	— Phys. Chem. I 3-2-4
Math 221	— Calculus III 4-0-4	ChE 228	— Chem. Proc. Princ. II . . . 3-0-3
Mech 230	— Statics & Dynamics 4-0-4	Math 222	— Differential Equation . . . 4-0-4
SS	— Basic Soc. Sci. Reqt.* . 3-0-3	Phys 230	— Physics III 4-1-4
Hum 231	— Man & Cult. in Hist. Per.II 3-0-3	SS 201	— Economics 3-0-3

THIRD YEAR

Chem 335	— Phys. Chemistry II 4-3-5	Chem 344	— Org. Chemistry II 4-3-5
Chem 343	— Org. Chemistry I 3-0-3	ChE 346	— ChE Thermo II 3-0-3
ChE 345	— ChE Thermo I 3-0-3	ChE 349	— Reaction Kinetics 3-0-3
	Elective (Soc. Sci.) 3-0-3		Elective (Humanities) . . 3-0-3
ChE 363	— Transport Oper. I 3-0-3	ChE 364	— Transport Oper. II 3-0-3

FOURTH YEAR

ChE 467	— Transport Oper. III 4-0-4	Che 482	— Chem. Engr. Lab. 2-4-4
ChE 475	— Proc. Dyn. & Control . . . 4-2-5	ChE 472	— Proc. & Plant Design . . . 4-0-4
ChE 481	— Chem. Engr. Lab. 2-4-4		Elective (ChE) 3-0-3
	Elective (Technical) 3-0-3		Elective (Humanities) . . 3-0-3
			Elective (Hum/SS/OS) . 3-0-3

*Choose from SS202, SS210, SS221, or SS231 for basic requirements.

CIVIL ENGINEERING

Civil Engineering involves the art and science of looking at problems with a view towards solutions. It deals with people and cities, producing clean air and water, providing for the disposal of wastes, and developing efficient transportation, housing and water supply systems. It is concerned with the planning, design and construction phases of a project, including energy, environmental, and economic considerations.

The undergraduate program includes work in field measurements, construction materials and procedures, structural analysis and design, soil behavior, transportation engineering, water supply and pollution control. The department offers a set of elective courses through which the student can specialize in such areas as environmental control, soils and foundations, urban planning and urban systems, construction engineering, and surveying.

The Civil Engineering graduate is well prepared to enter the job market through federal, state, and municipal agencies, in the many consulting firms in the metropolitan area and throughout the country, or with the major industrial firms involved with aspects of planning design, construction or environmental control. Preparation is also given such that a student is able to enter the job market in research and development fields.

CIVIL ENGINEERING

FIRST YEAR **(See page 37)**

SECOND YEAR

1st Semester			2nd Semester		
CE 200	— Surveying*	3-3-4	CE 210	— Constr. Matls. & Procedures*	3-0-3
EG 204	— Civil Engr. Graphics	1-2-2	CE 231	— Strength of Materials	4-3-5
Math 221	— Calculus III	4-0-4	Hum 231	— Man & Cult. Hist. Per. II	3-0-3
Mech 230	— Statics & Dynamics	4-0-4	Math 223	— Elem. Diff. Eq. & Stat.	4-0-4
SS 201	— Economics	3-0-3	Phys 231	— Physics III	4-2-5

THIRD YEAR

CE 320	— Fluid Mechanics**	4-0-4	CE 321	— Water & Wastewater Engr.*	3-0-3
CE 332	— Structures I	3-2-4	CE 341	— Soil Mech.**	3-3-4
CE 342	— Geology†	3-0-3	CE 430	— Structures II	3-0-3
CE 350	— Transportation Engr.*	3-0-3	SS	— Basic SS Requirements***††	3-0-3
	— Elect. (Humanities)***	3-0-3	Eng 342	— Eng. Report Writing†	3-0-3
				Elective (Technical)	3-0-3

FOURTH YEAR

CE 432	— Structural Design	3-0-3	IE 497	— Enterprise Management	3-0-3
OS 471	— Management Practice	3-0-3	EE 405/ME 463		3-0-3
CE 494	— CE Design I	3-0-3	CE-495	— CE Design II	3-0-3
	Elective (Technical)	3-0-3		Elective (Technical)	3-0-3
	Elective (Humanities)†††	3-0-3		Elective (Hum/SS/OSS)	3-0-3

*,**,***,† Paired courses. Half of the students will take these in reverse order.
CE 342 must be taken before or concurrently with CE 341.
††Choose from SS 202, SS 210, SS 221 or SS 231 for basic requirements.
††† Student may choose from history, literature or philosophy only. Both humanities electives must *not* be chosen from the same field.

ELECTRICAL ENGINEERING

Electrical engineering is a diversified and challenging profession concerned with the design, development, fabrication, and control of the electrical devices upon which our technological society depends. Electrical engineers utilize their knowledge of devices and systems design to be involved in a multitude of areas. A small sampling would include: integrated circuits, computers, environmental and biomedical instrumentation, energy conversion and distribution, space vehicle control, microprocessor's, and satellite communications. The curriculum provides a broad education in mathematics, the physical sciences, humanities and social sciences. On this foundation is built a depth of understanding in electrical engineering and related fields. In the senior year, a student may emphasize an area of his/her interest by selecting from a broad range of electives, including a systems sequence in communications, control, computers, power, or medical instrumentation. The aim is to educate an electrical engineer who can think analytically and creatively, work effectively, and communicate the result of his/her work clearly to others.

Upon graduation, the electrical engineer has a variety of options open to him/her. He/she can enter industry in professional engineering work. He/she may go on to graduate school in electrical engineering, or related field, such as biomedical engineering. He/she may use his/her electrical engineering as the basis for further study in a different field, such as law or medicine.

ELECTRICAL ENGINEERING CURRICULUM

FIRST YEAR. **(See page 37.)**

SECOND YEAR

1st Semester			2nd Semester		
EE 210	— Electrical Engr. I	3-3-4	EE 212	— Electrical Engr. II	3-0-3
EG 205	— Engr. Communications	1-2-2	Math 222	— Differential Equations	4-0-4
Math 221	— Calculus III	4-0-4	ME 361	— Thermodynamics	3-0-3
Phys 231	— Physics III	4-2-5	Mech 230	— Statics & Dynamics	4-0-4
Hum 231	— Man & Culture in Hist. Per. II	3-0-3	SS 201	— Economics	3-0-3

THIRD YEAR

EE 323	— Passive Networks	4-0-4	EE 324	— Computer Aided Circuit Analysis & Design†	3-0-1½
EE 326	— Electromag. Fields I	4-0-4			
EE 331	— Electromag. & Energy Conv.	3-0-3	EE 343	— Semiconductor Devices†	3-0-1½
EE 342	— Active Circuits I	3-3-4	EE 327	Electromag. Fields II	3-0-3-
	Elective (Humanities)	3-0-3	EE 332	— Magnetics & Electromech. Energy Conv. Lab	1-2-2
			EE 344	— Active Circuits II	3-1-3
			EE 365	— Digital Logic & Circuit Design	3-0-3
			SS	— Basic Soc. Sc. Req't.*	3-0-3

FOURTH YEAR

EE 410	— Active Circuits II Lab	1-2-2	EE 415	— Elec. Engr. Project	3-0-3
OS 471	— Management Practices	3-0-3		Elective (E.E.)	3-0-3
	Elective (E.E.)	3-0-3		Elective (E.E. Syst. II)	3-0-3
	Elective (E.E. Syst. I)	3-0-3		E.E. Systems Lab	0-4-2
	Elective (Humanities)	3-0-3		Elective (Hum./Soc. Sci./ OS)**	3-0-3
	Elective (Technical)	3-0-3		Elective (Approved)	3-0-3

† 8-week mini-course
* Choose from SS 202, SS 210, SS 221, or SS 231 for basic requirement.
** Excluding OS471

INDUSTRIAL ENGINEERING

The Industrial Engineering curriculum prepares engineers to design, improve, and install and operate integrated systems of people, materials, and facilities needed by industry, commerce, and society. Industrial Engineers solve the problems which arise in the management of enterprises by applying the principles of engineering science, product and process design, work analysis, human factors, and management science. Industrial Engineering leads to a wide variety of professional opportunities in industrial, commercial, and public service enterprises and to graduate study in Industrial Engineering, Business Administration, Law, and other fields.

The Industrial Engineering curriculum combines three professional areas of practice: product and production process design, work analysis and management science, and offers exposure as well to the more specialized areas of research, design and development, manufacturing, distribution and personnel management. In the early years of the program, the curriculum is primarily concerned with mathematics, physical science, and engineering science, upon which depend the courses presented in the later years. Early courses stress fundamental principles and concepts, which develop gradually, and eventually culminate in a system design dealing with real engineering and management situations in an industrial, commercial, or public service enterprise.

INDUSTRIAL ENGINEERING CURRICULUM

FIRST YEAR **(See page 37)**

SECOND YEAR

1st Semester			2nd Semester		
IE 221	— Intro. to Industrial Engr.	3-0-3	EG 203	— Indust. Engr. Graphics	1-2-2
Math 221	— Calculus III	4-0-4	IE 224	— Production Proc. Design	3-0-3
Phys 231	— Physics III	4-2-5	Math 222	— Differential Equations	4-0-4
SS	— Basic Soc. Sci. Reqt.*	3-0-3	Mech 230	— Statics & Dynamics	4-0-4
SS 201	— Economics	3-0-3	Hum 231	— Man & Cult. in Hist. Pers. II	3-0-3

THIRD YEAR

IE 335	— Cost Analysis	3-0-3	EE 405	— Electrical Engr.	3-0-3
IE 337	— Methods Engr.	2-2-3	IE 331	— Applied Statistics	3-0-3
IE 355	— Human Factors	3-0-3	IE 334	— Engineering Economy	3-0-3
Math 333	— Probability & Statistics	3-0-3	IE 338	— Work Measurement	2-2-3
Mech 232	— Mechanics of Materials	3-1-3	IE	— Elective (Technical)	3-0-3
	Elective (Humanities)	3-0-3		Elective (Humanities)	3-0-3

FOURTH YEAR

IE 439	— Management Science	3-0-3	IE 440	— Mgmt. Science Practice	3-0-3
IE 443	— Systems Analysis	2-2-3	IE 444	— Systems Design	2-2-3
IE	— Elective (Tech.)	3-0-3	IE	— Elective (Technical)	3-0-3
ME 339	— Fund. of Mech. Design	3-0-3	OS	— Elective	3-0-3
ME 463	— Appl. Thermodynamics	3-0-3		Elective (Humanities)	3-0-3
OS 474	— Human Resources Mgmt.	3-0-3			

* Choose from SS 202, SS 210, SS 221, or SS 231 for basic requirement.

MECHANICAL ENGINEERING

Mechanical engineering is concerned with the design, development, manufacture, and operation of a wide variety of energy and dynamic systems. Mechanical engineers employ their knowledge of materials, systems design and control, and production methods to develop complex systems such as aircraft, power plants, and combustion engines, to meet design constraints as well as safety and environmental protection requirements. Mechanical engineers are also involved in developing alternate energy sources, including fossil fuel, geothermal, wind, tide, solar, hydroelectric and nuclear power generation systems, in response to the world-wide energy shortage.

The first two years of the curriculum provide a foundation for the basic mechanical engineering courses offered in the third year. The fourth year utilizes the knowledge acquired during the first three years to develop professional skills in applied areas such as thermal and fluid engineering, and systems design and control. Laboratory and project work supplement courses offered in the fourth year.

The Mechanical Engineering curriculum is designed to prepare the student for professional work as well as for graduate study. This broad basis, combined with a wide variety of technical electives in such areas as air, thermal, and noise pollution control, energy conversion, computer-aided design, and bioengineering, enables the graduates to work in engineering or pursue graduate studies in such non-technical areas as medicine or law.

MECHANICAL ENGINEERING CURRICULUM

FIRST YEAR **(See page 37)**

SECOND YEAR

1st Semester			2nd Semester		
Math 221	— Calculus III	4-0-4	ME 231	— Kinematics & Dynamics of Machinery	3-1-3
Mech 230	— Statics & Dynamics	4-0-4	Math 222	— Differential Equations	4-0-4
ME 215	— Engr. Mat & Proc.*	2-2-3	Mech 232	— Mechanics of Mat'ls	3-1-3
EG 202	— Elements of M.E.	1-2-2	Hum 231	— Man & Cult. in Hist. Per. II	3-0-3
Phys 231	— Physics III	4-2-5	SS 201	— Economics*	3-0-3
		15-6-18			16-2-16

THIRD YEAR

EE 305	— Elect. Engr. Princ.	3-2-4	ME 302	— Heat Transfer	3-0-3
ME 301	— Thermodynamics	4-0-4	ME 304	— Fluid Dynamics	3-1-3
SS	— Basic Soc. Sci. Req't.**	3-0-3	ME 306	— Analysis & Synthesis of Mech. Systems	3-2-4
ME 303	— Des. of Mach. Elem.	3-2-4			
ME 305	— Intro. to Sys. Dynamics	3-0-3	Hum	— Elective (Lit/Hist/Phil)	3-0-3
		16-4-18	ME 343	— Mechanical Lab I.	2-2-3
					14-5-16

FOURTH YEAR

ME 403	— Mechanical Systems I	2-2-3	ME 404	— Mechanical Systems II	2-2-3
ME 405	— Mechanical Lab. II	1-2-2	ME 406	— Mechanical Lab. III	1-2-2
	Elective (Lit/Hist/Phil)	3-0-3	OS 471	— Mgmt. Practices	3-0-3
	Elective (Mech. Engr.)	3-0-3		Elective (Technical)	3-0-3
	Elective (Free)***	3-0-3		Elective (OS or Hum.)	3-0-3
IE 494	— Enterprise Mgmt.	3-0-3		Elective (Mech. Engr.)	3-0-3
		15-4-17			15-4-17

*Paired courses, half of the students will take these in reverse order.
**Choose from SS 202, SS 210, SS 221 or SS 231 for basic requirement.
***Students may select course from those approved as M.E., Technical, Humanities, or SS Electives.

Engineering Science

The Engineering Science program is intended for students who wish to pursue an individual course of study in an interdisciplinary area of engineering and science. An appropriate selection of courses may serve as a preparation for graduate studies and professional work in one of the newer interdisciplinary engineering fields, such as nuclear engineering, biomedical engineering, materials science, systems engineering, or urban planning, to mention only a few.

The curriculum is also intended for students whose interests fall between science and engineering. The complexity of modern engineering problems often requires a team effort involving both scientists and engineers. As a result, the boundary between science and engineering has become indistinct. Many scientists do engineering work, and many engineers are deeply involved in scientific endeavors. The Engineering Science program provides an education for work at the boundary between science and engineering. The program is designed to give all engineering science students a strong background in both science and engineering. Qualified students may specialize, for example, in chemistry, environmental science, mathematics, or physics, while at the same time gaining an understanding of the engineering disciplines in which these sciences are applied.

Engineering science is offered as a part-time evening program. However, limited enrollment necessitates offering many of the junior and senior level engineering courses every other year. It is important that the student carefully plan an approved program to insure that progress at the normal rate can be made.

ENGINEERING SCIENCE CURRICULUM

FIRST YEAR **(See page 37)**

SECOND YEAR

1st Semester			2nd Semester		
Math 221	— Calculus III	4-0-4	Math 222	— Differential Equations	4-0-4
Mech 230	— Statics & Dynamics	4-0-4	Phys 231	— Physics III	4-2-5
SS 201	— Economics	3-0-3		Elective (Soc. Sci.)	3-0-3
	Elective	3-0-3		Elective (Humanities)	3-0-3
	Elective (Technical)	3-0-3		Elective	3-0-3

THIRD AND FOURTH YEARS

The following courses are required of all students in Engineering Science. In addition, each student will elect courses to complete the requirements for graduation with approval of his adviser.

OS 471 and OS Contemporary Issues Course	(Fourth Year)
Four courses in humanities	(Third and Fourth Years)
One course in thermodynamics	(At least 3 credits)
Four courses in engineering	(Totaling at least 12 credits)
Two courses in mathematics	(Totaling at least 6 credits)
Two courses in physics or chemistry or computer science.	(Totaling at least 6 credits)

OVER-ALL DEGREE REQUIREMENTS

A field of specialization totaling at least 24 credits must be completed. The field may include courses in more than one department, but it must represent a coherent and logical occupational objective. The field of specialization should consist of advanced undergraduate courses that show a progression in depth of knowledge in the field. The Fourth Year must include a course that unifies the background obtained in the field of specialization. The 24 credits may include any of the Third and Fourth Year general requirements.

A minimum of 135 credits is required for the degree of Bachelor of Science in Engineering Science. Individual programs of study must be approved by the Committee on the Undergraduate Engineering Science Program before the student can be officially admitted to the program. No student may register as an Engineering Science major after the freshman year unless he has been admitted to the program.

Courses in biology, anatomy, physiology and zoology are available at the adjacent Newark campus of Rutgers University. Students who have demonstrated exceptional ability may choose from offerings at the graduate level. (see Catalog of Graduate Programs)

CHEMISTRY

An Applied Chemistry option gives the student a concentration of courses in applied fields of chemistry and in engineering. While the Applied Chemistry program is designed to provide industry with competent people equipped to solve practical problems, it can also be used as the vehicle for admission to graduate chemistry programs or professional schools (e.g., medical, dental, law). Electives are available in many areas of engineering and science, including polymers, the environment, energy (including electrochemical technology, e.g., batteries, fuel cells, corrosion), biochemistry, bioengineering and food and nutrition technology.

MATHEMATICS

Students selecting the option in Applied Mathematics are required to complete a minimum of 24 credits numbered at the 300-level or higher. Math 332, 337, 491, 545 and 546 should be taken. Math 333 is recommended.

NUCLEAR SCIENCE AND ENGINEERING PHYSICS

Two areas of specialization are available, namely an option in engineering physics and one in nuclear science. The program in the engineering physics option offers a great deal of flexibility. The nuclear option involves studies in modern physics, nuclear physics, nuclear engineering and applications of theory to design problems in a nuclear reactor laboratory.

Engineering Technology

Accredited by the Technology Accreditation Commission of A.B.E.T.

BACHELOR'S DEGREE PROGRAMS

During the last decade there has been a strong trend toward further education in engineering technology and this has led to the establishment of the Bachelor's programs in technology. A new occupational identity, the technologist, has come into being.

The technologist has a practical approach to the solution of everyday problems and works closely with the technician and the engineer or scientist as an important member of the engineering-scientific team.

The Engineering Technology program offers an opportunity for further education to persons who have completed an appropriate associate degree program at a community college, technical institute, similar institution or who have an equivalent education. The program can be completed in two years of full-time day study or four years of part-time evening study (normally three evenings per week).

The program provides advanced education in technical and management skills, together with selected humanities and social science electives. A core curriculum is required of all students; and specialization in Construction and Contracting, Electrical, Environmental, Manufacturing or Mechanical engineering technologies is provided.

DEGREE REQUIREMENTS

All candidates for graduation must meet the following minimum criteria before a degree can be awarded.

a)	Mathematics and basic sciences*	23 credits
b)	Humanities and social sciences	23 credits
c)	Technical courses	45 credits
d)	Complete all the required courses in the option.	

*Basic sciences include physics, chemistry and life and earth sciences.

The above credit requirements include courses taken at other schools either in fulfillment of AAS degree requirements or as transfer credits to be used in equivalents for entrance into our programs with junior standing.

Credits earned at other schools plus those credits earned at NJIT must meet the above minima.

HUMANITIES, SOCIAL SCIENCE AND ORGANIZATIONAL SCIENCE REQUIREMENTS

Because of the importance of humanities and social science in a college education, electives in these areas are required during the junior and senior years of the Engineering Technology program. With these electives, the student can further develop interests in a given area, building upon the background acquired during years in the associate degree program.

The organizational science requirements in the Engineering Technology program are designed to further the student's understanding of the effects of science and technology on current issues and of the structures of industrial organizations and their demands upon the individual and personnel.

CERTIFICATE PROGRAMS

The Division of Technology offers part-time, evening certificate programs in five areas of technology: Architectural, Construction, Electrical, Mechanical and Plastics. Admission to these programs is available to individuals who have a high school diploma or a New Jersey High School Equivalency Certificate and have satisfactorily completed one year of high school college-preparatory algebra.

A separate admissions application must be completed for entrance into the Certificate Program. The catalog fully describing the various curricula and course offerings available may be obtained by writing or phoning:

New Jersey Institute of Technology
Division of Technology
323 High Street, Newark, New Jersey 07102
Telephone: (201) 645-5231

ENGINEERING TECHNOLOGY CURRICULUMS

CONSTRUCTION AND CONTRACTING OPTION

The Construction and Contracting option is a program with specializations in general construction, heavy construction, building construction, mechanical and electrical contracting or field supervision. It prepares the holder of an associate degree in any of the construction related fields for a higher level of employment demanded in the ever-growing construction industry.

JUNIOR YEAR

1st Semester		2nd Semester	
CIS 202	— Computer Programming & Business Problems . . 2-2-3	Math 108	— Math Analysis I 3-0-3
Eng 342	— Tech. Report Writing . . . 3-0-3	OS 371	— Superv. & Empl. Rel. . . 3-0-3
Math 106	— Basic College Math 4-0-4	CET 331	— Structural Systems 3-3-4
CET 301	— Constr. Surveying 2-3-3	CET 314	— Constr. Procedures II . . 3-3-4
CET 313	— Constr. Procedures I . . . 3-3-4		Elec. (S.S. or Hum.) . . . 3-0-3

*Waived if the student has sufficient preparation. An elective will be substituted in an area which will satisfy degree requirements.

SENIOR YEAR

CET 411	— Cost Est. & Scheduling . 3-0-3	CET 435	— Design of Temp. Struct. for Construction 3-3-4
IET 414	— Ind. Cost Analysis 3-0-3	OS 472	— Mgmt. & Org. Behavior . 3-0-3
MET 450	— Mech. & Elec. Syst. I . . 3-3-4	CET 422	— Hydraulic & Hydrologic Problems in Constr. 3-0-3
	Elective (Humanities) . . . 3-0-3		Elective (SS or Hum.) . . 3-0-3
	Elective (OS or Tech.) . . X-X-X		Elective (OS or Tech.) . X-X-X

TECHNICAL ELECTIVES

Technical electives are scheduled on the basis of student interest. The following electives are suggested as most appropriate for the majority of students. Students may choose other electives after consultation with and approval from the program coordinators..

1st Semester		2nd Semester	
Chem 202	Chem. for Today's Society 2-2-3	IET 416	Production Scheduling 3-0-3
CET 415	Building Constr. 3-0-3	IET 419	Work Meas. Tech. 3-0-3
CET 416	Heavy Construction 3-0-3	IET 421	Contracts & Specif. 3-0-3
CET 431	Construction Testing 2-2-3	MatSci 311	Properties of Matls. 3-0-3
CET 441	Soils & Earthwork 3-0-3	MET 303	Appl. Thermodynamics 3-0-3
CET 490	Senior Project 3-0-3	MET 417	Solar Energy Appl. 3-0-3
EET 309	Electric Circuits & Mach. 3-0-3	MET 451	Mech. & Elec. Syst. II 3-0-3
Math 333	Probability & Statistics 3-0-3	CE 412	Constr. Codes & Specifications 3-0-3

ELECTRICAL SYSTEMS OPTION

The Electrical Systems option is designed as a continuation of an associate degree program in electrical or electronics technology, with emphasis on the theory and application of electrical circuits. Electives provide specialization in communications, computers, controls, power generation and distribution, and electrical machinery. Minor elective areas may be developed to satisfy student needs.

JUNIOR YEAR

1st Semester		2nd Semester	
CIS 202	Computer Programming & Business Problems 2-2-3	EET 302	Circuit Analysis II 3-0-3
EET 301	Circuit Analysis I 3-0-3	EET 304	Circuit Measurements II 1-3-2
EET 303	Circuit Measurements I 1-3-2	Math 209	Mathematical Analysis II 3-0-3
Eng 342	Technical Report Writing 3-0-3	OS 371	Supervision & Empl. Rel. 3-0-3
Math 108	Mathematical Analysis I 3-0-3	MatSc 311	Prop. of Materials* 3-0-3
MET 303	Appl. Thermodynamics* 3-0-3		Elective (S.S. or Hum.) 3-0-3

SENIOR YEAR

EET 405	Discrete & Integ. Cir. 3-3-4	EET 406	Control Syst. & Transd. 3-3-4
IET 414	Industrial Cost Analysis 3-0-3	EET 408	Electrical Syst. Project 1-3-3
	Elective (OS or Tech.) x-x-x	OS 472	Mgmt. & Org. Behavior 3-0-3
	Elective (Humanities) 3-0-3		Elective (OS or Tech.) x-x-x
	Elective (Technical) x-x-x		Elective (S.S. or Hum.) 3-0-3

TECHNICAL ELECTIVES

Technical electives are scheduled on the basis of student interest. The following electives are suggested as most appropriate for the majority of students. Students may choose other electives after consultation with and approval from the program coordinators.

CIS 330	Mini-computer Syst. 2-2-3	IET 416	Production Sched. 3-0-3
Chem 202	Chem for Today's Society 2-2-3	IET 419	Work Meas. Techniques 3-0-3
EET 410	Microprocessors 2-2-3	IET 420	Quality Control 3-0-3
EET 411	Energy Conversion Devices 3-0-3	IET 421	Contract & Spec. 3-0-3
EET 412	Power Generation & Distrib. 3-0-3	MET 307	Plastics Technology 3-0-3
EET 413	Pulse & Digital Circuits 3-0-3	MET 409	Air Cond. & Refrig. 3-0-3
EET 414	Communication Syst. 3-0-3	MET 410	Electro-Mech. Equip. 3-0-3
IET 315	Industrial Statistics 3-0-3	MET 416	Mechanical Instru. Lab 2-2-3
		MET 417	Solar Engergy Appl. 3-0-3

*The student may use a substitute for these courses in consultation with his/her adviser. Math 108 will be waived for incoming students who have sufficient preparation in mathematics. An elective will be substituted in an area which will satisfy degree requirements.

ENVIRONMENTAL TECHNOLOGY OPTION

The Environmental option is of interest to students who wish to specialize in the broad areas of air, water, and wastewater analysis and treatment. Graduates of this program are prepared to assume a variety of positions involving management, design, or analysis of environment related processes and activities in industry and governmental agencies. This option is designed for those who hold associate degrees in the physical or life sciences as well as engineering-oriented technologies.

JUNIOR YEAR

1st Semester		2nd Semester	
Math 106	— Basic College Math* . . . 4-0-4	Math 108	— Mathematical Analysis I 3-0-3
Eng 342	— Tech Report Writing . . . 3-0-3	ENT 312	— Chem. & Biology of Water & Wastewater Treatment 3-3-4
CIS 202	— Computer Programming & Business Problems . . 2-2-3	OS 371	— Supervision & Employee Rel. 3-0-3
ENT 311	— Chemistry of Contaminated Atmospheres & Emissions 3-3-4		Elective (Technical) 3-0-3
	Elective (Technical) 3-0-3		Elective (SS or Hum.) . . 3-0-3

*Waived if the student has sufficient preparation. An elective will be substituted in an area which will satisfy degree requirements.

SENIOR YEAR

ENT 415	— Wastewater Analysis . . . 3-3-4	ENT 416	— Unit Operations of Water & Wastewater Treatment . 3-0-3
MET 304	— Fluid Machinery & Equip. 3-0-3	OS 472	— Mgmt. & Org. Behavior. 3-0-3
IET 414	— Indust. Cost Analysis . . 3-0-3		Elective (OS or Tech.) . . x-x-x
	Elective (OS or Tech.) . . x-x-x		Elective (SS or Hum.) . . 3-0-3
	Elective (Humanitites) . . 3-0-3		Elective (Technical) . . . . x-x-x

TECHNICAL ELECTIVES

Technical electives are scheduled on the basis of student interest. The following electives are suggested as most appropriate for the majority of students. Students may choose other electives after consultation with and approval from the program coordinators.

Chem 303	— Appl. Chem. Principles . 3-0-3	ENT 419	— Envir. Quality & the Law 3-0-3
Chem 483	— Bio-organic Chemistry . . 3-0-3	IET 315	— Industrial Statistics 3-0-3
Chem 486	— Intro. Physical Chemistry 3-0-3	IET 419	— Work Meas. Techniques 3-0-3
CET 422	— Hydraulic Prob. in Construc. 3-0-3	IET 421	— Contracts & Spec. 3-0-3
EET 309	— Elec. Circuits & Mach. . 3-0-3	MatSc 311	— Properties of Matls. 3-0-3
ENT 313	— Public Health Tech. 3-0-3	MET 303	— Appl. Thermodynamics . 3-0-3
ENT 414	— Industrial Toxicology . . . 3-0-3	MET 415	— Auto. Control Systems . . 3-0-3
ENT 417	— Industrial Safety & Health 3-0-3	MET 416	— Mech. Instr. Lab 2-2-3
		MET 417	— Solar Engery Appl. 3-0-3
ENT 418	— Air Pollution Control 3-0-3		

MANUFACTURING TECHNOLOGY OPTION

The Manufacturing option is a broad program emphasizing the quantitative methods of production management. It prepares the holder of an associate degree in any field of technology for work in quality control, work measurement, reliability, cost analysis, plant layout, materials handling, and supervision.

JUNIOR YEAR

1st Semester		2nd Semester	
CIS 202	— Computer Programming and Business Problems . 2-2-3	IET 312	— Prod. & Proc. Design II . 3-0-3
Eng 342	— Tech. Report Writing . . . 3-0-3	IET 313	— Quantative Mgmt. Methods 3-0-3
IET 311	— Product & Process Design I 3-0-3	Math 108	— Math. Analysis I 3-0-3
IET 315	— Industrial Statistics 3-0-3	OS 371	— Superv. & Empl. Rel. . . 3-0-3
Math 106	— Basic College Math* . . . 4-0-4	IET 420	— Quality Control 3-0-3
IET 414	— Industrial Cost Anal. . . . 3-0-3		Elective (SS or Hum.) . . 3-0-3

SENIOR YEAR

IET 416	— Production Scheduling . 3-0-3	IET 418	— Production Mgmt. II . . . 3-3-4
IET 417	— Production Mgmt. I 3-3-4	OS 472	— Mgmt. & Org. Behavior 3-0-3
	Elective (OS or Tech.) . . x-x-x		Elective (OS or Tech.) . . x-x-x
	Elective (Humanities) . . 3-0-3		Elective (SS or Hum.) . . 3-0-3
	Elective (Technical) . . . . x-x-x		Elective (Technical) . . . . x-x-x

*Will be waived for incoming students who have sufficient preparation. An elective will be substituted in an area which will satisfy graduation requirements.

MatSc 311 — Required for students who have not had an equivalent course.

TECHNICAL ELECTIVES

Technical electives are scheduled on the basis of student interest. The following electives are suggested as most appropriate for the majority of students. Students may choose other electives after consultation with and approval from the program coordinator.

Chem 202	— Chem. for Today's Society 2-2-3	MET 303	— Appl. Thermodynamics 3-0-3
CET 301	— Constr. Surveying 2-3-3	MET 304	— Fluid Mach. & Equip . . . 3-0-3
CET 422	— Hydraulic Prob. in — Construction 3-0-3	MET 306	— Industrial Meas. 3-0-3
		MET 307	— Plastics Technology 3-0-3
EET 309	— Elec. Circuits & Mach. . 3-0-3	MET 407	— Structural Design 3-0-3
IET 405	— Numerical Control for Machine Tools 3-0-3	MET 410	— Electro-Mechan. Equip. 3-0-3
		MET 412	— Automated Prod. Meth. 3-0-3
IET 421	— Contracts & Specif. 3-0-3	MET 413	— Environmental Tech. . . . 3-0-3
MatSc 311	— Properties of Matls. 3-0-3	MET 417	— Solar Energy Appl. 3-0-3

MECHANICAL SYSTEMS OPTION

The Mechanical Systems option is a continuation of an associate degree program in mechanical technology, with an emphasis on design. Electives permit specialization in electromechanical equipment, air conditioning and refrigeration, manufacturing equipment, and other fields.

JUNIOR YEAR

1st Semester		2nd Semester	
CIS 202	— Computer Programming & Business Problems . . 2-2-3	Math 209	— Mathematical Analysis II 3-0-3
Eng 342	— Tech. Report Writing . . . 3-0-3	MET 302	— Machine Design II 3-0-3
Math 108	— Mathematical Analysis I 3-0-3	MET 304	— Fluid Mach. & Equip. . . 3-0-3
MET 301	— Machine Design I 3-0-3	OS 371	— Superv. & Empl. Rel. . . 3-0-3
MET 314	— Dynamics of Mach.* . . . 3-0-3		Elective (SS or Hum.) . . 3-0-3
	Elective (Technical) . . . . x-x-x		Elective (Technical) . . . . x-x-x

SENIOR YEAR

1st Semester		2nd Semester	
IET 414	— Industrial Cost Analysis . 3-0-3	MET 408	— Mech. Design Proj. 1-3-3
MET 415	— Automatic Control Sys. . 3-0-3	OS 472	— Mgmt. & Org. Behavior . 3-0-3
MET 416	— Mech. Instr. Lab 2-2-3		Elective (OS or Tech.) . . x-x-x
	Elective (OS or Tech.) . . x-x-x		Elective (SS or Hum.) . . 3-0-3
	Elective (Humanities) . . 3-0-3		Elective (Technical) . . . . x-x-x
	Elective (Technical) . . . . x-x-x		

*Students who have taken IET 315 may use MET 314 as a technical elective.

TECHNICAL ELECTIVES Technical electives are scheduled on the basis of student interest. The following electives are suggested as most appropriate for the majority of students. Students may choose other electives after consultation with and approval from the program coordinator.

Chem 202	— Chem. for Today's Society 2-2-3	MET 306	— Industrial Meas. 3-0-3
EET 309	— Elec. Circuits & Mach. . 3-0-3	MET 307	— Plastics Technology 3-0-3
ENT 313	— Public Health Tech. 3-0-3	MET 308	— Plastics Processing Tech. 3-0-3
IET 315	— Industrial Statistics 3-0-3	MET 407	— Structural Design 3-0-3
IET 416	— Production Sched. 3-0-3	MET 409	— Air Cond. & Refrig. 3-0-3
IET 419	— Work Meas. Tech. 3-0-3	MET 410	— Electro-Mech. Equip. . . 3-0-3
IET 420	— Quality Control 3-0-3	MET 411	— Manufacturing Equip. . . 3-0-3
MatSc 311	— Properties of Matls. . . . 3-0-3	MET 412	— Automated Prod. Meth. . 3-0-3
MET 303	— Appl. Thermodynamics . 3-0-3	MET 413	— Environmental Tech. . . . 3-0-3
		MET 417	— Solar Energy Appl. 3-0-3

Industrial Administration

The Bachelor of Science in Industrial Administration program applies modern management principles to the administration of industrial organizations. Students may specialize in areas such as industrial relations, financial administration, and information management. The program can serve as an entry to a broad range of management positions in business and government in this complex technological age. The BSIA can also be used as the foundation for graduate study in business administration, management, or public administration.

The BSIA curriculum is designed to articulate closely with business transfer programs at county colleges. Students may enter the program as freshmen or as juniors after completing an Associate degree at a county college or similar institution.

A minimum of 127 credits is required for the degree of Bachelor of Science in Industrial Administration.

INDUSTRIAL ADMINISTRATION CURRICULUM

FIRST YEAR

1st Semester		2nd Semester	
Eng 111	— English Composition ... 3-0-3	Hum 112	— Man & Cult. in Age of Crisis 3-0-3
IM 110	— Ind. Acct. & Budg. I ... 3-0-3	IM 111	— Ind. Acct. & Budg. II ... 3-0-3
Math 102	— Mathematical Concepts . 3-0-3	IM 112	— Admin. Systems 3-0-3
OS 171	— Ind. Org. & Mgmt. 3-0-3	Math 105	— Prob. & Statistics 3-0-3
	Elective (Soc. Sci.) 3-0-3	OS 261	— Behavioral Science 3-0-3
	Physical Education 0-1-0		Physical Education 0-1-0
	Orientation 1-0-0		

SECOND YEAR

Hum 231	— Man & Cult. in Hist. Pers. 3-0-3	SS 301	— Economic Analysis 3-0-3
		OS 381	— Pers. Mgmt. & Ind. Rel. 3-0-3
SS 201	— Economics 3-0-3		Elective (Humanities) .. 3-0-3
CIS 202	— Comp. Program for Bus. Appl. 3-0-3		Elective (Science) 3-0-3
			Elective (Com. Inf. Sci.)* 3-0-3
IM 305	— Business Statistics 3-0-3		
	Elective (Science) 3-0-3		

THIRD YEAR

Math 106	— Basic Coll. Math 4-0-4	IM 442	— Fin. of Bus. Enterprise — 3-0-3
IM 230	— Cost Analysis 3-0-3	Math 138	— General Calculus I 3-0-3
	Elective (Major) 3-0-3		Elective (Soc. Sci.) 3-0-3
	Elective (Humanities) . 3-0-3		Elective (Org. Sci.) 3-0-3
	Elective (Hum. or Soc. Sci.) 3-0-3		Elective (Major) 3-0-3
			Elective (Humanities) .. 3-0-3

FOURTH YEAR

IM 441	— Industrial Marketing ... 3-0-3	IE 446	— Law 3-0-3
OS 457	— Tech. & Society I 3-0-3	OS 458	— Tech. & Society II 3-0-3
	Elective (Major) 3-0-3		Elective (Major) 3-0-3
	Elective (Free) 3-0-3		Elective (Major) 3-0-3
	Elective (Humanities) .. 3-0-3		Elective (Org. Sci.)** .. 3-0-3
	Elective (Major) 3-0-3		

*Students with a major concentration in Industrial Relations may substitute an OS course. Students with a major concentration in Financial Administration may substitute IM 339.

**Students with a major concentration in Information Management may substitute a CIS course.

FIELD OF SPECIALIZATION

A field of specialization totaling at least 18 credits in a "major elective" must be completed. The area of concentration, planned in consultation with the student's adviser, may include courses in more than one department; but it should be selected with a career objective in mind. Students whose career objective lies in financial administration, industrial relations, or information management might find the following selection of courses the most appropriate to their needs:

FINANCIAL ADMINISTRATION

IM 231	— Operations Control	3-0-3
IM 333	— Public Finance	3-0-3
IM 336	— Industrial Safety Admin.	3-0-3
IM 339	— Computerized Mgmt. Control	3-0-3
IM 351	— Purch. & Matls. Mgmt.	3-0-3
IM 352	— Risk Management	3-0-3
IM 445	— Managerial Economics	3-0-3
IM 448	— Production Simulation Seminar	3-0-3
IM 449	— Financial Simulation Sem.	3-0-3
IM 483	— Controllership, Budgeting & Control	3-0-3
IM 484	— Investment Management	3-0-3
SS411	— Money & Banking	3-0-3

INDUSTRIAL RELATIONS

IM 336	— Indust. Safety Admin.	3-0-3
OS 371	— Supervision & Emp. Rel.	3-0-3
OS 391	— Labor-Mgmt. Relations	3-0-3
OS 461	— Group Development & Dynamics	3-0-3
OS 473	— Empl. Mgmt. Commun.	3-0-3
OS 481	— Job & Wage Analysis	3-0-3
OS 482	— Training & Development	3-0-3
OS 484	— Admin. of Equal Employment Opportunity Programs	3-0-3
SS 311	— Industrial Psychology	3-0-3
SS 402	— Labor Market Analysis	3-0-3

INFORMATION MANAGEMENT

CIS 331	— Mach. & Assem. Lang. Prog.	2-2-3
CIS 337	— Programming Syst. Libraries	3-0-3
CIS 351	— Computer Organization	3-0-3
CIS 365	— Computer Application to Commercial Problems	2-2-3
CIS 461	— System Simulation	2-2-3
CIS 465	— Computer Techniques for Mgmt. Info. Systems	3-0-3

Note: Certain graduate courses in all three major areas are open to qualified students with adviser approval.

Surveying

Surveying is the art and science of measuring the physical features of any portion of the surface of the earth, moon or planets and delineating them accurately on a map or storing the information in a computer data bank. The application of surveying techniques include such non-traditional areas as medicine, satellite navigation, and criminology. The varied applications coupled with rapidly changing technology has resulted in the development of areas of specialization. Some of these areas include: geodesy, photogrammetry, remote sensing, hydrographic surveys, topography, property surveys, cartography, engineering and construction.

The undergraduate curriculum addresses many of the specialties which comprise surveying. A strong foundation of mathematics, science and computer programming forms the basis for the advanced surveying courses. Related to this is the requirement to be able to communicate effectively with other design professionals and the public in general. Thus a strong background is also provided in the humanities and social sciences with emphasis on communication skills.

FIRST YEAR **(See page 37)**

SECOND YEAR

1st Semester			2nd Semester		
CE 200	— Surveying	3-3-4	CE 301S	— Advanced Surveying	3-3-4
CIS 313	— Fund. Comp. & Info. Science	3-0-3	CE 342	— Geology	3-0-3
Math 221	— Calculus III	4-0-4	Hum 231	— Man & Culture in Hist. Perspective	3-0-3
Mech 230	— Statistics & Dynanics	3-0-3	Math 223	— Elem. of Diff. Eq. & Stat.	4-0-4
SS 201	— Economics	3-0-3	Phys 231	— Physics III	4-2-5

THIRD YEAR

1st Semester			2nd Semester		
CE 320	— Fluid Mechanics	4-0-4	CE 321	— Water & Wastewater Engr	3-0-3
CIS 428	— Interactive Graphics	3-0-3	IE 497	— Enterprise Mgt.	3-0-3
Eng 342	— Tech. Report Writing	3-0-3	SS	— Basic Soc. Sci. Reqt.†	3-0-3
CE 305	— Aerial Photo Interp.	3-0-3	Hum	— Elective (Humanities)††	3-0-3
CE 302	— Geodetic Surveying	3-3-4	CE 303	— Photogrammetry I	3-0-3
			CE 304	— Adjust. Comp's I	3-0-3

FOURTH YEAR

OS 471	— Management Practice	3-0-3	CE 231	— Strength of Materials	4-3-5
Hum	— Elective (Humanities)††	3-0-3		— Elective (Hum/SS/OSS)	3-0-3
CE 403	— Photogrammetry II	3-3-4	CE 307	— Geometric Design for Highways	3-0-3
CE 404	— Adjust. Comp's II	3-0-3			
CE 402	— Geodetic Astronomy	3-0-3	CE 405	— Hydrographic Surv'g	3-0-3
	— Elective (Technical)	3-0-3		— Elective (Technical)	3-0-3

†Choose from SS 202, SS 210, SS 221 or SS 231 for basic requirement.
††Student may choose from history, literature or philosophy only. Both humanities electives must not be chosen from the same field.

Man and Technology

The Man and Technology program is a liberal education for a technological age. It resembles a liberal arts program in the flexibility of its requirements. It differs from a liberal arts program because it has a strong technical component. The program is designed for those who want an understanding of the role of technology in society, but who do not necessarily plan to pursue a technical career.

The degree requirements are stated in broad, general terms rather than in terms of specific courses. The individual student can therefore design a program of study that meets his/her own interest and goals. All of the great variety of courses offered at NJIT are available to students in the Man and Technology program. Through established cross-registration procedures, all courses at Rutgers-Newark College of Arts and Sciences are also available. With this great diversity of building blocks, an almost infinite variety of specific programs is possible.

Here are a few possibilities for interdisciplinary concentrations:

• A student aiming for a career in patent law or environmental law can combine courses in the social sciences and the communications arts with courses in engineering, as preparation for law school.

• A student planning a career in science writing — as a science reporter for popular media or as an editor for a technical journal — can develop a technical background while learning writing skills.

• A student interested in understanding the impact of technology on the environment can choose from an array of courses in biology, ecology, and environmental engineering.

• A student concerned about the problems of cities can select courses in urban economics, urban sociology, planning, architecture, and urban housing.

• A student focusing on the growing field of technology assessment can structure his/her program around courses in economics, sociology, and political science while also learning the methodology of engineering.

To develop a program of study, the student will work closely with a faculty adviser in choosing appropriate courses and in planning a complete program. In all cases, a coherent, interdisciplinary program focusing on the student's career objectives will be developed.

After an initial orientation meeting, entering students will submit a tentative program of study, developed in consultation with a faculty adviser knowledgeable in the area of the student's interest. This program will be tailored to the interests of the individual student while satisfying general degree requirements. During the first semester of the junior year, the student, with the assistance of his/her adviser, will submit for approval a final course of study, as well as a brief outline of his/her proposed senior project. Later changes can be made, with adviser approval.

The Man and Technology program is supervised by a Faculty Committee chaired by Dr. John Pattinson, Chairman of the Humanities Department. The program co-ordinator is Dr. John E. O'Connor.

DEGREE REQUIREMENTS

In completing the requirements for a Bachelor of Science degree in the Man and Technology program, each student must meet the following general requirements:

1. Total Credits: A minimum of 124 credits is required for the degree; of this total, 60 credits must be in junior-senior level courses (courses numbered 300 or above).

2. Fundamental Areas: A minimum of 15 credits must be completed in each of the four fundamental areas listed below. It is expected that, in his/her first two years, the student will concentrate on these requirements; however, he/she may extend completion into his/her junior and senior years.

   A. Natural Science: at least two courses in mathematics and two courses in a laboratory science (biology, chemistry, geology, physics).
   B. Social Sciences: economics, geography, political science, psychology, sociology.
   C. Humanities: English, history, philosophy, the arts.
   D. **Either 1)** Engineering and Engineering Science: Chemical, Civil, Electrical, Industrial, Mechanical Engineering, Computer Science, and Mechanics.
      Or 2) Architecture: a combination of courses in Architecture, Engineering, Engineering Science, and Computer Science.

3. Interdisciplinary Concentration: At least 24 credits in junior-senior level courses, which must be a coherent, related combination of an engineering or engineering science field with one of the other three major fields.

4. Man & Technology core curriculum: 12 credits in final two years.

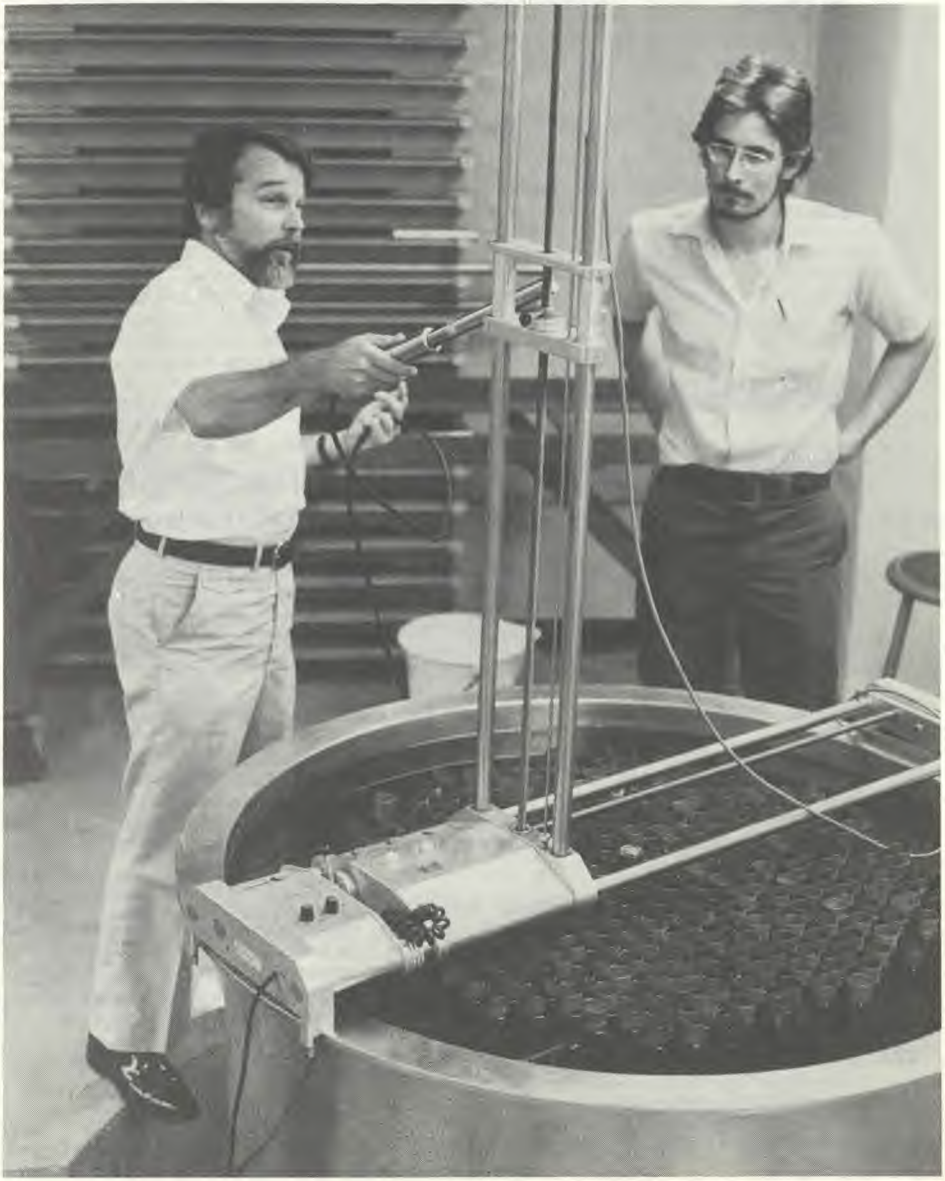
Junior Year

MT 308 Alternative Technologies (3 credits)
MT 310 Technology and Human Values (3 credits)

Senior Year

MT 490 & MT 491 PROJECT AND SEMINAR (6 credits). This project must be proposed and approved in the junior year and initiated in the first semester of the senior year. The project falling within the student's area of concentration will require a definition of aims, a search of the literature, and application of skills and knowledge acquired in formal course work. It may also require consultation with persons in academic, governmental, and industrial fields. The student will work closely with one of more faculty advisers as he/she defines and executes his/her project. A weekly seminar will be an important component of the senior projects course. The seminar will be devoted to a critical examination of the role of technology in society. Presentations will be made by students and by faculty from a wide range of disciplines.

Courses of Instruction



Courses of Instruction

Courses numbered between 100 and 199 are normally taken by freshmen.
Courses numbered 200-299 are normally taken by sophomores.
Courses numbered 300-399 are normally taken by seniors.
Courses numbered 500-599 are graduate courses open to undergraduates with advisers approval or, pertaining to Architecture, are courses taken by fifth-year undergraduate students.

The numbers after each course (i.e., 3-3-4) represent the number of recitation hours, laboratory hours and credits, respectively.

Prerequisites: Listed prerequisites must be completed before registering for a course. A prerequisite may be waived only on written permission of the department offering the course.

Aerospace Studies

Chairman: Heiki Ellermets
Professor: Ellermets; *Assistant Professors:* Olsen, Ruffolo, Thomason.

AS 111. UNITED STATES MILITARY FORCES IN THE CONTEMPORARY WORLD I. 1-1-1.
This introductory course explores the doctrine, mission, and organization of the United States Air Force. It examines the mission and weaponry of the U.S. strategic offensive and defensive forces — including the Navy — and the function and employment of nuclear weapons. There is also a study of the technological and political significance of a missile defense system. One hour of class and one hour of Leadership Laboratory per week.

112. UNITED STATES MILITARY FORCES IN THE CONTEMPORARY WORLD II. 1-1-1.
Prerequisite: As 111 or approval of the PAS. This course is a study of U.S. general purpose forces and aerospace support forces. It explores the mission, resources, and operation of tactical air forces, and their role in limited warfare. The support functions of research, logistics, and education are also introduced. One hour of class and one hour of Leadership Laboratory per week.

221. DEVELOPMENT AND GROWTH OF AIR POWER I. 1-1-1.
Prerequisite: As 112 or approval of the PAS. This course examines the development of air power over the past sixty years. It traces the development of various concepts of employment of air power and focuses on factors which have prompted research and technological change. One hour of class and one hour of Leadership Laboratory per week.

222. DEVELOPMENT AND GROWTH OF AIR POWER II. 1-1-1.
Prerequisite: AS 221 or approval of the PAS. This course stresses the variety of events and elements in the history of air power, especially where these provide significant examples of the impact of air power on strategic thought. One hour of class and one hour of Leadership Laboratory per week.

AS 333. LEADERSHIP AND MANAGEMENT FOR THE PROFESSIONAL OFFICER I. 3-1-3.
Prerequisite: AS 222 or approval of the Professor of Aerospace Studies. This seminar course explores the theory, function, and practice of leadership as applied to specific situations. A broad introduction to general management principles and philosophy is also highlighted. Emphasis is placed on the analysis, practice, and refinement of communicative skills. Three hours of class and one hour of Leadership Laboratory per week.

334. LEADERSHIP AND MANAGEMENT FOR THE PROFESSIONAL OFFICER II. 3-1-3.
Prerequisite: AS 333 or approval of the Professor of Aerospace Studies. This seminar course details management principles, tools, practices, and controls used by the junior military officer. Emphasis is placed on management philosophy and ethics, as well as further refinement of communicative skills in a managerial environment. Both the decision making and the actual execution of decisions are discussed. Three hours of class and one hour of Leadership Laboratory per week.

443. NATIONAL SECURITY FORCES IN CONTEMPORARY AMERICAN SOCIETY I. 3-1-3.
Prerequisite: AS 334 or approval of the Professor of Aerospace Studies. Focusing on the American Armed Forces as an integral element of American society, this course examines a broad range of topics related to American civil and military relations and the environmental context in which U.S. defense policy is formulated. Specific topics include the role of the professional soldier in a democratic society; socialization processes within the American military forces; and the requisites for maintaining adequate national security forces. A special emphasis will be placed on the communicative skills within the context of the course material. Three hours of class and one hour of Leadership Laboratory per week.

444. NATIONAL SECURITY FORCES IN CONTEMPORARY AMERICAN SOCIETY II. 3-1-3.
Prerequisite: AS 443 or approval of the Professor of Aerospace Studies. Focusing on the Armed Services as an integral part of the world society, this course examines the broader range of American civil-military relations and the environmental context formulating defense policy. Special themes emphasized are: political — economic — and social constraints upon the national defense structure; the impact of technological and international developments upon strategic preparedness and the policy-making process; and a futuristic look into the world diplomatic — military scene. A special topic is the Laws of War and American military law highlighted by a study of military justice and its effect on the citizen-soldier. Three hours of class and one hour of Leadership Laboratory per week.

Architecture

Dean (Acting): Barry Jackson
Associate Professors: Elwell, Hatch, Jackson, Linn, Wall, Weisman, West, Zdepski; *Assistant Professors:* Gallis, Gibson, Strauss, Thomasson, Wexler.

Arch 101. INTRODUCTION TO MAN AND ENVIRONMENT I. 2-3-3.
An introduction to professional environmental design which includes an overview of the relationship between man and his environment - both natural and built. The emphasis is on "how to see" and "how to comprehend" what is around us, to identify and discuss the interdependent forces of change at work in the environment, and to clarify the role of the environmental designer in affecting the natural and built environment. Field trips to study selected environmental situations and professional design offices are required of all students.

Arch 102. INTRODUCTION TO MAN AND ENVIRONMENT II. 2-3-3.
A continuation of Arch 101. Prerequisite: Arch 101.

111. HISTORY OF ARCHITECTURE I. 3-0-3.
A chronological survey of the social, political, technological, functional, and aesthetic implications of Western architecture. Subject matter will include Etruscan, Aegean, Greek, Roman, Early Christian, Medieval, and Gothic architecture ranging from military to domestic examples.

112. HISTORY OF ARCHITECTURE II. 3-0-3.
A continuation of Arch 111 with emphasis on Renaissance, Mannerist and Baroque, 18th and 19th Century picturesque styles, and a brief introductory survey to 20th Century.

201. ENVIRONMENTAL DESIGN I. 2-6-3.
The study of basic principles and elements of design with emphasis upon design methodology, design sensitivity, and communication skills. Field trips to visit and study selected environments and professional design offices are required of all students. Prerequisite: Arch 102 or equivalent.

202. ENVIRONMENTAL DESIGN II. 2-6-3.
A continuation of Arch 201. Prerequisite: Arch 201.

212. INTRODUCTION TO RADICAL ARCHITECTURE. 3-0-3.
Examination of utopian, visionary, imaginary, pop, iconic, tribal, vernacular, kitsch, dream, accidental, unplanned, psychic, adhoc, illusionistic, symbolic, minimal, monumental, destructive, fantasy, mythological, religious, surreal, catalog, and magical architecture. Architecture, environment and object will be examined as individual, cultural, or social expression. This course intends to heighten awareness of students to the objects and environments that saturate their senses, to the role that architecture has in transforming society, and the role that society has in transforming society, and the role that society has in transforming architecture.

213. MYTHICAL HOUSE. 3-0-3.
This course will show that the house develops not only in response to reasoning, the laws of physics, and biological needs but also in response to magic, ritual, culture, personality, fantasy and dreams.
"A House lives despite its construction in stone, it buldges, cracks and leaves behind fossilized relics as it fills with the dreams of its inhabitants."
(From the Journals — *Expedition to Levittown*)
Details include: the cave, from shelter to temple; transformations of nature; the soap opera as cave painting; "House Beautiful", the House, an extention of personality, the prison cell and army barracks; the vernacular house; bird housing and doll housing; hiding places, nooks, smells, and sounds; space capsule as house-house as space capsule; proposals for dream houses, past, present and future.

214. LANDSCAPE VALUES. 2-3-3.
A study of the natural landscape as a source and reflection of human attitudes and values. An introduction to the structure and functions of ecological systems as they exist in natural and urban environments. Nature studied as a guiding determinant and inspirational source for the settlement and design of the land. Also, nature viewed as a means for expressing human ideals and attitudes towards humanity and the civilized environment. A survey of landscape types and conditions representing attitudes of preservation, conservation, production, transformation, and reclamation. Landscape analyzed for values of functional use, aesthetic enrichment, and cultural symbolism. Assessment of specific settings for their reflection of existing human values and their potential capacity to provide others. Prerequisite: Sophomore standing.

215. LANDSCAPE DEVELOPMENT CONCEPTS. 2-3-3.
Study of predominant attitudes, approaches, and ideologies toward the development of the natural landscape. Use of historical and contemporary case studies. Study will include library research, field trips, sketching and diagramming, and written reports. Prerequisite: Sophomore standing.

Arch 216. URBAN VALUES. 2-3-3.
A study of when and how the physical environment has successfully attained the benefits of urbanization. A survey of urban planning practice and urban design approaches; historical, contemporary and theoretical. How the physical environment resulting from these factors is responsive to human values. Functions and processes of nature, the city, and the human user and how they influence the form and content of the city. Case studies will include cities, towns, new towns, and specialized (recreation and retirement) communities. Systematic methods will be utilized to present the concepts of the course as well as to serve as a study technique; laboratory work will include field trips, demonstration exercises, and analysis of case study data. Prerequisite: Sophomore standing.

217. URBAN VALUES II. 2-3-3.
A continuation of Arch 216. Further study of urbanization from the viewpoint of natural amenity and human aesthetic values. More emphasis on in depth case studies including the making of recommendations for achieving a more humane urbanization. Prerequisite: Arch 216.

218. SPECIAL TOPICS: NEW YORK CITY LABORATORY. 1-2-3.
The course will explore the architectural and environmental development of New York City during the past 200 years in an organized series of field trips — each week encompassing a section and/or representative aspect of the city's evolution. Prerequisite: Arch 111-112 or equivalent.

219. ENVIRONMENTAL PRODUCT DESIGN. 2-3-3.
A lecture/seminar/workshop that encompasses the design, workshop fabrication, and testing of environmental products such as small scale shelters, exhibit systems and furniture. Particular emphasis will be placed on understanding the nature of materials and mass production processes as they relate to design, and on acquiring workshop skills. Prerequisite: an introductory background in environmental design.

312. WORKSHOP IN ENVIRONMENTAL EDUCATION I. 2-3-3.
This course will involve architecture students with a group of high school students in the solution of a joint environmental design project. Participants will first work towards developing their own understanding of sensitivity to the man-made environment. Emphasis will be on learner-directed and discovery-guided inquiry, and educational methods to increase public awareness of the physical settings created for human activities. Prerequisite: Admission to the Architecture Program.

313. WORKSHOP IN ENVIRONMENTAL EDUCATION II. 2-3-3.
A continuation of Arch 312. Prerequisite: Arch 312.

320. ENVIRONMENTAL ARTS AND ARCHITECTURE. 3-0-3.
A historical review of public art and architecture. Public versus private sensibility and the sociological forces that have determined the character and iconography of the public environment will be investigated, along with new forces of change such as indeterminancy, dematerialization, ecumenism, pluralism, and deinstitutionalization.

350. ARCHITECTURE TOPICS I. 9-0-9.
Introduction to the concepts of ecology, environmental behavior, history theory, planning, research, programming, architectural economics, site planning, structures, materials/construction, environmental control systems and professional practice. Prerequisite: Admission to the Architecture Program.

351. ARCHITECTURE TOPICS II. 9-0-9.
A continuation of Arch 350. Prerequisite: Arch 350.

360. ARCHITECTURE STUDIO I. 0-15-5.
Comprehensive design studies dealing with the concepts introduced in Arch 350-351. Arch 360-361 must be taken concurrently with Arch 350-351.

361. ARCHITECTURE STUDIO II. 0-15-5.
A continuation of Arch 360. Prerequisite: Arch 360.

Arch 391. INDEPENDENT STUDY. 1 credit.

392. INDEPENDENT STUDY. 2 credits.

393. INDEPENDENT STUDY. 3 credits.
Faculty supervisor to be selected by student. Prerequisite: Admission to the Architecture Program and written approval for independent study. Self-paced study on an individual or small-group basis. Through supervised independent study students are encouraged to develop professional design applications for non-architecture electives and concentrations.

401. THEORY SEMINAR: METHODS AND MEANINGS. 3-0-3.
The investigation of new and old approaches to architecture as a field of study providing new foundations for the formulation of individual approaches. The course will include: the analysis of methods of investigation in architecture, and the meanings of architecture to the people who create it: architect, client, user, and investigator; traditional and new methods: media and their combinations, scholarships, propaganda, word and image; relationships between future, present and past; relationships between current architectural ideas and current ideas in art, technology, science and communication. Prerequisite: Junior standing or the equivalent.

402. HISTORY SEMINAR. 3-0-3.
This course will be an introduction to the theory and practise of the history of architecture; why we study history; what uses it has, and how our motivations affect what we discover. Included will be the relative importance of social forces, style and individuality as causes; advantages and disadvantages of historical awareness for the architect (contemporary vs. Bauhaus attitudes), and contrast of cultures emphasizingg continuous tradition and cultures emphasizing awareness of multiple pasts.

403. THE AMERICAN HOME AND HOUSEHOLD. 3-0-3.
A cultural, architectural, and psychological analysis of various American homes and households throughout history. Included are: the Puritan society and Colonial home....the Victorian home and family....the frontier homestead....19th century utopian communes...immigrants, the working class poor and urban tenements...war housing and suburban homes. We will explore the meaning, use and design of each domestic setting from the point of view of society, the family and the individual, considering differences based on sex, race and class. Slide lectures incorporate photographs and excerpts from original historical writings found in journals, diaries, court records, wills and famous books and popular magazines of the times. Prerequisite: None.

410. SPATIAL A, B, C's I. 3-0-3.
To study how the concept of architectural space and shape emerges to childrens' awareness. Special emphasis will be placed on Piaget's pioneering works. A major portion of the course deals with pragmatic investigations of certain aspects of architecture-for-children, either through drawings, models, or full size site installations. Prerequisites: not open to freshmen.

411. SPATIAL A, B, C's II. 3-0-3.
Continuation of Spatial A, B, C's I. The course undertakes feedback and modification of previous investigations undertaken in Arch. 410, with additional content covering adventure playgrounds, cognitive mapping, Montessori educational approaches, as well as more complex Piagetian ideas concerning child development. The work of other architects who have designed environments for children will be reviewed. Prerequisites: Arch 410.

450. ARCHITECTURE TOPICS III. 9-0-9.
The continued development of concepts introduced in Arch 350-351. Prerequisite: Arch 351.

451. ARCHITECTURE TOPICS IV. 9-0-9.
A continuation of Arch 450. Prerequisite: Arch 450.

Arch 460. ARCHITECTURE STUDIO III. 0-15-5.
Comprehensive design studies dealing with concept development in Arch 450-451. Arch 460-461 must be taken concurrently with Arch 450-451.

461. ARCHITECTURE STUDIO IV. 0-15-5.
A continuation of Arch 460. Prerequisite: Arch 460.

491. INDEPENDENT STUDY. 1 credit.

492. INDEPENDENT STUDY. 2 credits.

493. INDEPENDENT STUDY. 3 credits.
These courses are the fourth-year equivalents to Arch 391, 392, and 393.

550. ARCHITECTURE TOPICS V. 6-0-6.
The analysis of design solutions with emphasis upon specialization with an interdisciplinary approach. Prerequisite: Arch 451.

551. ARCHITECTURE TOPICS VI. 6-0-6.
A continuation of Arch 550. Prerequisite: Arch 550.

560. ARCHITECTURE STUDIO V. 0-15-5.
Studies dealing with the seminar topics of Arch 550-551. Arch 560-561 must be taken concurrently with Arch 550-551.

561. ARCHITECTURE STUDIO VI. 0-15-5.
A continuation of Arch 560. Prerequisite: Arch 560.

591. INDEPENDENT STUDY. 1 credit.

592. INDEPENDENT STUDY. 2 credits.

593. INDEPENDENT STUDY. 3 credits.
These courses are the fifth year equivalents to Arch 491, 492, and 493.

Chemical Engineering and Chemistry

Chairman: Deran Hanesian
Associate Chairman: John E. McCormick
Associate Chairman: Howard Kimmel
Assistant Chairman: H.T. Chen
Assistant Chairman: Donald Getzin

Chemical Engineering Staff: *Professors:* Andersen, Chen, Hanesian, Huang, McCormick, Perna, Roche, Tassios; *Associate Professor:* Greenstein; *Assistant Professors:* Abd-El-Bary, Bart, Dutta, Lewandowski.

Chemistry Staff: *Professors:* Kimmel, Ram, Shilman, Snyder, Suchow, Trattner; *Associate Professors:* Bozzelli, Dauerman, Getzin, Kebbekus, Kristol, Lambert, Parker, Perlmutter; *Assistant Professors:* Cagnati, Greenberg, Grow, Lei, Tomkins.

ChE 227. CHEMICAL PROCESS PRINCIPLES I. 3-0-3. **CHEMICAL ENGINEERING**
Prerequisites: Chem 116, CIS 101, Math 112. An introduction to the analysis of chemical processes, with special emphasis on mass balances.

228. CHEMICAL PROCESS PRINCIPLES II. 3-0-3.
Prerequisite: ChE 227. A continuation of ChE 227 with special emphasis on energy balances.

ChE 310. WORK EXPERIENCE I.
Prerequisites: Completion of the Sophomore Year, approval of the Department, and permission of the Cooperative Education Director. Cooperative education work experience of six months for the first working period. CO-OP students only can register for this course.

311. WORK EXPERIENCE II.
CO-OP students only can register for this course for the second six months work experience. See ChE 310 above.

345. CHEMICAL ENGINEERING THERMODYNAMICS I. 3-0-3.
Prerequisites: ChE 228, Chem 232. The thermal properties of matter are studied and interpreted in terms of the fundamental concepts and laws of thermodynamics. Generalized methods for handling p-V-T relations and thermodynamic properties of fluids are considered. Applications are made to batch and flow processes.

346. CHEMICAL ENGINEERING THERMODYNAMICS II. 3-0-3.
Prerequisite: ChE 345. The concepts and methods developed in ChE 345 are applied to the treatment of compressors, heat engines, refrigeration, phase equilibria, and chemical reactors. The student is introduced to the thermodynamic analysis of practical processes as a method for the evaluation of energy utilization.

349. REACTION KINETICS. 3-0-3.
Prerequisites: Chem 335, ChE 228. A study of the mechanisms and kinetics of homogenous chemical reactions in batch and flow reactors, and the applications of kinetics to both isothermal and nonisothermal reactor design. An introduction to the kinetics of heterogenous catalytic reactions and reactor design is included.

363. TRANSPORT OPERATIONS I. 3-0-3.
Prerequisite: ChE 228. The principles of the molecular and turbulent transport of momentum, heat, and mass, with applications to the design of chemical process equipment are considered. This first semester of a 3-course sequence emphasizes momentum transport, with applications.

364. TRANSPORT OPERATIONS II. 3-0-3.
Prerequisites: ChE 363, Math 222. A continuation of ChE 363, emphasizing heat transport, with applications.

444. INTRODUCTION TO POLYMER ENGINEERING. 3-0-3.
Prerequisites: ChE 349, Math 221. An introductory course in basic concepts of polymer engineering. Topics covered include nature of high polymers, rheology, polymerization kinetics, and stability and control of polymerizations.

455. PROCESS SYNTHESIS & EVALUATION. 3-0-3.
Prerequisite: ChE 364. This course provides chemical engineers with a working knowledge of the technical fundamentals and current practices in process synthesis and process evaluation. The concepts covered are essential for implementing the decisions made by engineers working in research development, design, operations, and management.

466. POLLUTION CONTROL IN CHEMICAL PROCESSES. 3-0-3.
Prerequisite: ChE 467 or 551. This course applies chemical engineering principles to problems of pollution. The emphasis will be on the treatment of various side and discharge streams that are environmentally undesirable. A case study approach is used to evaluate processes and pinpoint pollution sources. Quantitative designs and calculations will be required.

467. TRANSPORT OPERATIONS III. 4-0-4.
Prerequisites: ChE 346, ChE 364. This course completes the transport operations sequence. It covers mass transfer operations, simultaneous heat and mass transfer and simultaneous mass and momentum transfer operations. The course applies these basic operations to equipment siting and synthesis of processes.

ChE 468. AIR POLLUTION CONTROL PRINCIPLES. 3-0-3.
Prerequisite: Chem 335 or Undergraduate thermodynamics. Introduction to the problems of air pollution control. Pollutant identification, inventory, monitoring and sampling are included. Aerochemistry and methods for minimizing air pollution are also covered.

472. PROCESS AND PLANT DESIGN. 4-0-4.
Prerequisites: ChE 349, ChE 467 and ChE 364. The process and equipment design of process units is covered focusing on process design, equipment design, and process-equipment parameter studies. The emphasis of the process design segment is to cover, for a process, the flow sheet and equipment sequence as related to raw materials and location factors, establishment of process operating conditions and preparation of necessary material and energy balances. The second segment concentrates on the preparation of preliminary investment and operating cost estimates, incorporating the size and/or mechanical designs of equipment, and the utility and instrumentation requirements. The third segment is an exposure to the interrelationships of process and design variables via the utilization of process simulation programs available on the Institute's computing facilities.

473. MATHEMATICAL METHODS IN CHEMICAL ENGINEERING. 3-0-3.
Prerequisite: ChE 364. Matrix operations, Fourier Series, and Numerical Methods are developed and applied to the solution of problems in chemical engineering. Numerical results and use of computers are required.

475. PROCESS DYNAMICS AND CONTROL. 4-2-5.
Prerequisites: ChE 364, ChE 349. Integrated theory laboratory course. An introduction to the principles of process dynamics and control with applications to the automatic control of chemical processes. Mathematical description and analysis of chemical process systems.

476. INTRODUCTION TO BIOCHEMICAL ENGINEERING. 3-0-3.
Prerequisites: Chem 344 or 483 and either Chem 334 or 335 or 486. The application of chemical engineering to biological processes. Biochemical reaction systems and their technological employment. The material basis of living systems, enzyme reactions, cellular organization and function, metabolism and transport, effect of the physical and chemical environment in cell behavior, modeling and kinetic behavior of biological populations.

477. UNIT OPERATIONS IN FOOD ENGINEERING. 3-0-3.
Prerequisite: ChE 364. The application of unit operations to foodstuffs, their production and processing (rheology, fluid flow, heat transfer, and mass transfer).

481. CHEMICAL ENGINEERING LABORATORY. 2-4-4.
Prerequisite: ChE 364. A communication-experimentation course which introduces the student to concepts of experimentation and analysis, both oral and written technical communication, and laboratory investigations in the areas of Fluid Dynamics and Energy Transport. Experimental investigations are undertaken utilizing both bench and pilot plant sized apparatus. Special emphasis is placed on the relationships between theoretical and experimental analysis of results obtained, design and synthesis application, and their presentation.

482. CHEMICAL ENGINEERING LABORATORY. 2-4-4.
Prerequisites: ChE 481, ChE 349, ChE 467. Laboratory investigations of topics in Mass Transport, Kinetic Phenomena and elected special topics. Experiments are undertaken on both pilot plant and bench scale sized equipment to illustrate relationships between predictive theory and actual experimental results. Emphasis is placed on the design and synthesis application of the results and their presentation.

484. SPECIAL TOPICS IN MASS TRANSFER. 3-0-3.
Prerequisites: ChE 467, ChE 364. This course is concerned with the application and design of equipment in special mass transfer operations. The four major topics will be Humidification, Adsorption and Ion Exchange, Drying, and Leaching. Optional, less conventional topics will also be covered at the

discretion of, and with consensus of, the class and the instructor.

ChE 486. SYNTHETIC FUELS. 3-0-3.
Prerequisites: ChE 228, Chem 343. A survey of the chemical processes involved in converting available fossil fuels to more useable forms, to supplement or replace exisiting energy sources. Consideration is given to the technical, economic, and environmental problems that must be solved to produce synthetic fuels.

491. RESEARCH AND INDEPENDENT STUDY. 0-6-3.
An honors course open to a limited number of qualified students. This course provides the student with an opportunity to work in research or on projects of special interest under the individual guidance of a member of the department staff. Department approval is required for admission to this course. Students taking ChE 491 must take ChE 492. The grade for this course is Satisfactory or Unsatisfactory. Credit for graduation will be given only on completion of ChE 492 at which time grades for both ChE 491 and ChE 492 will be submitted.

492. RESEARCH AND INDEPENDENT STUDY. 0-6-3.
A required continuation of ChE 491 at the honors level.

551. PRINCIPLES OF MASS TRANSFER. 3-0-3.
Prerequisites: Undergraduate thermodynamics and integral calculus. An introductory course in basic concepts of mass transfer. Special emphasis is placed on mass transfer concepts applicable to stage and continuous operations. Topics covered include evaporation, gas absorption, and distillation. Not available for credit to chemical engineering students.

575. STATISTICAL THERMODYNAMICS. 3-0-3.
Prerequisite: Undergraduate course in thermodynamics. Application of statistical methods to the evaluation of thermodynamic properties. Among the topics considered are the ideal gas, monatomic crystals, chemical equilibrium, the transition state theory of reaction, inter-molecular forces, and virial coefficients.

583. PETROLEUM REFINING. 3-0-3.
Prerequisite: ChE 349. An introduction to the chemical processing of petroleum to produce fuels, lubricants, and petrochemical feedstocks. Lectures and readings from the current literature emphasize modern refining practice in an era of uncertain petroleum supplies and changing product demands.

CHEMISTRY

Chem. 101. INTRODUCTORY CHEMISTRY. 3-0-3.
The course presents the elementary chemical principles and their application to the understanding of descriptive chemistry. Not available to pre-architecture or B.S.I.A. students.

111. FUNDAMENTALS OF CHEMISTRY AND MATERIALS I. 3-0-3.
Prerequisites: H.S. math including algebra and trigonometry. An introductory course in chemistry and the chemistry of engineering materials suitable for students who have not had H.S. chemistry or for those who wish to pace their studies. Not open to students who have taken Chem 115 or 117.

112. FUNDAMENTALS OF CHEMISTRY AND MATERIALS II. 4-3-5.
Prerequisite: Chem 111. This course is a continuation of Chem 111. Suitable laboratory experiments illustrate the course material.

113. FUNDAMENTALS OF CHEMISTRY AND MATERIALS III. 3-3-4.
Prerequisite: Chem 112. This is a continuation of Chem 112.

115. CHEMISTRY AND MATERIALS I. 4-2-5.
Prerequisite: H.S. math including algebra and trigonometry. This course introduces the student to the basic concepts of chemistry and presents their immediate application to the understanding of the structure, properties,

and uses of engineering materials. Suitable laboratory experiments illustrate the course material. Not open to students who have taken Chem III.

Chem. 116. **CHEMISTRY AND MATERIALS II. 3-2-4.**
Prerequisite: Chem 115 or equivalent. A continuation of Chem 115.

117. **HONORS CHEMISTRY AND MATERIALS I. 4-2-5.**
An honors chemistry course which parallels Chem 115 but is more comprehensive and rigorous. Field trips, molecular model building, laboratory projects, journal reading assignments and reports, and supplementary problems are required aspects of the program. Admission is by invitation only.

118. **HONORS CHEMISTRY AND MATERIALS II. 3-2-4.**
Prerequisite: Chem 117. This is a continuation of Chem 117, which parallels the course content of Chem 116.

202. **CHEMISTRY FOR TODAY'S SOCIETY. 2-2-3.**
Not open to students who have taken Chem 115 or 117. The relationship of chemistry to life and to living in today's society is considered. The course examines the application of chemistry to this modern world of drugs, biocides, fertilizers, detergents, plastics, pollutants, and covers other contemporary topics.

231. **PHYSICAL CHEMISTRY I. 3-0-3.**
Prerequisites: Chem 116 or equivalent, Math 221, Phys 121. This course is intended for non-chemical engineering students. The topics covered include the properties of ideal and non-ideal gases, liquids, solutions, thermo-chemistry thermodynamics, the phase rule, and phase equilibria. Not open to students who have taken or are taking Chem 232 or Chem 486.

232. **PHYSICAL CHEMISTRY I. 3-2-4.**
Prerequisites: Chem 116 or equivalent, Math 221, Phys 121. The topics covered in lecture include the properties of ideal and non-ideal gases, liquids, solutions, thermochemistry, thermodynamics, the phase rule, and phase equilibria. The laboratory is concerned with basic analytical principles and techniques. Not open to students who have taken or are taking Chem 486.

303. **APPLIED CHEMICAL PRINCIPLES. 3-0-3.**
Prerequisite: One semester of a college chemistry course which included a laboratory. This course is not open to students who have taken Chem 116 or 118. An elementary treatment of the physical and chemical processes occurring in water solutions is presented and applications to environmental and other contemporary problems are considered. A brief introduction to the properties or organic materials is included.

334. **PHYSICAL CHEMISTRY II. 3-0-3.**
Prerequisite: Chem 231 or 232. This course is intended for non-Chemical Engineering students. A continuation of Chem 231, the topics covered include homogeneous and heterogeneous chemical equilibria, ionic equilibria, electro-chemistry, kinetic theory of gases, transport phenomena, kinetics, and irreversible processes.

335. **PHYSICAL CHEMISTRY II. 4-3-5.**
Prerequisite: Chem 232. The lecture presents a continuation of Chem 232. The topics covered include homogeneous and heterogeneous chemical equilibria, ionic equilibria, electrochemistry, kinetic theory of gases, transport phenomena, kinetics, and irreversible processes. The laboratory consists of experiments in which the student applies and extends the basic knowledge of physical chemistry acquired in the lecture and is introduced to the various physical chemical instrumentation methods.

343. **ORGANIC CHEMISTRY I. 3-0-3.**
Prerequisite: Chem 116 or equivalent. The preparation and properties of the various classes of organic compounds are discussed, with attention given to industrial sources such as coal and petroleum and the commercial utilization of these materials in the synthesis of useful products used in

areas such as foods, cosmetics, textiles, plastics and pharmaceuticals. Not open to students who have taken or are taking Chem 483.

Chem. 344. ORGANIC CHEMISTRY II. 4-3-5.
Prerequisite: Chem 343. The lecture presents a continuation of Chem 343. The principles discussed in lecture are carried out in the laboratory.

440. FUNDAMENTALS OF POLYMERS. 3-0-3.
Prerequisites: Organic and Physical Chemistry. An introduction to the important fundamental aspects of polymers including preparation, structure, physical states and transitions, molecular weight distributions, viscous flow, mechanical properties at small deformations, and ultimate properties.

443. INTRODUCTORY POLYMER LABORATORY. 1-4-3.
Prerequisites: Chem 440. A course in practical methods useful in the preparation and characterization of macromolecules, including addition and condensation polymerization. Various methods useful in characterizing polymers will be studied, such as solution and bulk viscosity, light scattering, osmometry, D.T.A., T.G.A., x-ray diffraction, and various chromatographic and spectroscopic techniques.

449. PREPARATION AND ANALYSIS OF ORGANIC COMPOUNDS. 1-4-3.
Prerequisite: Chem 344. This course deals with the application of laboratory techniques learned in Chem 344 laboratory to the synthesis and characterization of organic compounds.

471. CHEMICAL ASPECTS OF INDUSTRIAL HEALTH. 2-3-3.
Prerequisites: Chem 116 or equivalent. This course is concerned with occupational health and safety as applied to hazardous modern technology; industrial hygiene and maximal threshold limits of work exposure. Occupational poisons, their threshold limits and effects on body systems will be considered also. Sampling and analysis of hazardous materials will be studied in the laboratory.

472. CHEMICAL TECHNOLOGY OF FOOD AND NUTRITION. 3-0-3.
Prerequisites: Physical Chemistry and organic chemistry. This course deals with the biochemistry of nutrients, food composition, processing and preservation; safety and sanitary factors in manufacturing and packaging; food laws and regulations.

483. BIO-ORGANIC CHEMISTRY. 3-0-3.
Prerequisite: Chem 116 or equivalent. This course is for non-Chemical Engineering students interested in environmental or biological engineering. The fundamentals of organic chemistry and biochemistry are studied and applied to living systems. This course is not open to students who have taken or are taking Chem 343.

484. MODERN ANALYTICAL CHEMISTRY. 1-4-3.
Prerequisite: Chem 116 or equivalent. The course teaches the basic principles and techniques of analytical determinations while emphasizing the application of the quantitive approach to the solution of environmental problems. The course includes the fundamental principles and techniques of analytical chemistry together with an introduction to separation techniques and instrumental analysis. These techniques are applied to the determination of environmental criteria.

486. INTRODUCTORY PHYSICAL CHEMISTRY. 3-0-3.
Prerequisites: Chem 116 or equivalent, Math 112, Phys 121. This course is for non-Chemical Engineering students interested in the environmental sciences. The topics covered include an introduction to thermodynamics and thermochemistry, properties of gases, liquids and solutions, chemical and ionic equilibria, electrochemistry, and kinetics of chemical reactions.

491. RESEARCH AND INDEPENDENT STUDY. 0-6-3.
Prerequisite: Senior standing. This course in intended for Engineering Science students who wish to integrate their knowledge and current work into a meaningful and productive effort, which may be in the form of a

laboratory or library project or a theoretical study under the guidance of a member of the department.

Chem. 492. **RESEARCH AND INDEPENDENT STUDY. 0-6-3.**
Prerequisite: Chem 491. A continuation of Chem 491.

502. **ADVANCED ORGANIC CHEMISTRY I. 3-0-3.**
Prerequisites: Undergraduate organic chemistry and physical chemistry. Organic molecules are treated from a structural, rather than a mechanistic, viewpoint. Topics covered include atomic and molecular structure, sterochemistry, reactive intermediated (cations, anions, radicals and carbenes), and spectroscopy.

552. **LASER CHEMISTRY AND TECHNOLOGY. 3-0-3.**
Prerequisite: Chem 116 or equivalent, Physics 231 or equivalent, Math 221. An introduction to the underlying chemistry and physical principles of lasers, their operation, uses and the related optoelectronic technology. The course will include an analysis of each class of laser; pumping mechanisms for creating the atomic and molecular excited states; detection of light; absorption and emission of radiation; current industrial and state of the art uses; and associated optoelectronic processes.

555. **ELECTROCHEMISTRY: PRINCIPLES AND APPLICATIONS. 3-0-3.**
Prerequisite: Chem 116 or equivalent and a course in thermodynamics or equivalent. The course is concerned with a study of the principles governing electrochemical methods such as conductance, emf, polarography, cyclic voltammetry, chronopotentiometry, coulometry and their application to electric energy storage and conversion, corrosion, electroplating, pollution monitoring and electrochemical sensors, and electrochemical synthesis.

571. **BIOCHEMISTRY. 3-0-3.**
Prerequisites: Undergraduate organic and physical chemistry, or permission of the instructor. An introductory course in biochemistry which includes fundamentals from the viewpoint of physical and organic chemistry and the industrial applications of the field. It is directed particularly to those students who have an interest in biophysics and bioengineering.

Civil and Environmental Engineering

Chairman: Eugene B. Golub
Associate Chairman: Edward G. Dauenheimer
Assistant Chairmen: Harold Deutschman (Graduate), Frederick G. Lehman (Undergraduate)

Professors: Cheng, H. Deutschman, Dresnack, Golub, Liskowitz, Monahan, Peck; *Associate Professors:* Chan, Ciesla, Cheremisinoff, Khera, Olenik, Pfafflin, Salek; *Assistant Professors:* Albert, Craig, Dauenheimer, Farkas, Hsu, Konon, Kuperstein, Raghu, Taylor.

CE 200. **SURVEYING. 3-3-4.**
Prerequisite: Math 111. Theory, fieldwork, and computations dealing with plane, topographic, and elements of route surveys.

210. **CONSTRUCTION MATERIALS AND PROCEDURES. 3-0-3.**
Prerequisite or Corequisite: EG 204. A study is made of current practices in construction, including earth moving, framing materials and procedures, masonry, carpentry, fenestration, roofing, electrical systems, and mechanical systems. Field trips to construction sites give the student the opportunity to view directly many of the practices.

CE 231. STRENGTH OF MATERIALS. 4-3-5.
Prerequisites: Mech 230, Math 221, or equivalents. This course designed for civil engineering students is more intensive than Mech 232. The student must have a working knowledge of statics with emphasis on force equilibrium and free body diagrams. Primary objectives include an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions. Classroom studies are supplemented by Laboratory Experiments.

301.* ADVANCED SURVEYING. 3-0-3.
Prerequisite: CE 200. The theory of practical astronomy and its applications, with primary emphasis on the civil engineer's interests, are studied. Also, study is made of more precise methods of surveying, not covered in CE 200, in the areas of vertical control, distance measuring, and geodetic calculations. Hydrographic surveying and stream flow measurements are also discussed. An occasional field period will be held in lieu of classes.

305.* AERIAL PHOTOGRAPHIC INTERPRETATION. 3-0-3.
Prerequisite or a corequisite: CE 342. Analysis and study of photographic techniques and procedures, land forms, surficial soils, and rock formations by the use of aerial photos and stereograms with special emphasis on the engineering significance of the results. The applications of other remote sensing devices and of aerial photography to land surveying, transportation engineering, environmental and sanitary engineering, construction engineering, soil mechanics and geological engineering are discussed.

307.* GEOMETRIC DESIGN FOR HIGHWAYS. 3-0-3.
Prerequisite: CE 200. A course in highway design based on a study of traffic distribution, volume and speed with consideration for the predictable future. The elements of at-grade intersections and interchanges are analyzed. Studies are made of the geometrics of highway design and intersection layout with advanced curve work including compound and transition curves.

310.* CONSTRUCTION METHODS. 3-0-3.
Prerequisites: CE 210, 231 (CE 231 may be taken concurrently). A continuation of CE 210 with emphasis on concrete construction, formwork design, steel erection, temporary retaining walls and geometric control. Modern materials and their adaptation to construction are discussed.

311. WORK EXPERIENCE I.
Prerequisite: Admission to the cooperative program in Civil and Environmental Engineering. Work experience of six months that is assigned, supervised and approved by the department and the Director of Cooperative Education.

320. FLUID MECHANICS. 4-0-4.
Prerequisites: Math 221, Mech 230. This course is designed to present the fundamental laws relating to the static and dynamic behavior of fluids. The emphasis is placed on applications dealing with the flow of water and other imcompressible fluids. These include flow in pipe systems and natural channels.

321. WATER AND WASTEWATER ENGINEERING. 3-0-3.
Prerequisites: Junior standing. The objective of this course is to train the student in methods for developing water supplies and the means to treat said supplies for consumption use. In addition, the nature of wastewaters and related treatment are examined. An emphasis on hydrologic techniques such as surface and ground water yield, hydrograph and routing analyses and probabilistic methods related to hydrologic studies are treated.

*A technical elective.

CE 322.* **HYDRAULIC ENGINEERING. 3-0-3.**
Prerequisites: CE 320, 321. The objective here is to provide the tools required to design or to demonstrate proficiency in the areas of water distribution systems and storm and sanitary sewer design. Concomitant with the above, various hydrologic and hydraulic techniques related to the above will be examined.

332. **STRUCTURES I. 3-2-4.**
Prerequisite: CE 231 or equivalent. The students must have a working knowledge of free body diagrams, equilibrium conditions for force systems and moments. Primary objectives include the following: An understanding of the various methods of analyzing determinate and indeterminate beams, frames, and trusses encountered in practice.

341. **SOIL MECHANICS. 3-3-4.**
Prerequisite: CE 231 or equivalent. A study of soil types and properties is made with the objective of developing a basic understanding of soil behavior on the part of the student. Theory and methods of compaction as well as properties of compacted soil are emphasized. Fundamentals pertaining to frost action, seepage, consolidation, stress distribution, and shear strength are introduced. Bearing capacity and settlement analysis are also presented. Studies in the classroom are supplemented by experimental work in the laboratory.

342. **GEOLOGY. 3-0-3.**
Prerequisite: Satisfactory sophomore standing or special permission. The science of geology is studied with emphasis on physical geologic processes. The principle of Uniformity of Process is stressed in the context of rock and soil formation, transformation, deformation, and mass movement. Aspects of historical geology and geomorphology are included.

343.* **GEOLOGY IN ENGINEERING. 3-0-3.**
Prerequisite: CE 342. This course deals with representative case histories of major civil engineering projects in which geological studies were involved and student oral presentations of a major term project. A formal written report is required for the latter.

350. **TRANSPORTATION ENGINEERING. 3-0-3.**
Prerequisite: Junior engineering standing. A study of the principal modes of transportation, with emphasis on the planning, design, and construction of facilities for modern transportation systems.

351.* **MUNICIPAL GOVERNMENT IN CONTEMPORARY SOCIETY; THEORY AND PRACTICE. 3-0-3.**
Prerequisite: Junior engineering standing. This course is designed to provide the municipal engineer or planner with a foundation for planning and operational efficiency based upon the concepts and problems of local government. Attention is focused on such topics as fiscal management, intergovernmental relations, and planning and operation of public works.

410.* **CONSTRUCTION SCHEDULING AND ESTIMATING I. 3-0-3.**
Prerequisite: CE 210. A study is made of Highway and Heavy Construction and organization of projects with special attention to critical path analysis and control. Case studies are used to illustrate current practices.

411.* **CONSTRUCTION SCHEDULING AND ESTIMATING II. 3-0-3.**
Prerequisite: CE 210. The course is a study of building construction. Case studies are used to illustrate current practices and organization of construction companies and field accounting practices are introduced.

412.* **CONSTRUCTION CODES AND SPECIFICATIONS. 3-0-3.**
Prerequisite: CE 210 or equivalent. This course deals with the code and specification aspect of engineered construction. Topics to be covered are: professional ethics, contracts, specifications, bidding procedures, building codes such as B.O.C.A. and New Jersey Uniform Construction

*A technical elective.

Code, construction safety, and the impact of the E.P.A. on construction.

CE 413. WORK EXPERIENCE II.
Prerequisite: Admission to the Co-op Program in Civil and Environmental Engineering. Work experience of six months that is assigned, supervised, and approved by the Department of Civil and Environmental Engineering and the Director of Cooperative Education.

430. STRUCTURES II. 3-0-3.
Prerequisites: CE 332 and CIS 101. The student must have a working knowledge of structural analysis including determinate and indeterminate beams and frames. Primary objectives include the following: To acquaint the student with the properties of concrete and steel and with the behavior of reinforced concrete as a structural material also, to develop methods for the design of reinforced concrete structural members such as beams, slabs, footings, and columns. Both ultimate strength design and working stress method will be studied.

432. STRUCTURAL DESIGN. 3-0-3.
Prerequisites: CE 332 and CIS 101. A working knowledge of structural analysis including determinate and indeterminate beams and frames is essential. The course objective is the development of current design procedures for structural steel elements and their use in multi-story buildings, bridges and industrial buildings.

440.* GEOTECHNICAL ENGINEERING. 3-0-3.
Prerequisite: CE 341. The objective of this course is to expose the student interested in geotechnical engineering as a specialty to the practical aspects of the field. Case histories and field trips are a major part of the course, and the practitioner's methodologies are emphasized including studies of existing data sources and field reconnaissance, site and subsurface exploration, the testing program, analysis and design.

450.* URBAN PLANNING. 3-0-3.
Prerequisite: Junior engineering standing. Introduction to urban planning, its principles, techniques, and use. Topics include development of cities, planning of new towns, redevelopment of central cities, and land-use and transportation planning.

451.* URBAN SYSTEMS. 3-0-3.
Prerequisites: CIS 101 and senior standing. Development of urban problem solving strategies and techniques. Management of urban problems by dealing with them as systems. Concepts, philosophy, and techniques of systems analysis are developed and applied to urban problems.

490.* CIVIL ENGINEERING PROJECTS. 3-0-3.
Prerequisite: Senior standing in Civil Engineering and approval of the department. The student works on one or more individually selected projects, guided by the Civil Engineering Department staff. The projects may include planning, research (library or laboratory), engineering reports, statistical or analytical investigations, and designs. Any of these may follow class inspired direction or the student may branch out on his own. The project or projects of each student must be completed and professionally presented by assigned due dates for appropriate review and recording of accomplishment. Critiques will be held and the student will present his work to other students having similar interests.

494. CIVIL ENGINEERING DESIGN I. 3-0-3.
Prerequisite: Senior standing in Civil Engineering. This design course will simulate the submission and acceptance process normally associated with the initial design phases for a civil engineering project. The course is intended to familiarize the students with the preparation of sketch plats, preliminary engineering design, and a related environmental assessment. Requirements will include written submittals and oral presentations in defense of same.

*A technical elective.

CE 495. CIVIL ENGINEERING DESIGN II. 3-0-3.
Prerequisite: CE 494. The purpose of this course is to provide the students with the type of design experience they would receive if they were currently engaged in Civil and Environmental Engineering design practice. The design areas that the students can select from include the following: Structures, Geotechnical Engineering, Transportation and Planning, Sanitary and Environmental Engineering, and Construction.

ENVIRONMENTAL ENGINEERING

EnE 360.* ENVIRONMENTAL ENGINEERING. 3-0-3.
Prerequisite: Chem 115 and junior standing. The object of this course is to train students in the methods used for water pollution control. Topics include the chemical, physical and biological processes which occur in waste treatment and in receiving waters; modeling schemes to determine allowable loadings; waste treatment processes used for water pollution control.

361.* ENVIRONMENTAL PROBLEMS. 3-0-3.
Prerequisite: Chem 115. The object of this course is to train students in air pollution control, the methods used for solid waste disposal and radioactive waste disposal. Topics include the chemistry of contaminated atmospheres; the influence of meteorological conditions on dispersion of pollutants; abatement, processes used in the control of emissions; classification and nature of solid waste, and solid waste disposal techniques; sources and methods for the disposal of radioactive contaminents; health effects.

560.* ENVIRONMENTAL CHEMISTRY. 3-0-3.
Prerequisite: Chem 116 or equivalent. Basic physical and chemical principles applicable to environmental and sanitary engineering are presented and amplified in the laboratory.
Laboratory Fee: $20.00.

MECHANICS

Mech 230. STATICS AND DYNAMICS. 4-0-4.
Prerequisites: Phys 111, Math 112. The student must have a working knowledge of college level algebra, trigonometry, and elements of calculus in addition to mechanics (physics). Primary objectives include the following: An understanding of equilibrium of particles and rigid bodies subject to concentrated and distributed forces, the mathematics of the motion of particles and rigid bodies, and of the relation of forces and motion of particles.

231. STATICS AND DYNAMICS. 4-0-4.
Prerequisite: An honors course for the student with adequate preparation in freshman physics and math courses. Primary objectives include an understanding of statics and dynamics as given in the regular Mech 230 course, virtual work, La Granges equations, and moments of inertia. Ability to solve gyroscopic and other three-dimensional problems that require an understanding of vector analysis.

232. MECHANICS OF MATERIALS. 3-1-3.
Prerequisites: Mech 230, Math 221, or equivalents. The entering student must have a working knowledge of statics with emphasis on force equilibrium and free body diagrams. Primary objectives include: an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple practical mechanical problems, and of the mechanical behavior of materials under various load conditions. Classroom studies are supplemented by laboratory experiments.

253. MECHANICS OF MATERIALS. 3-0-3.
Prerequisites: Mech 230, Math 221, or equivalents. In addition to covering the material in Mech 232, this honors course considers topics beyond the scope of the material covered in Mech 232. However, orientation and presentation are the same in both courses.

*A technical elective.

Computer and Information Science

Chairman: George J. Moshos
Associate Chairman: Anita J. LaSalle
Professors: Moshos, Turoff; *Associate Professor:* Scher; *Assistant Professors:* Baer, Baltrush, Featheringham, LaSalle, McHugh, Ryon, Sarian.

CIS 101. COMPUTER PROGRAMMING AND PROBLEM SOLVING. 2-1-2.
An introductory course in FORTRAN programming and its use in solving engineering and scientific problems. The emphasis is on the logical analysis of a problem and the formulation of a computer program leading to its solution.

102. HONORS COMPUTER PROGRAMMING & PROBLEM SOLVING. 2-1-2.
This course covers the same material as CIS 101 at an accelerated rate. The time thus gained (at least one half of the semester) is devoted to other programming languages such as PASCAL, SNOBOL, and LISP, as well as in-depth study of some applications, such as information storage and retrieval, sorting techniques and cryptography. Admission to the course is by invitation.

202. COMPUTER PROGRAMMING AND BUSINESS PROBLEMS. 2-2-3.
An introductory course in programming which develops the same level of FORTRAN knowledge as CIS 101. Problems used in this course will reflect business applications. In addition, an introduction to the concepts of COBOL programming is provided. This is a required course for the Industrial Administration, Engineering Technology and Architectural programs. CIS 202 may be used as the CIS 101 prerequisite for other CIS courses.

203. BUSINESS PROGRAMMING. 1-1-1.
Prerequisite: CIS 101. This eight-week mini-course provides, at an introductory level, the elements of commercial data processing utilizing the COBOL programming language. It is intended for students who have completed CIS 101 and have subsequently transferred into a curriculum for which CIS 202 is a required course (BSIA, Architecture or Engineering Technology.)

213. INTRODUCTION TO COMPUTER SCIENCE. 3-0-3.
Prerequisite: CIS 101 or CIS 202. Fundamentals of computer science are introduced for understanding the structures and uses of computing systems. Course covers a study of the representation of data and instructions, a survey of programming languages, operating systems, methods for accessing computing systems, and software design. Programming topics in FORTRAN and assembly language are included. Computer problems using both batch and interactive computing are assigned.

310. WORK EXPERIENCE I. 3 credits
Prerequisites: Junior standing, permission of Director of Cooperative Education. Industrial Work experience of six months providing industrial reinforcement of academic program. Direct exposure to industrial situations. Work assignments provided by and approved by Director, Cooperative Education.

330. MINI-COMPUTER SYSTEMS. 2-2-3.
Prerequisite: CIS 101 or CIS 202. This course deals with the software and hardware characteristics of mini-computers. Included is the programming and application of mini-computer systems. A variety of application areas is surveyed and practical solutions to problems in these applications are offered using functions available on the mini-computer. Areas of application include text handling, data entry, computerized communications, continuous simulation, process control and multi-mini-computer configurations. Individual assignments will be made requiring hands on operation of the mini-computer in the Computer and Information Science laboratory.

331. MACHINE AND ASSEMBLY LANGUAGE PROGRAMMING. 2-2-3.
Prerequisite: CIS 213. Fundamentals of machine organization and machine

language programming. Representation of computer instructions and data in assembly language, together with intensive practice in formulating, programming, running, and debugging programs for both numerical and logical problems.

CIS 332. PRINCIPLES OF OPERATING SYSTEMS. 2-2-3.
Prerequisite: CIS 331. Organization of operating systems covering batch, multiprogramming and virtual memory systems. Systems functions are considered both from the user's and designer's point of view. Included are introductions to data management, system communications, job control, scheduling and memory management. Laboratory work is assigned using the facilities of the Computing Center.

337. PROGRAMMING SYSTEMS LIBRARIES. 3-0-3.
Prerequisite: CIS 213. Programming systems are discussed from the perspective of making available programming libraries. Various libraries will be described. Includes structuring of programming libraries, forms of documentation, methods of evaluation, portability, convertability, and compatibility. Particular emphasis is given to programming and hardware standards.

341. INTRODUCTION TO LOGIC AND AUTOMATA. 3-0-3.
Prerequisites: CIS 101 or CIS 202. This course includes an introduction to logic and formal grammars. Theoretical models such as finite state machines, push-down stack machines and Turing machines are developed and related to issues in programming language theory.

351. COMPUTER ORGANIZATION. 3-0-3.
Prerequisite: CIS 213. A study of the components that make up a computer system. In particular, the hardware components are analyzed for those characteristics which are important in the design of software products. Topics covered include representation of information, basic processor organization, memory systems, file devices, peripheral devices, and data transmission.

365. COMPUTER APPLICATIONS TO COMMERCIAL PROBLEMS. 2-2-3.
Prerequisite: CIS 213. The design and implementation of commercially oriented computer systems. Emphasis is placed on modern computers as a tool for solving business problems. The COBOL programming language will be extensively studied and utilized in developing the programming techniques for the solution of these problems.

407. COMPUTER AUGMENTED DESIGN. 3-0-3.
(This course is not to be taken by CIS majors.) Prerequisites: CIS 101 or CIS 202 and Calculus. The topics covered are those needed by engineers for using the computer in engineering design. Included are: data structures for handling information, time-sharing facilities, interactive languages, problem-oriented languages, special application programs, numerical and non-numerical algorithms, and automated bibliographic searching.

408. COMPUTER CONFIGURATIONS. 3-0-3.
(This course is not to be taken by CIS majors.) Prerequisites: CIS 101 or CIS 202. This course covers computer hardware and architectures as they relate to engineering applications. The emphasis of this course is on modern hardware which engineers integrate into either the control of their processes or the management of their processes. Topics covered are: Signal Processing, differences between main-frame, mini and micro architectures, and the applications of these architectures in special purpose computers, computer graphics equipment and information retrieval systems.

410. WORK EXPERIENCE II. 3 credits.
Prerequisites: CIS 310, permission of Director of Cooperative Education. Industrial work experience for a six month assignment, normally with same industry as CIS 310. Work assignments provided by and approved by Director, Cooperative Education.

CIS 421. NUMERICAL CALCULUS. 3-0-3.
Prerequisite: CIS 101 or CIS 202; Corequisite: Math 222. This course deals with fundamentals of numerical methods, including discussion of errors, interpolation and approximation, linear systems of equations, solution of nonlinear equations and numerical solution of ordinary differential equations. The algorithmic approach and the efficient use of the computer are emphasized.

436. PRINCIPLES OF ALGORITHMS. 3-0-3.
Prerequisite: CIS 331; Corequisite: CIS 332. A study of advanced topics in programming including recursive programming; data structures, storage mapping functions, linked lists, trees, arrays, symbol tables; sorting techniques, parsing algorithms, decision tables, case studies of some exemplary algorithms, and an introduction to some research topics in the current literature.

438. PROGRAMMING FOR INTERACTIVE COMPUTER GRAPHICS. 3-0-3.
Prerequisites: CIS 101 or CIS 202. This course introduces fundamental concepts of interactive Computer Graphics oriented towards Computer-aided design systems. Such systems emerge in engineering, architecture and manufacturing. Topics include computer data structures for representation of 2 and 3-dimensional objects and algorithms for definition, modification and display of these objects in applications. This course will also discuss a selection of special topics in Interactive Graphics. Exercises will be given using the Institute's Interactive Graphics Laboratory.

453. MICROCOMPUTERS AND APPLICATIONS. 3-1-3.
Prerequisite: CIS 331. A study of the basic principles of microprocessors and their support modules; memory, serial and parallel interfaces. The course focuses on software system design for control by microcomputers and other applications, such as speech recognition and generation, music, and graphics. Individual exercises as well as one large project will be assigned for solution in the laboratory portion of the course.

455. COMPUTER CENTER ORGANIZATION. 3-0-3.
Prerequisite: CIS 213. An overview of computing centers and their organization for accomplishing specific objectives. Includes a classification of systems, analysis of cost and size, layout of equipment, methods of accessing computer facilities, equipment selection and facilities evaluation.

461. SYSTEMS SIMULATION. 3-0-3.
Prerequisites: Math 333; CIS 101 or CIS 202. An introduction to simulation and a comparison with other techniques of problem solving. Included are discrete simulation models, elementary queuing theory and stochastic processes, utilization of simulation languages, methodology, including generation of random numbers, design of simulation experiments for optimization, validation of simulation models and selected applications of simulation.

465. COMPUTER TECHNIQUES FOR MANAGEMENT INFORMATION SYSTEMS. 3-0-3.
Prerequisite: CIS 213; CIS 365. Design and programming concepts are presented for automation of management information systems. Includes the organization of files and techniques for processing information based upon organizational requirements and available hardware and software. Some case studies are presented.

490. GUIDED DESIGN IN SOFTWARE ENGINEERING. 3-0-3.
Corequisite: CIS 436. This course focuses on the issues of developing large computer programs (i.e., computer programs that take over one man-year effort to produce). It covers theory and methodology for the design and implementation of professional programs and considers all major aspects of production programming such as functional requirements and analysis, design, coding, testing, and proving, integration and maintenance. Tools and techniques for all areas of a programs life cycle will be covered. Students will participate in several phases of several large projects using a guided design approach.

CIS 491. COMPUTER SCIENCE PROJECT. 3-0-3.
Prerequisites: CIS 332; CIS 436; CIS 490. An opportunity for the student to integrate the knowledge and skills gained in previous computer science work into an individual research project. The project involves investigation of current literature as well as computer implementation of either a part of a large program, or the whole of a small system. The topic should be consonant with the emphasis of direction chosen by the students in their earlier computer science studies. To register for this course, a student must have a written project proposal approved by the department. Students attend a weekly seminar at which progress reports are presented and discussed.

500. INTRODUCTION TO SYSTEMS ANALYSIS. 3-0-3.
Prerequisite: Math 222. Provides the background information and techniques for the study of systems concepts at the graduate level. Covers the solution of a wide variety of system engineering problems chosen from different disciplines and introduces mathematical tools only as needed to find practical solutions to these problems. Includes topics from network analysis, morphological analysis, dynamic analysis of systems, transport processes, control theory, and probability theory. Also an overview of specialized languages for implementing various system approaches will be presented.

515. ADVANCED COMPUTER PROGRAMMING FOR ENGINEERS. 2-2-3.
Prerequisite: CIS 101, Math 222. This course is designed for engineering students who require an extensive knowledge of programming for their project or thesis work. Topics covered include a review of basic programming techniques, extensive treatment of algorithm design, error analysis and debugging using advanced features of FORTRAN IV, and programming facilities available on the operating system; as time permits, problem oriented languages such as CSMP are examined. Students specializing in computer science may not take this course for credit.

540. FUNDAMENTALS OF LOGIC AND AUTOMATA. 3-0-3.
Prerequisite: Math 22. This course is an introduction to mathematical logic, formal languages and computability theory. Some of the topics covered are: finite state machines, Turing machines, predicate calculus, mechanical theorem proving, recursively unsolvable problems, and the application of logical calculus to proving the correctness of programs. Emphasis is placed on intuitive understanding and applicability rather than mathematical rigor.

Electrical Engineering

Chairman: Joseph J. Strano
Associate Chairman: Robert R. Meola
Assistant Chairmen: Warren H. Ball (Graduate), Chung-Wei Chow (Undergraduate)

Professors: Anderson, Ball, Becher, Denno, Dickey, Klapper, Kuo, Meola, Meyer, Misra, Padalino, Russell, Strano, Thomas, Zambuto; *Associate Professors:* Ayoub, Carluccio, Chow, Clements, Cohen, McMillan, Reisman, Rips, Rose, Sohn, Troop, Whitman, Winston; *Assistant Professors:* Cornely, Frank, Rosenstark.

EE 210. ELECTRICAL ENGINEERING I. 3-3-4.
Prerequisites: CIS 101, Phys 121, Math 112. A class and laboratory course dealing with the basic concepts of dc and ac circuit analysis. The class work includes loop and node analysis, network theorems, resonance, mutual inductance and polyphase circuits. The laboratory work emphasizes basic measurement techniques.

EE 212. ELECTRICAL ENGINEERING II. 3-0-3.
Prerequisite: EE 210. This course is an introduction to electronic circuits and devices, particularly pn junction diodes, bipolar transistors and field-effect transistors. The elementary concepts of electronic device physics, transistor circuit biasing, and equivalent circuits are covered. Basic circuits for performing the electronic functions of amplification and rectification are studied.

305. ELECTRICAL ENGINEERING PRINCIPLES. 3-2-4.
Prerequisites: Phys 121, Math 222. Course for Mechanical Engineering Students with content similar to EE 405 with the addition of a laboratory which includes measurement techniques, passive circuits characteristics, electronic circuits, and motor performance. (This course is not for EE students.)

310. WORK EXPERIENCE I.
Cooperative Education Work Experience of six months providing industrial reinforcement of Academic Program. Direct exposure to industrial situations work assignments provided by and approved by Director. Prerequisite: Completion of Sophomore Year. Approval of Department and permission of Cooperative Education Director.

323. PASSIVE NETWORKS. 4-0-4.
Prerequisites: EE 210, Math 222 or 331. A course in the analysis of passive lumped-parameter electrical networks with emphasis on the linear systems approach. Topics covered include network theorems; signal representation; convolution, Fourier and Laplace transform methods, two-port network parameters, covering their interrelations and interconnection in parallel, series, and cascade.

324. COMPUTER-AIDED CIRCUIT ANALYSIS AND DESIGN. 3*-0-1½.
Prerequisite: EE 323. The digital computer will be employed as a tool in the analysis and design of simple linear passive and active circuits using frequency-response, s-plane, and time-domain methods. Included will be computer projects involving models of an audio amplifier, a control system, a transducer measurement circuit and analog filters.
Fortran IV will be the computer language used.
(*8-week mini-course.)

326. ELECTROMAGNETIC FIELDS I. 4-0-4
Prerequisite: Math 221 or 329 and Phys 121. This is an introductory engineering course in electromagnetic theory. Topics covered include vector analysis, static fields, time-dependent fields, Maxwell's equations, and plane waves.

327. ELECTROMAGNETIC FIELDS II. 3-0-3.
Prerequisite: EE 326. This course covers the circuit aspects of distributed parameter transmission lines and applications of Maxwell's equations to guided waves. Topics include transient and steady-state conditions in lossless and lossy transmission lines, reflection and refraction of plane waves in isotropic media, transmission modes in waveguides.

328. ELECTROMAGNETIC FIELDS II FOR HONORS STUDENTS. 3-0-3.
Prerequisites: EE 326 and Department admission to its Honors Program. Honors students covers the material of EE 327 at an accelerated rate and then proceed to consider advanced topics in microwaves.

331. ELECTROMAGNETICS AND ENERGY CONVERSION. 3-0-3.
Prerequisite: EE 210. Magnetic materials and their applications are discussed in this course. Included are the graphical and analytical solution and design of singly- and multiply-excited magnetic circuits, as well as the steady-state performance of electromechanical energy converters. The course is reinforced by the laboratory work of EE 332.

332. MAGNETICS AND ELECTROMECHANICAL ENERGY CONVERSION LABORATORY. 1-2-2.
Prerequisite: EE 331. Basic properties of magnetic materials are studied

through the permeameter, Epstein core loss and Rowland ring tests. The effects of superimposed ac and dc magnetization in an iron core are studied and applied in a saturable reactor motor speed control system. Transformers and rotating machines are studied under transient and steadystate conditions using special equipment with built-in information windings and passive computing circuits. Extensive use is made of the X-Y plotter, strip-chart recorder and cathode ray oscilloscope.

EE 342. ACTIVE CIRCUITS I. 3-3-4.
Prerequisite: EE 212. This class and laboratory course is an extension of previous work in engineering electronics. Basic equivalent circuits for electronic devices are reviewed. Singlestage and multistage small-signal amplifiers as well as tuned amplifiers are studied. Frequency response of amplifiers is included in considerable detail. Other subjects include single-ended power amplifiers, push-pull amplifiers, thyristors, and transistor switching.

343. SEMICONDUCTOR DEVICES.* 3-0-1½.
Prerequisite: EE 212. Concepts of solid state and physical devices are explained from the point of view of a design engineer for utilization and design of electronic solid state devices, particularly solid state devices. (*8-week mini-course.)

344. ACTIVE CIRCUITS II. 3-0-3.
Prerequisites: EE 323, 342. Extending the circuit design begun in EE 342, this course includes operational amplifiers, feedback, Nyquist criteria for stability, oscillators, and AM and FM systems of transmission.

365. DIGITAL LOGIC AND CIRCUIT DESIGN. 3-0-3.
Prerequisite: EE 210. This course develops the mathematical minimization techniques for designing digital sub-systems utilizing standard logic symbolism considering both cost and time units. Arithmetic units, coders, translators, comparitors, control units, indicator units and other sample circuits are designed. Flip-flops and registers are introduced as memory devices.

405. ELECTRICAL ENGINEERING PRINCIPLES. 3-0-3.
Prerequisites: Phy 121, Math 122. This course is designed primarily for civil engineers and industrial engineers. It covers working familiarity with basic circuits, both d.c. and a.c., understanding of tubes and transistors as amplifiers, feedback and application to automatic controls, transducers, simple problems in transmission, single and 3 phase systems, motors and generators, and transformers. Also, some coverage is given to wiring, switching and protection. (This course is not for EE students.)

410. ACTIVE CIRCUITS II LABORATORY. 1-2-2.
Prerequisite or Corequisite: EE 344. This course includes laboratory work in the areas covered in EE 344. The student designs, builds and tests circuits to meet given specifications utilizing his own components.

411. WORK EXPERIENCE II.
Cooperative Education Work Experience of six months, normally with same employer as EE 310. Prerequisite: EE 310 and permission of Director of Cooperative Education.

415. ELECTRICAL ENGINEERING PROJECT. 3-0-3.
Prerequisites: 344, 410. A synthesis and focusing of the student's previous experience, in and out of college, upon one or more electrical engineering projects selected by the student. Library research, design, cost analysis, construction, and testing are involved. Class members become aware of other projects by means of seminar discussions. A preliminary report is to be submitted by midterm in the immediately preceding semester to the student's EE Systems instructor.

EE 416. ELECTRICAL ENGINEERING PROJECT FOR HONORS STUDENTS. 3-0-3
Prerequisites: Senior standing and Department approval. This course, similar to EE 415, allows honors students to select projects of a research nature and work in close liaison with a research staff member of the department. Informal seminar meetings are to be held by the respective research staff members during the semester preceding registration for this course, and the students are expected to have their research well under way before being permitted to register for the course. Requirements are the same as for EE 415.

420. COMMUNICATIONS SYSTEMS I. 3-0-3.
Prerequisite: EE 344. An introduction to communications systems and modulation theory, including the calculation of spectra, correlation, effects of filtering, linear and angle modulation systems, and in introduction to stochastic processes.

421. COMMUNICATIONS SYSTEMS II. 3-0-3.
Prerequisite: EE 420. The study of communications theory is extended to the fundamentals of sampled-data communications, information theory and noise. Modulation systems are compared from the communication point of view. General communication theory is used to analyze the performance of hardware designs.

422. COMMUNICATIONS SYSTEMS II LABORATORY. 0-4-2.
Prerequisite: EE 420. Laboratory work in the design and synthesis of communications systems, closely coordinated with the communications systems course.

425. CONTROL SYSTEMS I. 3-0-3.
Prerequisite: EE 323. This course is an introduction to the field of automatic control engineering, a subject which deals with the analysis and design of automated and self-regulated systems. Topics covered include multiple input-multiple output systems, systems state-space representation, signal flow graphs, and various techniques of stability study. Analysis and design of linear control systems is covered. While main emphasis is placed on industrial systems, examples are presented to show the general applicability of the theory to various disciplines. Laboratory demonstrations are included.

426. CONTROL SYSTEMS II. 3-0-3.
Prerequisite: EE 425. The study of automatic control theory is continued with a number of important aspects of control systems and practical problems. A limited number of topics from different areas of control theory are selected and treated in reasonable depth, thereby relying largely on the application of fundamental principles to consideration of practical control problems. Among the areas discussed are discrete systems, nonlinear systems analysis, and design with emphasis on state plane and describing-function methods.

427. CONTROL SYSTEMS II LABORATORY. 0-4-2.
Prerequisites: EE 425; Corequisite: EE 426. Laboratory work in the design and synthesis of control systems, closely coordinated with the control systems courses.

430. COMPUTER SYSTEMS I. 3-0-3.
Prerequisites: Math 222, EE 365 or CIS 351. This is a foundation course for engineering and computer science students to develop an understanding of analog, digital and hybrid systems. Topics covered include linear and nonlinear analog computer elements, analog programming, scaling, and problem preparation procedures. The digital portion builds on the student's background of combinational logic to cover the design and application of sequential systems.

431. COMPUTER SYSTEMS II. 3-0-3.
Prerequisite: EE 430. This course is a continuation and extension of EE 430. Sequential digital systems are studied including counters, shift registers, and sequence generators. Additional topics are analog-digital and digital-analog conversion, memories, controllers, digital computer organization, and microprocessors.

EE 432. COMPUTER SYSTEMS II LABORATORY. 0-4-2.
Prerequisite: EE 430; Corequisite: EE 431. Laboratory work in the design of digital and analog circuits and systems, closely coordinated with the material of EE 430 and 431.

435. POWER SYSTEMS I. 3-0-3.
Prerequisites: CIS 101, EE 331. The main objectives of this course are to represent the electrical system with mathematical models, and to show how to use the models for both steady-state and dynamic systems analysis. A clear demonstration is given of the interplay among the frequency, voltage, and real and reactive power flow variables which characterize the steady-state operation of the system.

436. POWER SYSTEMS II. 3-0-3.
Prerequisite: EE 435. This course deals with the analysis and discussion of the electrical energy system control problem. Fault analysis and problems involved with system unbalanced operation will be analyzed in detail.

437. POWER SYSTEMS LABORATORY. 0-4-2.
Prerequisite: EE 435. Laboratory study of rotating electric machinery and transformer from the point of view of the power systems engineer. Some of the topics studied experimentally are magnetizing current inrush transients in transformers, torque angle characteristics of synchronous machines, parallel operation of alternators, a-c and d-c motor speed control systems, exciter response and ferroresonance phenomena in electric power systems.

440. MEDICAL INSTRUMENTATION SYSTEMS I. 3-0-3.
Prerequisites: EE 342 and 323. This is an introductory course which undertakes the study of some of the interfaces between the medical sciences and engineering. The emphasis is on clinical instrumentation applied to the measurement of physiological signals. The theoretical and practical aspects of transducers, amplifiers and signal processing devices for use with biological systems are covered.

441. MEDICAL INSTRUMENTATION SYSTEMS II. 3-0-3.
Prerequisite: EE 440. This is an extension of EE 440 which investigates tissue visualization techniques, clinical instrumentation systems, and engineering applications in the medical sciences. The problem of detecting, extracting and processing physiological data is studied from the general point of view, and the technical problems of medical care units are discussed.

442. MEDICAL INSTRUMENTATION SYSTEMS II LABORATORY. 0-4-2-.
Prerequisite: EE 440. The laboratory work covers transducers, amplifiers, active filters, recording systems and the response of a physiological system to exercise and other stimuli. Simulation experiments of the pupillary light reflex, muscle twitch and other physiological response are performed to indicate how engineering contributes to biological research.

450. ELECTROMECHANICAL ENERGY CONVERSION. 3-0-3.
Prerequisite: EE 331 and 332. Equivalent circuits of induction and synchronous machines are derived and applied to steady-state and transient problems. The theoretical work of the course is supplemented by demonstrations using machines having specially designed information windings.

451. DIRECT POWER GENERATION. 3-0-3.
Prerequisite: EE 210 or 405 or 305, and a course in thermodynamics. Principles of direct modes of electrical power generation and their environmental impacts. These methods include electrochemical, nuclear, thermionic and magnetohydrodynamic systems. Emphasis is on performance, system behavior and characteristics of such methods of generation.

452. COMPUTER APPLICATION TO POWER NETWORKS. 3-0-3.
Prerequisites: CIS 101, EE 323. This is a basic course to develop the techniques of computer applications in solving problems encountered most frequently in power system analysis. It is assumed that the student has a general understanding of elementary power system analysis.

EE 455. ANTENNAS AND RADIO ASTRONOMY. 3-0-3.
Prerequisite: EE 327. Antennas help convey information in the form of radio waves over long distances. To understand how this is accomplished we just relate the signal to its source. We do this by studying elementary radiators-oscillating point dipoles, monopoles, dipoles. To design practical antennas it is necessary to understand important properties of antennas such as their directional characteristics and their impedance. Although linear antennas are fine for broadcast applications, several antennas excited simultaneous (antenna arrays) are needed for point-to-point communications. With this background, we next explore space via radio information (radio astronomy). Initially the structure of the universe — the solar system, galaxies, etc. will be discussed. Next radio sources such as the sun, radio stars, pulsars, etc. will be examined as well as related physical phenomens. Finally, detection devices such as interferometers will be analyzed.

457. MICROWAVES AND INTEGRATED OPTICS. 3-0-3.
Prerequisite: EE 327. After a brief review of basic field theory and transmission line analysis, the study of rectangular, circular and surface waveguides will be undertaken. A circuit theory for waveguiding systems will be developed and utilized in the study of resonators, filters, and passive microwave devices such as alternators, phase changers and directional couplers. Techniques used in the study of microwave systems will then be applied to the new technology of integrated optics. The field of intergrated optics is devoted to the development of microscopic optical circuits. We will discuss waveguides of integrated optics and optical fibers, the transmission media of optical communication systems.

462. SEMI-CONDUCTOR CIRCUITS. 3-0-3.
Prerequisite: EE 344. Topics include characteristics of FET and bipolar transistors, low and high frequency analysis of FET and bipolar transistors, feedback in semi-conductor circuits, linear integrated circuit (IC) building block, the IC operational amplifier, linear IC's for communications, transistor logic gates, and digital IC building blocks.

463. MICROELECTRONIC DEVICES AND CIRCUITS. 3-0-3.
Prerequisites: EE 344, 326. Among the devices whose operation and characteristics are studied are the Schottky-Barrier diode, photodiode, IMPATT diode, and MOS transistor. The fabrication technologies used in the production of microelectronic circuits are briefly discussed. The dynamic switching behavior, design, and other characteristics of MOS, CMOS and bipolar digital integrated circuits are studied in detail. Other topics to be discussed will be selected from the subjects of optoelectronics, memory cell design, thyristors, and electronic reliability.

465. DIGITAL COMPUTER CIRCUITS. 3-0-3.
Prerequisite: EE 365. The techniques for the design of sequential digital logic synchronous and non-synchronous systems are developed. Counters, timers, controllers, serial arithmetic and coding units, and other sample systems are designed.

466. ANALOG AND DIGITAL CIRCUITS. 3-0-3.
Prerequisite: EE 365, EE 344. Analog and digital sub-systems and components are studied. This course is a valuable adjunct for, but by no means limited to, those students taking the Computer Systems Sequence. In the analog portion, basic operational amplifier circuits are first studied, followed by a consideration on the limitations of practical amplifiers, methods of electronic function generation, and analog control circuitry. Several analog instrumentation systems are then discussed. The digital portion of the course builds on the student's knowledge of the design of combinational logic systems and considers the details of implementation using both discrete and integrated circuitry. Sequential systems design and circuit design considerations are also covered.

467. ANALOG COMPUTATION IN ANALYSIS AND DESIGN. 3-0-3.
Prerequisite: Math 222. This course introduces the analog computer as a tool in engineering analysis and design. Emphasis is placed on programming procedures for the study of linear and non-linear systems. Engineer-

ing applications are stressed. Use of the computer in the laboratory will be required to complete several analysis and design problems. (No credit allowed for students taking EE 430.)

EE 468. COMPUTER INTERFACE DESIGN. 3-0-3.
Prerequisites: CIS 101, EE 212, or equivalents. This course introduces the principles involved when implementing a microcomputer or minicomputer into a system for measurement and control. Topics covered: computer organization and instructions, modes of input-output addressing, interrupt systems, data acquisition, peripheral devices, and interface components.

470. NETWORK SYNTHESIS. 3-0-3.
Prerequisite: EE 323. An introduction to passive and active network synthesis. Topics from passive synthesis include testing for physical realizability, and the synthesis of LC and RC one-port and two-port networks. Topics from active synthesis include the effect of controlled sources on the poles and zeros of transfer functions, and use of the operational amplifier in designing active RC filters, oscillators and phase equalizers.

471. PULSE TECHNIQUES. 3-0-3.
Prerequisite: EE 344. This course deals with analysis of circuitry for the generation and shaping of waveforms. Fundamental applications are covered, including linear and diode waveshaping, compensated amplifiers, clipping and clamping circuits, switching circuits, multivibrators, and other selected topics.

472. DIGITAL DATA COMMUNICATIONS. 3-0-3.
Prerequisite: EE 344. The course is an introduction to the design of communication systems for the transmission of digital data. Topics include representation and spectral properties of digital signals, modulation and multiplexing, effects of restricted bandwidth, ideal systems, error rates, synchronization and reference extraction, and typical systems design. Not open to students enrolled in EE 420 - EE 421.

475. FEEDBACK AMPLIFIERS. 3-0-3.
Prerequisite: EE 344. This course covers the analysis and design of single loop BJT, FET and integrated feedback amplifiers. Exact methods for evaluating return ratio, amplifier gain and impedance are given. Parameter sensitivity, frequency response, impulse response and the Nyquist stability criterion are examined. Detailed computer assisted design of compensating networks is undertaken for achieving Bode's ideal loop gain characteristic.

476. CONTROL ENGINEERING. 3-0-3.
Prerequisites: EE 323 or Math 222. This is an introductory course in the analysis and design of feedback control systems. The material covered includes such items as: system characterization, block diagram manipulation, stability, sensitivity, error response, state variable methods, root locus, performance indices, compensation methods, and the consideration or a variety of applications of control engineering to various engineering disciplines.

477. TRANSDUCERS. 3-0-3.
Prerequisites: EE 323, 331. A discussion of some of the basic energy conversion processes and application of the principles studied to various types of electromagnetic transducers which are important in the electronic and control system fields. Typical applications of theory will be made to Halleffect devices, digital-to-analog converters, loudspeakers, hysteresis and eddy-current torque devices, a-c and d-c servomotors, and rate generators. Many of the devices studied are applied to control systems. Classroom demonstrations of the principles studied form an important part of the course.

480. SIMULATION OF PHYSIOLOGICAL SYSTEMS. 3-0-3.
Prerequisite: Math 222. A course introducing the student to applications of engineering techniques to solutions of biological problems. Basic concepts of physiology are presented, followed by a discussion of various

modeling techniques applied to specific biological systems. Examples of feedback control systems in biology are presented.

EE 530. ELECTROMAGNETIC FIELD ANALYSIS. 3-0-3.
Prerequisite: "Undergraduate vector analysis or equivalent." The course covers electrostatic fields, magnetostatic fields, Maxwell's equations, the Poynting vector, relationship between circuit theory and Maxwell's equations, some low-frequency and high-frequency applications of the equations; retarded potential type of solutions; wave equations; and plane waves.

540. ELECTRONIC CIRCUITS. 3-0-3.
Prerequisite: EE 342. The material treated in this course includes the analysis and design of various types of amplifiers, oscillators, and power supplies. Topics also considered are: feedback circuits, comparators, and some simple digital circuits.

550. CIRCUIT ANALYSIS. 3-0-3.
Prerequisite: EE 323. The course is an introduction to the analysis of linear circuits and systems. Techniques used include mesh and nodal analysis, network theorems, steadystate and transient methods, analogs, Fourier series and transforms, and Laplace transforms. Pole-zero diagrams are developed as an aid in the study of low-order systems.

563. INTRODUCTION TO CONTROL SYSTEMS. 3-0-3.
Prerequisite: "Bachelor's degree in engineering." Linear feedback control systems are treated in both state variable and transfer function representation. Nyquist criterion, root-locus and parameter-plane methods are introduced and applied to both analysis and design of linear time-invariant systems. Principles of controllability and observability are studied. A survey of various topics is given, such as a.c. carrier control systems and some selected nonlinear and optimization problems.

575. INTRODUCTION TO DIGITAL CIRCUITS. 3-0-3.
Prerequisite: "Undergraduate course in electronic circuits." This course develops the mathematics and minimization techniques together with the circuit implementation for the design of combinational and sequential digital solid state logic circuits. Elementary computer and control circuits are used as examples.

580. THE ANALOG COMPUTER AS USED IN ELECTRICAL ENGINEERING. 3-0-3.
Prerequisite: Undergraduate course in electronic circuits. The course considers the basic analog computer and the types of applicable problems. The topics of amplitude and time scaling, ordinary linear and nonlinear differential equations, simulation of transfer functions in the time domain, problem "set up" and solution checks are studied.

Engineering Technology

Courses listed in this section are not available for engineering students without special permission of their advisors.

CONSTRUCTION AND CONTRACTING ENGINEERING TECHNOLOGY

CET 301. CONSTRUCTION SURVEYING. 2-3-3.
Corequisite: Math 107. All aspects of horizontal and vertical control measurements and settings and layouts applied to various construction problems.

313. CONSTRUCTION PROCEDURES I. 3-3-4.
An introduction to heavy construction practices. Emphasis is on construction equipment, site preparation, piles, drilling and blasting, concrete construction and construction safety. Case studies in heavy construction are used.

CET 314. CONSTRUCTION PROCEDURES II. 3-3-4.
Prerequisite: CET 313. An introduction to building construction practices and building materials. Emphasis is on structural systems, construction materials and detailed finishing operations required to make a serviceable structure.

331. STRUCTURAL SYSTEMS. 3-3-4.
Prerequisite: Strength of materials. Study of types and behavior of modern structures using both analytical and intuitive techniques. Examples will include beam and column, one and two way slab systems, stressed skin structures and lateral bracing systems.

411. COST ESTIMATING AND SCHEDULING. 3-0-3.
Corequisite: CET 313. Take off of quantities of materials from typical building and highway projects. Pricing for labor, materials, and equipment will come from standard reference guides. A CPM schedule will be developed as part of the estimate.

415. BUILDING CONSTRUCTION. 3-0-3.
Prerequisite: CET 314. Planning and control of all operations employed in construction of buildings. Typical buildings will be studied in detail. Preparation of building procedures and cost estimates will be made.

416. HEAVY CONSTRUCTION. 3-0-3.
Prerequisite: Surveying and CET 313. Practices unique to heavy construction are studied in detail. Typical structures considered include bridges, tunnels, highways, dams, and utilities.

422. HYDRAULIC AND HYDROLOGIC PROBLEMS IN CONSTRUCTION. 3-0-3.
Prerequisite: Applied Mathematics. A study of fluid flow as it applies to construction problems. Pumping, rainfall runoff, stream flow, pipe flow, hydrostatic pressure systems, scour, and seepage are among the subjects covered.

431. CONSTRUCTION TESTING. 2-2-3.
A course designed for the Construction and Contracting Technology student which will expose him to a variety of construction related field tests and field testing equipment. Included will be concrete mix design, concrete forming and testing, soil density and compaction, permeability tests, asphalt tests, load testing of wood and steel shores, and the use of Bentonite in construction.

435. DESIGN OF TEMPORARY STRUCTURES FOR CONSTRUCTION. 3-3-4.
Prerequisite: CET 331. Analysis of loadings on, and design of temporary structures required in construction. Formwork, shoring and scaffolding systems, temporary retaining walls, and temporary bridges are among the subjects covered.

441. SOILS AND EARTHWORK. 3-0-3.
Prerequisite: Strength of materials. A study of the significant soil types and tests. Problems are investigated relating to soil mechanics, soil supported foundations for engineering structures. Appropriate field trips are made.

490. SENIOR PROJECT. 3-0-3.
Prerequisite: Senior standing in Construction and Contracting Technology. The student works on one or more individually selected projects guided by the Department staff. The project must be construction related and may include planning, research (library or lab), engineering report and statistical, analytical or field investigation. Any of these may follow class inspired direction, or the student may branch out on his own. The project or projects of each student must be completed and professionally presented by assigned due date for appropriate review and recording of accomplishments. Critiques will be held and the student will present his work to other students having similar interests.

ELECTRICAL ENGINEERING TECHNOLOGY

EET 301. CIRCUIT ANALYSIS I. 3-0-3.
Prerequisite: DC & AC circuit analysis; (AAS level); Corequisite: Math 108. Steady-state analysis of circuits; topics to be reviewed include mesh analysis, nodal analysis, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer, and controlled sources. The description of circuits by means of differential equations is studied.

302. CIRCUIT ANALYSIS II. 3-0-3.
Prerequisite: EET 301. This course is a continuation of EET 301. The transient analysis of circuits is studied using differential equation methods. Use is also made of LaPlace transforms for the steady-state and transient analysis of circuits.

303. CIRCUIT MEASUREMENTS I. 1-3-2.
Prerequisite: Electronics laboratory experience (AAS level); Corequisite: Math 108. Lecture and laboratory sessions are designed to develop techniques for the measurement of various circuit parameters as well as the theoretical prediction of these parameters. Computer circuit analysis using ECAP is introduced.

304. CIRCUIT MEASUREMENTS II. 1-3-2.
Prerequisite: EET 303, Math 108. This lecture and laboratory course is a continuation of EET 303. The course is designed to further develop techniques for the measurement of parameters in linear and non-linear circuits. Use is made of spectrum analyzers and analog computers and other instrumentation. Transfer functions and their use in 2-port networks will be included. Computer analysis of networks will be used.

309. ELECTRIC CIRCUITS AND MACHINES. 3-0-3.
Prerequisite: Basic physics; Corequisite: Math 107. This course is for non-electrical technology students who have no circuit and machinery background. The course includes a study of electric and magnetic circuits, motors and motor applications, transformers and power distribution in single phase and balanced polyphase systems. Demonstrations of subject matter are used to emphasize the basic principles for applying electricity to industrial situations.

405. DISCRETE AND INTEGRATED CIRCUITS. 3-3-4.
Prerequisite: EET 304. Various active circuits are analyzed in both their discrete and integrated forms. Advantages of the different forms are studied and compared. Laboratory measurements of selected circuits are performed to verify their design characteristics.

406. CONTROL SYSTEMS AND TRANSDUCERS. 3-3-4.
Prerequisite: EET 302. This course is a class and laboratory study of automatic control. Principles of analysis and design of control systems are introduced. Transducer characteristics and their applications in instrumentation and control are investigated.

408. ELECTRICAL SYSTEMS PROJECT. 1-3-3.
Prerequisite: EET 405; Corequisite: EET 406. In this laboratory course, each student will construct and analyze a project of his own choice. The project may be of the small equipment design or measurement system type.

410. MICROPROCESSORS. 2-2-3.
Prerequisite: Some programming experience. This elective course covers the operations, breadboarding, and interfacing of devices peripheral to microcomputers. Also, emphasis is placed on the applications of these microcomputers in industrial measurement and control.

411. ENERGY CONVERSION DEVICES. 3-0-3.
Prerequisite: EET 301. A study of various energy conversion devices, including d-c and a-c equipment which converts mechanical energy to electrical energy and vice versa. Demonstrations will be used to emphasize important aspects of the theory.

412. POWER GENERATION AND DISTRIBUTION. 3-0-3.
Prerequisite: EET 411. Electrical power generation systems, including

hydroelectric, steam and atomic plants. Substation and transmission line topics will also be included as part of the distribution system.

EET 413. PULSE AND DIGITAL CIRCUITS. 3-0-3.
Corequisite: EET 405. Analysis and design of circuits and digital systems for the generation and shaping of waves. Applications include multivibrators, switching and counting circuits, and voltage and current sweeps.

414. COMMUNICATION SYSTEMS. 3-0-3.
Corequisite: EET 405. A study of amplitude modulation, frequency modulation, and pulse modulation systems of transmission and reception. Applications of these systems in radio, television and telemetry will be included.

ENVIRONMENTAL ENGINEERING TECHNOLOGY

ENT 311. CHEMISTRY OF CONTAMINATED ATMOSPHERES AND EMISSIONS. 3-3-4.
Prerequisite: A course in college chemistry with laboratory. This course deals with the chemical and physical processes which lead to the generation of pollutants from sources and the formation of harmful pollutants such as photochemical smog in the atmosphere. Knowledge of these processes is essential for understanding the operation of abatement equipment used for the control of these emissions. Methods for monitoring pollutants in the atmosphere will be demonstrated in the laboratory.

312. CHEMISTRY AND BIOLOGY OF WATER AND WASTEWATER TREATMENT. 3-3-4.
Prerequisite: A course in college chemistry with laboratory. This course deals with the physical, chemical, and biological processes utilized in water and wastewater treatment. Factors which influence these processes are considered. Methods and instrumentation utilized in monitoring these processes are demonstrated in the laboratory.

313. PUBLIC HEALTH TECHNOLOGY. 3-0-3.
Prerequisites: ENT 311, 312. This course involves the examination of the following topics relating to public health and the environment: milk and food examination, industrial hygiene, vector control, solid waste control, and air and water pollution control.

414. INDUSTRIAL TOXICOLOGY. 3-0-3.
Prerequisite: A course in college chemistry. This course is an introduction to the study of the occupational poisons, their threshold limits and effects on body systems. Particular emphasis is placed on the effects produced by introducing toxic materials in the air and water.

415. WATER AND WASTEWATER ANALYSIS. 3-3-4.
Prerequisites: ENT 312 and one year of college chemistry. This course deals with actual laboratory and field measurements of parameters such as biochemical oxygen demand, total organic carbon, and dissolved oxygen, that are used to characterize the chemical, physical and biological processes in water and wastewater treatment. The theory and application of wet chemical techniques and instruments used for these measurements are discussed.

416. UNIT OPERATIONS OF WATER AND WASTEWATER TREATMENT. 3-0-3.
Prerequisite: ENT 312. This course deals with the principles which govern the equipment used in water and wastewater treatment. The types of equipment available and their selection for different applications and operations are covered.

417. INDUSTRIAL SAFETY AND HEALTH. 3-0-3.
Prerequisite: A course in college chemistry. This is a study of occupational safety and health hazards. Emphasis on toxic materials hazards, threshold limit values to health, comfort and work area safety. A review of legislation and its impact in these areas as well as implementation of safety programs to meet legal and safe level working requirements.

ENT 418. AIR POLLUTION CONTROL. 3-0-3.
Prerequisites: ENT 311 and one year of college chemistry. This course is concerned with understanding the principles which cover the operation of control equipment used in abatement of gaseous and particulate emissions. Such particulate removal equipment as the settling chamber, cyclones, spray towers, scrubbers, electrostatic precipitators and fabric filters are discussed. Also, methods primarily used for gaseous emission control from stationary sources as well as automotive emissions will be considered.

419. ENVIRONMENTAL QUALITY AND THE LAW. 3-0-3.
The effects of federal, state, local, and international law on environmental quality of life are studied. Student discussions are encouraged.

MANUFACTURING ENGINEERING TECHNOLOGY

IET 311. PRODUCT AND PROCESS DESIGN I. 3-0-3.
A development of the principles of producibility, methodology and economics, in view of product requirements with respect to materials, tolerances and desired finish.

312. PRODUCT AND PROCESS DESIGN II. 3-0-3.
Prerequisite: IET 311. Matching the production process to the product requirements, applying the principles developed in IET 311 to the design of production sequences and routing.

313. QUANTITATIVE MANAGEMENT METHODS. 3-0-3.
An introduction of mathematical and statistical techniques for use in managerial decision making. Topics will include model building, simulation, and the application of various quantitative techniques to such areas as production, inventory control, quality control, budgeting, manpower planning, capital investment, and distribution.

315. INDUSTRIAL STATISTICS. 3-0-3.
Introduction to data collection and analysis and the concepts of probability. Data collection will include the basics of sampling while data analysis will include calculation and interpretation of measures of central tendency and variation, and statistical testing of hypotheses.

405. NUMERICAL CONTROL FOR MACHINE TOOLS. 3-0-3.
Designed as a first course in numerical control. The course prepares the student in the understanding of the fundamental concepts of numerical control systems and components as well as learning "how to" program. No formal laboratory is indicated. Hands-on experience is gained through assigned projects requiring program preparation, program input via manual, tape and teletype means. Program varification via actual use of CNC equipment.

414. INDUSTRIAL COST ANALYSIS. 3-0-3.
An introduction to general and cost accounting, estimating, and budgeting. Break-even analysis and project selection on the basis of minimum cost is treated. Cost control techniques are discussed. Problems involving the time value of money are treated.

416. PRODUCTION SCHEDULING. 3-0-3.
A study of manual and computerized methods for setting schedules. Gantt charts, CPM, PERT, PERT/COST, Line of Balance, are some of the topics treated. Problems of line balancing and machine loading are discussed.

417. PRODUCTION MANAGEMENT I. 3-3-4.
Prerequisites: IET 312, 313. Operational principles and techniques of plant management. Included topics are plant organization, location, layout, materials handling, production planning and control, inspection, methods and standards, wage payment plans.

418. PRODUCTION MANAGEMENT II. 3-3-4.
Prerequisites: IET 414, 417. The design, operation and control of industrial systems. Emphasis will be given to projects encompassing various aspects of plant operations and management.

IET 419. WORK MEASUREMENT TECHNIQUES. 3-0-3.
(Not to be taken by Manufacturing students.) Work measurement and methods appraisal techniques for industrial and clerical operations. Charting, micro-motion study, stop watch analysis, element analysis, rating and leveling, practice studies of hand and machine operations, work sampling, predetermined times.

420. QUALITY CONTROL. 3-0-3.
Prerequisite: IET 315. The management of industrial quality control, development and treatment of the operational and statistical principles of acceptance sampling and process control, and problems in control chart operations.

421. CONTRACTS AND SPECIFICATIONS. 3-0-3.
Legal aspects of construction contracts and specifications. Scope, format, and use of various types of specifications such as descriptive, outline, and performance.

MECHANICAL ENGINEERING TECHNOLOGY

MET 301. MACHINE DESIGN I. 3-0-3.
Prerequisite: Elementary strength of materials; Corequisite: Math 108. The application of principles of mechanisms and strength of materials to mechanical engineering design. Topics include theories of failure, fatigue, weldments, fasteners, spring and other machine elements subject to static and dynamic loading.

302. MACHINE DESIGN II. 3-0-3.
Prerequisites: Math 108, MET 301. A continuation of MET 301, including the design of power screws, brakes, clutches, belt and chain drives, gears, gear trains, bearings, thick-wall cylinders, and other machine elements.

303. APPLIED THERMODYNAMICS. 3-0-3.
Corequisite: Math 108. The topics discussed in this course are the basic principles of thermodynamics and their applications to internal combustion engines, turbines, compressors, power generating and refrigeration systems.

304. FLUID MACHINERY AND EQUIPMENT. 3-0-3.
The operations, performance and selection of equipment and machinery for fluid power applications will be studied. Topics will include properties of fluids used in engineering applications, fluid control and protection devices, storage and supply equipment, pipe flow systems and ducting design, applied measuring devices, basic fluid machinery design and selection including basic classification, operation, performance characteristics and selection of pumps and compressors, fans, and turbines.

306. INDUSTRIAL MEASUREMENTS. 3-0-3.
Measurements, including the concepts of error, analysis and tolerances are covered. In addition to general electrical, optical, and mechanical industrial applications consideration is given to the requirements of typical test, inspection, and tool room facilities. Students develop an understanding of theory and practice.

307. PLASTICS TECHNOLOGY. 3-0-3.
Prerequisite: None. An introduction to the basic concepts of plastics conversion, resin classification, processing techniques, and significant engineering properties. Laboratory demonstrations will be incorporated into the lecture sequence.

308. PLASTICS PROCESSING TECHNIQUES. 3-0-3.
A study of the various plastics processing techniques for both thermoset and thermoplastic materials. Included are extrusion, injection molding, blow molding, compression molding and rim processes.

314. DYNAMICS OF MACHINERY. 3-0-3.
Corequisite: Math 108. A course designed to acquaint students with motion and forces in machines. Topics include velocities and accelerations, and

associated forces in linkages, gears, cams and other machine systems; rectilinear and torsional vibration of machine elements; static and dynamic machine balancing; introduction to feedback control system.

MET 407. STRUCTURAL DESIGN. 3-0-3.
Prerequisite: Elementary strength of materials. A course designed to acquaint students with the fundamentals of structural design. Graphical as well as analytical solutions are discussed. Topics include: cranes, derricks and dredges; pulley alignments; mast and backstay stresses; tipping forces; journal reactions — the friction circle applied to machines; reactions at rolling surfaces; efficiency; truss analysis; machine and component deflections; composite beams; reinforced concrete beams and columns.

408. MACHINE DESIGN PROJECT. 1-3-3.
Prerequisite: MET 302. A project and lecture course which applies the principles learned in Machine Design (MET 301 and MET 302) to more advanced design situations. Typical mechanical systems are designed by individual students and by small groups.

409. AIR CONDITIONING AND REFRIGERATION. 3-0-3.
Prerequisite: MET 303. Calculation of building cooling and heating loads, psychrometric calculations, air distribution and duct design, compression and absorption refrigeration cycles, automatic control of refrigeration systems.

410. ELECTRO-MECHANICAL EQUIPMENT. 3-0-3.
Prerequisite: EET 309. Applications of mechanical vibration and electric circuit concepts to the principles of design, selection, and operation of electro-mechanical devices such as gyroscopes, integrators, accelerometers, and other common transducers.

411. MANUFACTURING EQUIPMENT. 3-0-3.
Prerequisite: IET 312 or MET 302. The objective of the course is intended to cover the fundamental principles for the evolution of a carefully conceived manufacturing scheme and to establish a clear relationship between production engineering and design. Representative topics to be studied are the development of location systems and operational sequences, tool and tooling classifications, tolerance and dimensional analysis and their control and special production techniques.

412. AUTOMATED PRODUCTION METHODS. 3-0-3.
Prerequisite: IET 312 or MET 302. An introduction to the techniques of automation that are employed in various manufacturing and metal working processes. The emphasis is placed on a particular process, rather than on a particular industry. To this end, topics such as feedback control loops, workpiece and materials handling devices, indexing, automatic inspection and numerical tape method are studied.

413. ENVIRONMENTAL TECHNOLOGY. 3-0-3.
Introduction to water, air, noise, thermal, nuclear and solid waste pollution. Special topics include water pollution from various manufacturing industries; air pollution from fossil power plants; internal combustion engines and jets; industrial noise pollution; solid and atomic wastes disposal; and legal aspects of pollution control.

415. AUTOMATIC CONTROL SYSTEMS. 3-0-3.
An introduction to the basic concepts of automatic control systems will be considered. Process characteristics, transducer dynamics, and frequency response will be among the topics studied.

416. MECHANICAL INSTRUMENTATION LABORATORY. 2-2-3.
Laboratory projects will be performed dealing with mechanical instrumentation. Basic measurement techniques — displacement, force, pressure, temperature, flow, etc. will be covered.

417. SOLAR ENERGY APPLICATIONS. 3-0-3.
Prerequisite: Thermodynamics or its equivalent. This course is an elective

course for technologists. It is concerned with the practical application and the end uses of solar energy. The technology of applications for domestic water heating, space heating, and low-temperature water heating for industrial processes will be emphasized as well as instrumentation and controls for solar systems.

MET 450. MECHANICAL & ELECTRICAL SYSTEMS I. 3-3-4.
Prerequisite: College physics. Provides a working knowledge of the various systems used in the building construction industry. Such topics as site work; thermal control systems including plumbing, heating, ventilating and air-conditioning; electrical power distribution and lighting are discussed in detail. Lectures will be presented using residential, industrial and commercial applications from industry. Class projects are included in the laboratory.

451. MECHANICAL & ELECTRICAL SYSTEMS II. 3-0-3.
Prerequisite: MET 405. A continuation of MET 450 from a more advanced viewpoint. Specifications will be studied along with Mechanical & Electrical designs as related to overall architectural studies. These comprehensive designs will require decisions of a more sophisticated nature.

Industrial and Management Engineering

Chairman: James L. Rigassio
Associate Chairman: Stan S. Thomas

Professors: Goldstein, Mihalasky, Rigassio, Wolf; *Associate Professors:* Gage, Horwitz, Stone, Thomas; *Assistant Professor:* Glickman, Kopf; *Special Lecturers:* Cibroski, Danco, Pekarski, Percival.

IE 221. INTRODUCTION TO INDUSTRIAL ENGINEERING. 3-0-3.
Open to second year students in engineering, engineering science or computer science. This course gives a broad and fundamental view of the field of industrial engineering in both its traditional and contemporary aspects, and introduces the student to operations research as applied to industrial and managerial problems, stressing the logical methods used. It specifically treats problems in all phases of industry-research, finance, production, and distribution and builds to an analysis of decision theory and model building.

224. PRODUCTION PROCESS DESIGN. 3-0-3.
Open to second year students in engineering. Introduction to design and control of manufacturing processes. Study covers theory and practice of manufacturing techniques, measurement and quality control, automated processes and tape controlled machines. Selection of the best and most economical process to meet design specifications is stressed. In addition to lecture and discussion the student observes equipment in operations in the laboratory and in plants which are visited.

310. WORK EXPERIENCE I.
Cooperative Education Work Experience of six months providing industrial reinforcement of Academic Program. Direct exposure to industrial situations work assignments provided by and approved by Director. Prerequisite: Completion of Sophomore Year. Approval of Department and permission of Cooperative Education Director.

IE 331. APPLIED STATISTICAL METHODS. 3-0-3.
Prerequisite: Math 333. This course presents statistical methods together with their applications. Subjects treated include the selection, classification, treatment, and analysis of data, frequency distributions, central tendency, dispersion, skewness, curve fitting, probability distributions, student's "t," significant differences, analysis of variance, regression, and correlation. Special emphasis is placed on the application to industrial fields.

334. ENGINEERING ECONOMY AND CAPITAL INVESTMENT ANALYSIS. 3-0-3.
Prerequisite: SS 201. Introduction to the principles of engineering economics for utilization in evaluation of potential capital investments. These include conditions of certainty and uncertainty, risk, time, value of money, depreciation, marginal and sensitivity analysis, cost of capital, multiple alternatives, and replacement.

335. ENGINEERING COST ANALYSIS AND CONTROL. 3-0-3.
Prerequisites: IE 221, SS 201. The intent of this course is to provide an understanding of basic accounting methods used in management information systems; emphasis will be on the development of standard costs, effect of cost on services, break even and variance analysis, cost volume relationships, and utilization of financial data for control of operation.

337. METHODS ENGINEERING. 2-2-3.
Prerequisites: IE 221, 224. Included are production planning and control, work simplification, human factors, methods, tool design, the use of motion economy, jig and fixture design, and micromotion analysis techniques.

338. WORK MEASUREMENT. 2-2-3.
Prerequisites: IE 337, Math 333. Quantitative analysis of manufacturing activities, man and machine systems, wage payment plans, line balancing problems, and plant design decisions. Involved is the use of standard data, method measurement systems, work sampling, time study, predetermined time systems, value analysis and simulation of production systems.

355. HUMAN FACTORS. 3-0-3.
Prerequisite: Junior IE standing or equivalent. Man-machine systems analysis including — study of workplace layout, measurement of employee efficiency and productivity, criteria for tool and fixture design or selection, industrial fatigue, environmental influences on performance including the effects of illumination, noise, vibration, thermal and other atmospheric factors. The control and measurement of work stress; Introduction to Industrial Hygiene; the impact of OSHA. Familiarization with the facilities of the Human Factors Laboratory via demonstrations and supervised experiments; special techniques for experimenting with man.

411. WORK EXPERIENCE II.
Cooperative Education Work Experience of six months, normally with same employer as IE 310. Prerequisite: IE 310 and permission of Director of Cooperative Education.

439. MANAGEMENT SCIENCE. 3-0-3.
Prerequisites: Math 333, IE 221, SS 201. Introduction to quantitative and analytical techniques useful in managerial decision-making, including model formulation, linear programming, network analysis applied to PERT/CPM, queueing theory.

440. CONTEMPORARY PRACTICES IN MANAGEMENT SCIENCE. 3-0-3.
Prerequisite: IE 439. Extension of the concepts studied in IE 439 to include topics such as simulation, dynamic programming, inventory models, and game theory. An important aspect of this course will be discussions by and with leading managers using management science techniques.

443. SYSTEMS ANALYSIS. 2-2-3.
Prerequisite: IE 338. The concepts of industrial engineering systems and sub-systems design; principles, procedures, and techniques of systems design; the management control as an integral system component. Selec-

tion of a specific system design for the project of IE 444, establishment of plant contacts, determination of the systems specifications, preliminary collection, classification, and analysis of the system data.

IE 444. SYSTEMS DESIGN AND CONTROL. 2-2-3.
Prerequisite: IE 443. A course in which research projects will culminate in a systems design, including the related management controls. The design will draw upon the applicable mathematical, scientific, engineering, and humanistic principles included in the curriculum. Whether theoretically and/or practically oriented, the design will classify within or between the broad curriculum areas of process design, work design, or management science.

446. LAW. 3-0-3.
Open to any fourth year student in a bachelor's degree program. This course familiarizes the student with basic principles of common and statutory law applicable to business and professional relationships, emphasizing contracts, negotiable instruments, sales of goods, agency and business organization.

450. PRODUCT ENGINEERING STANDARDS. 3-0-3.
Open to any fourth year engineering student. A course designed to aid the engineer in developing and using standards in the design, manufacturing and use of products. Topics included in the course are economics of using standard parts, procedures, drawing and assembly techniques; and use of national and international standards. The role of standards-setting bodies and methods for the development of product testing standards used in industry and commerce will be reviewed.

451. INDUSTRIAL MEASURING SYSTEMS. 3-0-3.
Prerequisite: Math 333. The course reviews contemporary measuring systems. It will provide a basic understanding of the various methods, their accuracy, reliability, and relative costs to perform. It will include measuring methods needed for compliance evaluation in accordance with occupational and safety legislation, industrial processes and product design.

456. HUMAN FACTORS ENGINEERING. 3-0-3.
Open to any fourth year engineering student. Study of man-machine systems with emphasis on investigation of human sensory and motor processes, tool design and machine control devices, and the effects of environmental conditions on human performance. Special attention is given to application and interpretation of the William-Steiger Occupational Safety and Health Act of 1970 as it relates to human factors consideration in industrial engineering work. Field trips to industrial human factors laboratories are arranged, in which application and implementation of human factors research findings are demonstrated.

457. MARKETING AND DISTRIBUTION SYSTEMS. 3-0-3.
Prerequisites: Math 333, IE 221. This course includes basic marketing and distribution problems, with special reference to operational problems solvable by the mathematical methods of management science. Among the problems treated are decision making in marketing planning, market research, statistical treatment of opinion "polls," product strategy, industrial marketing, and distribution systems.

459. PRODUCTION PLANNING AND CONTROL. 3-0-3.
Prerequisites: CS 101, IE 221. A study of the components and functioning of integrated production, planning and control systems. Consideration is given to material, equipment, and manpower requirements for optimizing continuous and intermittent manufacturing operations. The use of a computer to simulate such models is introduced.

461. PRODUCT QUALITY ASSURANCE. 3-0-3.
Prerequisite: IE 331. Introduction to the philosophy and methodology needed to assure the design and manufacture of a product of acceptable quality and reliability. Quality control techniques, reliability measurement techniques, maintainability techniques, and related areas such as physics of failure and logistics support will be surveyed.

IE 462. BUDGETARY PLANNING AND CONTROL. 3-0-3.
Prerequisites: IE 334, 335, SS 201. Introduction of budgeting procedures as a tool for planning and control in the areas of production, sales, indirect expense, cash, inventory, and capital expenditures. Emphasis is placed on the application of industrial engineering principles in the preparation and execution of budgets for profit planning and management.

463. ORGANIZATION PLANNING AND CONTROL. 3-0-3.
Open to fourth year industrial engineering students. A study of classical and behavioral approaches to organization planning, this course integrates both functional and adoptive points of view in regard to the delineation of the duties, responsibilities, authorities, and relationships of the positions of a business enterprise. Included in the course is a survey of current practice in organization design and control.

465. PATENT LAW. 3-0-3.
Open to any fourth year engineering student. A broad coverage of the principles and philosophy of patent law is treated in this course. The main goal is to point out more effective protection and exploitation of ideas and inventions. Also, trademark selection and protection will be considered.

466. ACTIVITY ANALYSIS AND FACILITIES LAYOUT. 3-0-3.
Prerequisites: IE 221, 224. Analysis of organized human activities typified by industrial and office operations. Modern methods are applied to location and layout of facilities so that they may be utilized in a healthful and effective manner. Logistics of motion of people and materials, flow analysis, plant layout, and material handling techniques are included.

467. QUANTITATIVE METHODS IN FORECASTING. 3-0-3.
Prerequisites: IE 439, Math 333. An analytical approach to forecasting, based on time series technique, with application to marketing, inventory control, and management. Techniques include regression, auto-regression and moving average processes and exponential smoothing. Applications and computational efficiency are stressed.

471. PRODUCT LIABILITY LAW. 3-0-3.
Open to any fourth year student in a bachelor's degree program. A presentation of the laws applicable to products liability, the quantitative cost analysis and the effect of legal doctrines on minimizing product liability. Use of actuarial techniques applicable to design; manufacturing, and marketing problems. Some of the topics to be discussed are: warranties, notices, disclaimers, definition of liability and use of expert witnesses. When possible, an observance of an actual trial will be arranged.

472. PRODUCT LIABILITY ENGINEERING. 3-0-3.
Open to any fourth year engineering student. A presentation of the techniques available to the engineer to minimize the hazards of design and manufacturing which result in product liability cases. The effect of legal precedents on design, manufacturing, advertising, marketing, and using a product are discussed while developing technical disciplines such as: reliability prediction and analysis methods, assuring the quality of manufactured product, loss control systems, safety engineering precepts and design review. A review of government regulations for safety and protection is included.

473. SAFETY ENGINEERING. 3-0-3.
Open to any fourth year engineering student. The principles and practices of safety engineering in product and facilities design. Among the topics treated are safe practices and hazard control, safety standards and codes, inspection procedures, insurance and governmental regulations and safety statistics. The student will participate in current safety engineering research studies. The Williams-Steiger Occupational Safety and Health Act of 1970 will be covered.

474. SYSTEMS ENGINEERING IN HOSPITALS. 3-0-3.
Prerequisites: IE 335, 443. Analysis and examination of the systems required for the sound design and management of modern hospital facilities. Included in the systems to be discussed are: management control, management information, inventory control, cost control, scheduling of

hospital services, systems for establishing standards in para-professional laboratory, nursing and other service areas. Students will be required to develop a project on assignment in a hospital and will design a hospital system or a portion thereof for the particular hospital.

IE 475. HOSPITAL UNIT PROCESSES. 3-0-3.
Prerequisite: Junior class standing. Unit processes in a hospital. Provision of patient care. Planning for hospital services. Functional plans for hospital construction. Functional hospital organization. Business office operations. Medical and surgical services. Nursing services. Laboratory services. Pharmacy services. Medical records. Dietary services. Outpatient services. Hospital visitations. Hospital project required.

476. HOSPITALS AND HEALTH CARE FACILITIES, LIABILITY. 3-0-3.
Prerequisite: IE 446. A course encompassing case law and statutory law to provide an understanding of the liabilities that may be incurred in managing a modern hospital or health care facility.

481. INVESTIGATIONS IN INDUSTRIAL ENGINEERING I. 3-0-3.
Prerequisite: Junior or senior standing. Individual investigation under faculty guidance through consultation, readings, and visits with recognized authorities and institutions, dealing with specialized Industrial Engineering design problems. Each student will explore in depth an area in which he has an interest and will report in a seminar situation.

482. INVESTIGATIONS IN INDUSTRIAL ENGINEERING II. 3-0-3.
Prerequisite: Junior or senior standing. Further individual investigations, a continuation of IE 481.

494. ENTERPRISE MANAGEMENT. 3-0-3.
Prerequisite: SS 201. A survey course for electrical and mechanical engineering students which includes sources of investment funds; interest and time value of money; organizational structure; product development and distribution; production management; engineering economy analysis of alternatives; break-even analysis; economy of public projects and public utilities; estimating and control of enterprise costs. Emphasis is on the operational production management with orientation to cost analysis.

497. ENTERPRISE MANAGEMENT. 3-0-3.
Prerequisite: SS 201. A survey course for civil engineering students concerned with organization, design, administration, and operation of enterprises; the economic evaluation of projects and alternatives; and time value of money analysis with special emphasis on their application to civil engineering of public projects and public utilities. Legal aspects such as contracts, agency, and workmen's compensation are examined.

498. BASIC ACCOUNTING AND FINANCE FOR CONSTRUCTION MANAGEMENT. 3-0-3.
Open to fourth year civil engineering students. A basic background course in the principles of accounting and cost accounting necessary for the understanding of financial data and statistics in connection with the supervision of engineering projects. Sources and methods for financing these projects, both public and private, are discussed.

499. MANAGEMENT AND CONTROL OF CONSTRUCTION. 3-0-3.
Prerequisite: IE 498 or permission of the instructor. Introduction to financial and management techniques employed by construction management to maintain operating control. Topics include pre-job procedures, subcontracting policies, insurance problems, change order routines, and profit controls.

INDUSTRIAL MANAGEMENT

IM 110. INDUSTRIAL ACCOUNTING AND BUDGETING I. 3-0-3.
Open to first year students in the B.S.I.A. program. A course in basic accounting concepts. Basic accounting documents, work sheets, ledgers, and procedures for keeping accounts are covered. Emphasis is given to inventory and job order accounting methods.

IM 111. INDUSTRIAL ACCOUNTING AND BUDGETING II. 3-0-3.
Prerequisite: IM 110. A continuation of IM 110 covering valuation, depreciation, costing methods, overhead accumulations and distribution. Emphasis given to standard costs, cost estimating and budgets.

112. ADMINISTRATIVE SYSTEMS. 3-0-3.
Open to first year students in the B.S.I.A. program. A survey of the concepts and techniques for planning and controlling the business and service functions of an enterprise. Subsystem analysis, flow charting and work control techniques are applied to sales and service, storekeeping and warehousing, maintenance and engineering, central administration and general office functions. The job of the controller is studied.

230. COST ANALYSIS. 3-0-3.
Prerequisites: IM 110, 111. A course in the techniques of evaluating labor material and overhead costs. Rate of return, variance analysis and breakeven analysis are among the subjects covered.

231. OPERATING CONTROL. 3-0-3.
Open to third year students in the B.S.I.A. program. A study of the modern techniques of control based on systems concepts. The areas covered relate to control of production, quality, materials, cost and facilities. Special attention is given to use of the computer in operations control.

305. BUSINESS STATISTICS. 3-0-3.
Prerequisite: Math 105. Introduction to business data analysis for application in management decision-making processes. Productivity measures, employment trends, national income data, and consumer price changes are given special attention. The course is applications-oriented, and is intended to provide background necessary to meet the needs of Industrial Administration students. Methods for collection of business and economic data, presentation of data and computer applications, index numbers, historical analysis trend projections, survey sampling, and planning for business research are covered.

333. PUBLIC FINANCE. 3-0-3.
Prerequisite: SS 201. A study of financial principles and methods of funding applicable to public projects. Funding sources and administration of projects, and the relationship of governmental agencies in the construction and maintenance of public projects are covered. Case studies in public agency and municipality fiscal planning are included.

336. INDUSTRIAL SAFETY ADMINISTRATION. 3-0-3.
Prerequisites: IM 231, OS 361. A course in the planning for and appraising of safety performance. The fundamentals of accident prevention, job safety analysis, accident investigation and sources of hazards are covered. Attention is given to federal and state standards and occupational health and safety legislation.

339. COMPUTERIZED MANAGEMENT CONTROL. 3-0-3.
Prerequisite: CS 202. A treatment of the managerial functions of planning, operating and control in which the computer is used as an information source and an operating device. Applications to order processing, warehousing, machine and process control, forecasting, scheduling and management reporting are covered. Special problems in manpower scheduling using PERT and CPM techniques are studied.

351. PURCHASING AND MATERIALS MANAGEMENT. 3-0-3.
This course considers the functions necessary to effectively and efficiently procure the resources necessary for the operation of the enterprise. Topics include: purchasing system procedures, quality assurance, specification preparation, contracts, and traffic. Emphasized will be materials management.

352. RISK MANAGEMENT. 3-0-3.
Covers the management of risk in the enterprise. The factors that can cause liability to the firm and the methods that can be employed to minimize these costs will be examined and evaluated. Specific concerns

will be Fire, Property and Liability Insurance, Workmen's Compensation, Product Liability, OSHA, Insurance Administration.

IM 401. HOSPITAL ADMINISTRATION. 3-0-3.
Prerequisite: Junior Class Standing. This course is designed to acquaint the student with hospital administration related to: Regional area from which the modern hospital's patients are drawn; the Federal, State, Municipal and other rules, regulations, and requirements that affect hospital administration. The problem involved in fund-raising; sources of external financial aid, grants, research funding; relationships between the modern hospital and American Hospital Association, American Medical Association, hospital and medical insurance, as well as accrediting and regulatory agencies; hospital management, hospital administration, budgetary controls, the functions of each of the divisions, departments and sections of the modern hospital. The role of the computer in the modern hospital will be discussed, both in terms of the business and control function and in relationship to patient care. Hospital visitations. Hospital project required.

441. INDUSTRIAL MARKETING. 3-0-3.
Prerequisites: Basic statistics and calculus. A study of the relationship between production and distribution. Among the subjects treated are sales forecasting, product development, packaging, pricing, customer relations, warehousing, advertising and promotion.

442. FINANCE OF BUSINESS ENTERPRISE. 3-0-3.
Prerequisites: IM 110, 111. A course in the principles and problems of funding the enterprise. Access to capital, means of long and short term financing, instruments of equity and debt, capital budgeting and analysis of financial statements are studied.

445. MANAGERIAL ECONOMICS. 3-0-3.
Prerequisite: SS 201. A course treating the internal and external influences on business enterprise and the methods by which businesses evaluate and react to these influences. Economic models pertaining to demand forecasting, market strategy, pricing, competition and profit behavior are studied.

448. PRODUCTION SIMULATION SEMINAR. 3-0-3.
Prerequisites: IM 111, 230, OS 381, SS 201. An exercise in production analysis and control utilizing a digital computer as a simulated enterprise in the ongoing process of production and requiring decisions under uncertainty conditions in production facilities and equipment, inventory management, capacity utilization, production quotas and control, manpower requirements, and financial needs.

449. FINANCIAL SIMULATION SEMINAR. 3-0-3.
Prerequisites: IM 111, 230, OS 381, SS 301. An exercise in financial analysis and control. An enterprise, using a management game, will be simulated upon the digital computer to measure the process of growth, requiring the generation of new funds. Students in groups of "management teams" select financial sources and measure administrative effectiveness by use of ratio analysis techniques as profitability and liquidity indicants. Capitalization structures and securities management are seminar subjects.

483. BUDGETING AND CONTROL. 3-0-3.
An introduction to budgeting and control in the firm. The course concerns itself with such responsibilities as design and maintenance of accounting records, internal audit systems, budgets, payrolls, profit planning, and cost control.

484. INVESTMENT MANAGEMENT. 3-0-3.
An introduction to analytical procedures employed in the making of investment decisions involving commitment of funds. Private and government instruments include common stock, bonds, options, commercial paper, mortgages, federal, state and municipal obligations. These will be considered in the context of the needs of cash management by corporation, investment of surplus fund, pension fund administration, and investment portfolios.

MANAGEMENT ENGINEERING

EM 501. INDUSTRIAL MANAGEMENT. 3 credits, 1st or 2nd sem.
Prerequisites: Senior standing only. Not open to Industrial Engineering students. A course in the field of industrial management stressing the operational aspects of the management techniques. Included topics are organization, product design and development, distribution, logistics, marketing, plant location and layout, materials handling, production planning and control, inventory control, quality control, work analysis, and incentive plans.

502. ENGINEERING COST ANALYSIS. 3 credits, 1st or 2nd sem.
Prerequisites: Senior standing only. Not open to Industrial Engineering students. A course stressing the financial, engineering economy, and cost control aspects of industrial management. It treats the accounting cycle and introduces cost accounting procedures and cost model techniques of making cost comparisons through engineering economy studies as an approach to problems of industrial management.

503. METHODS AND APPLICATIONS OF INDUSTRIAL STATISTICS AND PROBABILITY. 3 credits, 1st or 2nd sem.
Prerequisites: Senior standing only. Not open to Industrial Engineering students. An analytical approach to basic engineering probability and statistics, with applications drawn from both manufacturing and process industries. Emphasis is placed upon the utility of statistical inference derived from engineering data.

Humanities

Chairman: John Patrick Pattinson
Associate Chairman: Robert E. Lynch

Professors: Camp, Crater, Estrin, Lyngstad, Napier, Pattinson, Steinberg, Winters; *Associate Professors:* Goldberg, Johnson, Krantz, Lynch, O'Connor, Tobias, Wise; *Assistant Professors:* Badenhausen, Hodge, Lee, Sher, Steffen; *Special Lecturer:* Baum, Gile.

INTRODUCTORY COURSES

Eng. 106-107 ENGLISH AS A SECOND LANGUAGE I & II. 3-1-3.
These courses offer instruction in the basic skills of English as a second language with emphasis on the writing and, to a lesser extent, the speaking of English. In addition, collateral reading and extensive study of vocabulary are provided. Placement in these courses is determined by performance on standardized composition and reading comprehension tests.

108-109. BASIC SKILLS READING AND WRITING I & II. 3-1-3.
These courses provide instruction in the reading and writing skills necessary for success in a college curriculum. The writing content is similar to that of Eng. 110. Placement in this sequence is based on performance on standardized composition and reading comprehension tests.

110. ELEMENTS OF COMPOSITION AND COMMUNICATION. 3-0-3.
Intended for students judged deficient in writing skills. Intensive instruction in the techniques of correct and effective writing, including diction, mechanics, sentence structure, organizational principles. (Some freshmen may be required to take this course before Eng 111.)

111. ENGLISH COMPOSITION. 3-0-3.
Required of all freshmen. The course aims to promote the student's proficiency in English composition through systematic practice and appropriate readings. There will also be practice in oral expression.

Eng. 115. COMPOSITION AND LITERATURE. 3-0-3.
Prerequisite: Department approval. An honors course parallel to Eng 111. The course is designed for students whose skill in writing and interest in literature are greater than those of the average student.

Hum 112. MAN AND CULTURE IN HISTORICAL PERSPECTIVE I. 3-0-3.
Prerequisite: Eng. 111 or Eng. 115. Man's changing view of himself and his world as seen in the history, literature, arts, and philosophy of past eras, from ancient times through the Renaissance. An interdisciplinary approach.

115. MAN AND CULTURE IN HISTORICAL PERSPECTIVE I. 3-0-3.
Prerequisite: Eng. 111 or 115 and departmental approval. An honors course parallel to Hum. 112 for selected students.

231. MAN AND CULTURE IN HISTORICAL PERSPECTIVE II. 3-0-3.
Prerequisites: Six hours of Humanities courses (excluding Eng. 101 and 110). Man's changing views of himself and his world as seen in the history, literature, arts, and philosophy of past eras, from the seventeenth century through the contemporary world. An interdisciplinary approach.

235. MAN AND CULTURE IN HISTORICAL PERSPECTIVE II. 3-0-3.
Prerequisites: Six hours of Humanities courses (excluding Eng. 101 and 110) and departmental approval. An honors course parallel to Hum. 231 for selected students.

Eng. 238. ADVANCED COMPOSITION. 3-0-3.
Prerequisite: Eng. 111 or 115. An advanced course in written and oral communication. Readings in literature and history.

SPECIAL COURSES

Students should check their departmental curriculum requirements before registering for 300-level Humanities courses. These courses are not equivalent to 400-level Humanities courses.

Hum. 310. TECHNOLOGY AND HUMAN VALUES. 3-0-3.
See description for MT. 310, page 106.

Eng. 339. PRACTICAL JOURNALISM. 3-0-3.
Prerequisite: Eng. 111 or 115. A specialized writing course that includes a descriptive and analytical survey of news systems. Assignments will include practice in writing straight news items, sports writing, feature writing, science writing, interviewing and editing — with emphasis on understanding methods. The survey of printed and broadcast news systems will include the influence of technological, economic, legal, ethical and historical factors.

340. ORAL COMMUNICATION. 3-0-3.
Prerequisite: Eng. 111 or 115. Development of the principles, attitudes, and verbal skills essential to effective oral communication through studying great historic speeches, analyzing the psychology of speech situations, preparing appropriate speech patterns, and delivering a wide range of speeches adapted to the needs of specific occasions and varied contemporary audiences.

342. TECHNICAL REPORT WRITING. 3-0-3.
Prerequisite: Eng. 111, 115 or 6 credits of humanities for BSET students. An advanced course in written and oral communication, including instruction and practice in preparing technical reports of various types, in writing business letters, and in speaking before groups on technical subjects. Required by some departments. Not a regular Humanities elective.

HUMANITIES ELECTIVES

(Before registering for Humanities Electives, students should check their departmental curriculum pamphlets. Engineering students should refer also to the Statement of Humanities Requirements on page 47.)

HISTORY His. 441. THE AMERICAN EXPERIENCE. 3-0-3.
Prerequisite: † American history from the colonies to the twentieth century, with concentration on several selected themes basic to an understanding of the changing cultural patterns and social values of American civilization.

445. COMMUNICATION THROUGH THE AGES. 3-0-3.
Prerequisite: † Modes of communication, ancient and modern, in their social and cultural context — from cave-painting to computers. Topics include literacy and economic development in the West; the technological revolution in media beginning with Daguerre, Samuel Morse and Alexander Graham Bell; the institutional development of mass media and popular culture; and contemporary trends in world communication and interaction.

451. ANCIENT GREECE AND THE PERSIAN EMPIRE. 3-0-3.
Prerequisite: † The political, institutional and cultural developments of Ancient Greece and the Persian Empire from the Mycenean period to the King's Peace (386 B.C.).

452. THE HELLENISTIC STATES AND THE ROMAN REPUBLIC. 3-0-3.
Prerequisite: † The political and cultural developments of the Hellenistic states and their influence on the Republic of Rome to 30 B.C.

459. HISTORY OF THE MIDDLE EAST I. 3-0-3.
Prerequisite: † The political, cultural and institutional developments in the Middle East from the Parthians to the capture of Constantinople by the Ottoman Turks. Four periods will be analyzed: The Parthian, the Sassanid Persian, the Caliphate, and the Seljuk and Ottoman Turks.

460. HISTORY OF THE MIDDLE EAST II. 3-0-3.
Prerequisite: † The political, cultural and institutional developments in the Middle East from the capture of Constantinople by the Ottoman Turks to the impact of the Arab-Israeli conflict on the world today.

461. THE FOUNDING OF THE AMERICAN NATION. 3-0-3.
Prerequisite: † North America in the Colonial and Revolutionary periods, with emphasis on patterns of cultural and institutional development from early settlement through the ratification of the Constitution.

463. THE UNITED STATES AS A WORLD POWER. 3-0-3.
Prerequisite: † American domestic and foreign policy in the twentieth century. Topics include imperialism, the Progressive Era, the Depression, the New Deal, World Wars I and II, the Cold War, America and the world today.

† The prerequisite for all 400-level electives is completion of all Freshman and Sophomore Humanities courses required by the student's major department.

472. CONTEMPORARY EUROPE. 3-0-3.
Prerequisite: † European society in the twentieth century. Nationalism, imperialism, totalitarianism, movements toward European unity, and prominent cultural developments.

474. MODERN RUSSIAN CIVILIZATION. 3-0-3.
Prerequisite: † Tsarist and Soviet Russia in the 19th and 20th centuries. Serfdom, industrialization, revolutionary movements, the 1917 revolutions, and the development of the Soviet State and society.

476. POLITICAL AND SOCIAL MOVEMENTS. 3-0-3.
Prerequisite: † Significant movements of political and social dissent in the past century and their justifications, including liberalism, democracy, socialism, communism, fascism, and guerrilla and non-violent resistance.

482. WAR AND MODERNIZATION. 3-0-3.
Prerequisite: † Warfare and its effects upon traditional institutions and its role in the process of modernization in the last three centuries. Topics include war from the time of Peter the Great to the Second World War, and varied paths of modernization in several countries of Europe and Asia.

His. 483. THE MAKING OF MODERN THOUGHT. 3-0-3.
Prerequisite: † The formation of contemporary images of man, nature, and society since the mid-nineteenth century. Emphasis on Marx, Darwin, and Freud and their legacy to twentieth-century thought.

485. TECHNOLOGY IN HISTORY: THROUGH THE INDUSTRIAL REVOLUTION. 3-0-3.
Prerequisite: † An examination of the relation between cultural and technical developments. Special emphasis on the interaction of political, religious, and social values and institutions with the historical development of technology.

486. TECHNOLOGY IN HISTORY: INDUSTRIAL REVOLUTION TO THE PRESENT. 3-0-3.
Prerequisite: † The spread of the Industrial Revolution to Continental Europe, the United States, and Russia. Development and rationalization of technology from the electrochemical revolution to the Space Age. The relationship of technology to science and industry. Implications of technical change for human values.

488. CITIES IN HISTORY. 3-0-3.
Prerequisite: † European and North American cities since the Middle Ages. Their origins, growth, functions, and response to social needs. The industrial city of the nineteenth century; the metropolis of the twentieth century, with special attention to the Newark region.

489. POPULATION AND HISTORY. 3-0-3.
Prerequisite: † Deals with the interrelation between population, economy, and society in the Western world since 1500. Typical areas considered include the effects of disease, war, and diet on populations and on civilization; the roots of the "population explosion"; and the impact of demographic and economic change on the daily life of common people.

490. HISTORICAL PROBLEMS OF THE TWENTIETH CENTURY THROUGH FILM. 3-0-3.
Prerequisite: † A study of selected problems in the twentieth century using film as a "window into history." Such topics as the rise of Nazi Germany, America in the thirties, World War II and American society, the development of cities, and the emergence of the "Third World" will be considered. In any one semester only two topics will be selected for study. The material for the course will include documentary films, newsreels, TV news films, and theatrical feature films as well as selected readings.

LITERATURE

Lit 442. FICTION: THEMES, TECHNIQUES, TRADITIONS. 3-0-3.
Prerequisite: † Readings in the short story and the novel from different countries and eras; study of representative themes and styles; discussion of significant ideas, narrative methods, and socio-cultural attitudes.

451. GREEK AND ROMAN CLASSICS IN TRANSLATION. 3-0-3.
Prerequisite: † Masterpieces of classical literature: the epics of Homer; and Vergil; Greek comedy and tragedy; selections from the philosophical work of Plato and Lucretius; some Greek and Roman lyric poems; and examples of Roman satire. These works are studied primarily as literary masterpieces in their own right, but some account is given of their historical setting and of their influence upon subsequent literature.

453. TWENTIETH CENTURY AMERICAN LITERATURE TO 1950. 3-0-3.
Prerequisite: † Maturing America's struggle to find itself is surveyed through representatives of regionalism, the turmoil of the cities, and our new awareness of Europe. The course presents the prose, poetry, and drama of the period through such writers as James, Adams, London, Dreiser, Lewis, Dos Passos, Stein, Hemingway, Faulkner, Frost, Eliot, and O'Neill.

Lit 455. TWENTIETH-CENTURY EUROPEAN FICTION. 3-0-3.
Prerequisite: † Short novels by such writers as Gide, Hesse, Lagerkvist, Musil, Silone, Camus, Gombrowicz, Grass and Kundera. Their unique insights into the psychology of self-discovery; their philosophical, religious, and social ideas; their achievements in the art of narrative.

456. MODERN CONTINENTAL AND BRITISH DRAMA. 3-0-3.
Prerequisite: † An examination of some of the dramas from the late nineteenth and from the twentieth century with the purpose of gaining some understanding of how dramatists, in both subject matter and technique, reflect the spirit of the times. Representative playwrights include Ibsen, Shaw, Wilde, Strindberg, Synge, Chekhov, O'Casey, Pirandello, Anouilh, Brecht, Ionesco, and Pinter.

457. AMERICAN LITERATURE SINCE 1950. 3-0-3.
Prerequisite: † Fiction, drama, and poetry of the outstanding postwar writers, with emphasis on long and short fiction. In drama, Williams, Miller, Albee; in poetry, Ginsberg, Dickey, Ferlinghetti, Bly, and others; in fiction, Bellow, Mailer, Malamud, Kesey, Cheever, and Vonnegut.

459. TWENTIETH CENTURY AMERICAN DRAMA. 3-0-3.
Prerequisite: † An examination of the development of twentieth century American drama with emphasis upon the ways, often experimental, in which the playwrights reflect the spirit of the times. A brief survey of American musical theater will be included.

462. THE RUSSIAN NOVEL AND SHORT STORY. 3-0-3.
Prerequisite: † Russian fiction of the 19th and 20th centuries. A balance will be maintained between two ways of looking at the material: (1) as artistic expressions of individual visions of man's condition, and (2) as documents that find a definite place within Russian social and intellectual history.

464. MODERN SATIRE. 3-0-3.
Prerequisite: † Social and political satire of the twentieth century. Readings in a variety of satirical forms, with emphasis on contemporary authors.

465. MODERN AMERICAN NON-FICTION. 3-0-3.
Prerequisite: † Critical readings in important non-fiction from the informal essays of H. L. Mencken to the "new journalism" of Norman Mailer and Tom Wolfe. The subject matter is Americana, as perceived at various instants since the First World War. Emphasis on modern prose style and the place of non-fiction in literature.

466. THE PSYCHOLOGICAL NOVEL. 3-0-3.
Prerequisite: † A study of selected novels exploring the dynamics of the human psyche. The fictional works examined are supplemented by readings of psychoanalytic texts, used partly as a basis for discussion of the literature, partly as an analytic complement to the intuitive insights offered by the fiction.

469. HISTORICAL LITERATURE. 3-0-3.
Prerequisite: † Many novels and plays have been based on actual incidents and historical personalities. This course examines a number of such works. The original historical material will be compared with the literary work it inspired, providing insights into the nature of the creative process and the contrasting purposes of the historian and the creative writer.

475. WILLIAM SHAKESPEARE. 3-0-3.
Prerequisite: † Selected plays from the histories, comedies, and tragedies, and some short poems, chosen to typify the various facets of this writer. Attention to Shakespeare's times and to the basis for his distinction among dramatists.

480. THE PHILOSOPHY OF LANGUAGE: PATTERNS. 3-0-3.
Prerequisite: † Examination of formation, tradition, and change in some typical patterns drawn from English, including American English, with the most noted speculations upon the ways of the human mind that these pat-

terns reflect. Consideration of the relations between language and religion, science, and literature.

Lit 481. **PHILOSOPHY OF LANGUAGE: SYMBOLISM AND SOCIETY. 3-0-3.**
Prerequisite: † Examination of various symbolic aspects of language with a study of dialects, etymology, and semantics, in addition to analysis of censored literature.

488. **THE CITY IN MODERN LITERATURE. 3-0-3.**
Prerequisite: † Diverse images of the pleasures and perils of urban life as depicted by modern novelists, poets and playwrights with special attention paid to works describing life in the metropolitan area. Such writers as Dreiser, Albee, Bellow, Feiffer, and Claude Brown are included.

490. **SCIENCE FICTION. 3-0-3.**
Prerequisite: † Selected readings in modern and near-modern science fiction short stories, novels, and criticism. Discussions will focus on both the special nature of science fiction as a literary genre and its function as prophetic extrapolation and social criticism. Whenever possible, discussion will be supplemented by required viewing of appropriate SF films.

PHILOSOPHY

Phil 431. **PROBLEMS IN PHILOSOPHY. 3-0-3.**
Prerequisite: † An examination of problems of a social, ethical, aesthetic, religious, and scientific nature and a study of the related principles and methods of philosophy. Readings will be chosen from a wide range of periods and schools from the Greeks to the present, with some application of philosophical analysis to individual and societal problems.

450. **REPRESENTATIVE PHILOSOPHIES. 3-0-3.**
Prerequisite: † The ideals of a few great thinkers, from a variety of historical periods. The purpose is to show the student at first hand how these men once accelerated intellectual progress and how their work may contribute to the solution of modern problems.

455. **THE PHILOSOPHY OF SCIENCE. 3-0-3.**
Prerequisite: † An investigation into the foundations and implications of modern science, with special emphasis on the influence of philosophy on scientific thought and of scientific thought on philosophic questions raised by man's consciousness of himself.

ARTS

Arts 431. **DEVELOPING MUSICAL PERCEPTION. 3-0-3.**
Prerequisite: † Elements of music — its sensuous basis, rhythm, harmony, etc. — and historical differences in their use will be studied in order to show their function in the listener's response to the whole of a composition. All discussions will bring attention to the problem of the verbal language available to describe music and its effects.

432. **VISUAL FUNDAMENTALS. 3-0-3.**
Prerequisite: † Analysis of form and color in two- and three-dimensional art. Examples will be drawn from all periods and media, including modern architecture. Some studio work will be required, but the emphasis is on the student's ability to discuss fundamentals with understanding. A useful terminology for the discussion of art is developed.

433. **HISTORY AND CRITICISM OF FILMS. 3-0-3.**
Prerequisite: † The genesis and development of cinema techniques, analyzed with an introduction to criticism of the movie as an art form. Selected American and foreign films are analyzed and criticized.

434. **ELEMENTS OF THE THEATRE. 3-0-3.**
Prerequisite: † and permission of the instructor. Using the resources of the NJIT Theatre, students receive instruction in the elements of stage presentation: acting, design, theatre history, and lighting and other technologies.

451. **REPRESENTATIVE WESTERN MUSIC. 3-0-3.**
Prerequisite: † The development of creative listening to carefully programmed representative forms, styles, and schools of all the main eras of Western music down to and including the "New Music."

Arts 455. APPRECIATION OF MODERN ART. 3-0-3.
Prerequisite: † The development of modern art, including advertising and industrial design as well as fine arts, is traced in light of the profound changes in social and cultural life since the 1850's. Methods of organization and style are analyzed, and ability to express an understanding of concepts is stressed.

457. VISUAL MEDIA AND COMMUNICATION. 3-0-3.
Prerequisite: † A design approach to communications theory and practice in the areas of photography, film, and video. There will be discussions on the development of the technology and theory of communications along with a direct "hands on" approach to media.

SEMINARS Hum 491, 492, 493, 494. SEMINARS IN THE HUMANITIES. 3-0-3.
Prerequisite: † plus recommendations by former Humanities instructors. Honors courses. The subjects will be announced at the time of registration. Each seminar is limited to twelve students.

MAN AND TECHNOLOGY

MT 301. INDEPENDENT STUDY. 1 credit.

302. INDEPENDENT STUDY. 2 credits.

303. INDEPENDENT STUDY. 3 credits.

401. INDEPENDENT STUDY. 1 credit.

402. INDEPENDENT STUDY. 2 credits.

403. INDEPENDENT STUDY. 3 credits.
The prerequisites for independent study courses in Man & Technology are Junior standing in the program and the written approval of the Coordinator of Man & Technology. The courses consist of self-paced study on an individual or small group basis in a specific area integral to a student's Man & Technology concentration but not available on a regular course basis.

308. TECHNOLOGICAL ALTERNATIVES. 3-0-3.
The course looks to the future, explores technological alternatives, and considers the proper technologies for specific industries and areas, taking into account economies of scale and the implications of all these for the quality of life.

310. TECHNOLOGY AND HUMAN VALUES. 3-0-3.
Prerequisites: Junior standing and six hours of humanities (excluding Eng. 101 and Eng. 110). The course examines the interactions between science/technology and human values. Specifically, it explores psychological, moral, and philosophical consequences of, and humanistic responses to, technological change. Readings — essays, fiction and research articles — will treat such topics as the philosophical foundations of modern science, scientism, technicism; the impact of technology on images of man found in modern literature; and the moral implications of various kinds of recent technology.

(This course is required for Man & Technology, but it is open to other students as a free elective or as a Hum/OS/SS 300-level elective (Hum. 310). It does not fulfill the 400-level Humanities requirement.)

490. PROJECT AND SEMINAR I. 3 credits.
Prerequisite: Senior standing in the "Man and Technology" program. A comprehensive study of an aspect of man and technology. The problem solution will require application of knowledge and skills acquired in course work, self study and library research as well as consultation with persons in the academic community, industry and government. The completed study will be submitted as a detailed written report. The seminar series will meet weekly. Speakers from education, government and industry will address themselves to topics of current interest to "Man and Technology" students.

MT 491. PROJECT AND SEMINAR II. 3 credits.
A continuation of MT 490.

† The prerequisite for all 400-level electives is completion of all Freshman and Sophomore Humanities courses required by the student's major department.

Mathematics

Chairman: Henry Zatzkis
Associate Chairman: Carl Konove
Assistant Chairman: Achilles E. Foster

Distinguished Professor: Zatzkis; *Professors:* Barkan, Foster, Konove. *Associate Professors:* Andrushkiw, Blackmore, Brower, Chase, Flatow, Katzen, Lieb, Lione, Perez, Rausen, Voronka; *Assistant Professors:* Berliner, Cohen, Gilbert, Kappraff, Plastock, Tavantzis, Zames. *Special Lecturers:* Dios, Elk, Millman.

Math 102. MATHEMATICAL CONCEPTS. 3-0-3.
This course contains an introduction to college algebra and selected topics in analytic geometry. Applications from many fields including science and industry are stressed throughout the course.

105. PROBABILITY AND STATISTICS. 3-0-3.
Prerequisite: Math 102. This course considers notions of probability. The topics studied include the binomial and normal distributions, expected value, and variance. The notions of sampling, hypothesis testing, and confidence intervals are applied to elementary situations.

106. BASIC COLLEGE MATHEMATICS. 4-0-4.
This course includes topics in algebra, trigonometry, and analytic geometry with an emphasis on problem solving.

107. INTRODUCTION TO COLLEGE MATHEMATICS. 4-0-4.
Topics from algebra, triogonometry and analytic geometry are covered in this course with particular emphasis on the formulation and analysis of physical problems. The basic elements of differential and integral calculus are introduced.

108. MATHEMATICAL ANALYSIS I. 3-0-3.
Prerequisite: Math 106 or equivalent. This course contains review topics from analytic geometry and elementary calculus along with further topics in differential and integral calculus useful to the technologist and industrial administrator. The notion of a differential equation is included.

109. INTRODUCTORY MATHEMATICS I E. 2-1-2.
This course contains review topics from college algebra, trigonometry, and analytic geometry with particular emphasis on the formulation and analysis of physical problems.

110. CALCULUS IE. 2-1-2.
Prerequisite: Math 109. This course includes some of the material covered in Math 111 described below.

111. CALCULUS I. 4-0-4.
Prerequisite: 3½ units of H.S. mathematics or Math 109 or Math 107. This course considers the theory and techniques of differentiation and integration with applications of both processes to engineering and physics. Included are some topics from coordinate geometry.

Math 112. CALCULUS II. 4-0-4.
Prerequisite: Math 111. This course is a continuation of Math 111. Topics considered include the differentiation and integration of inverse trigonometric, exponential, and logarithmic functions and further methods of integration. Applications of the definite integral to physical problems are also included.

115. FINITE MATHEMATICS. 3-0-3.
Prerequisite: 3½ units of high school mathematics or Math 107 or equivalent. This course is an introduction to finite mathematics. The topics covered are linear inequalities, matrix algebra, linear programming, probability and statistics, and a brief introduction to calculus.

116. MATHEMATICS OF THE ENVIRONMENT. 3-0-3.
Prerequisite: Math 106 or Math 111 or Math 115 or Math 138. This course is an introduction to mathematical ideas and techniques that have important applications in architecture. Included are such topics as symmetry groups in the plane; stacking, nesting and fitting; modules and numbers; and planar graph relations.

118. HONORS MATHEMATICS I. 4-0-4.
This is the first semester of an eight-semester program in Honors Mathematics. Topics covered include rates of change, continuity, theory of differentiation and integration, as well as applications to engineering problems. Admission to this course is by invitation, based on SAT scores and class standing.

119. HONORS MATHEMATICS II. 4-0-4.
Prerequisite: Math 111 or 118. This is the second semester of an eight-semester program in Honors Mathematics. Topics covered include methods of integration, determinants and linear equations, advanced analytic geometry, hyperbolic functions, polar coordinates and curves by methods of analysis, introduction to vector analysis and parametric equations. Admission to this course requires departmental approval.

138. GENERAL CALCULUS I. 3-0-3.
This course consists of the introduction to differential and integral calculus of a single variable.

209. MATHEMATICAL ANALYSIS II. 3-0-3.
Prerequisite: Math 108. This course is a continuation of Math 108. Topics include differential equations, LaPlace transform techniques, Fourier and other series.

219. CALCULUS II E. 3-0-3.
Prerequisite: Math 110. This course includes the subject matter of the latter part of Math 111 and the first half of Math 112.

220. CALCULUS III E. 3-0-3.
Prerequisite: Math 219. This course includes the subject matter of the second half of Math 112 and the first part of Math 221, described below.

221. CALCULUS III. 4-0-4.
Prerequisite: Math 112. This course is a continuation of Math 112. The main topics considered are partial differentiation, multiple integrals, infinite series, vectors, Fourier series, and the expansion of functions.

222. DIFFERENTIAL EQUATIONS. 4-0-4.
Prerequisite: Math 221. Methods for solving ordinary differential equations are studied, together with physical and geometrical applications. LaPlace transforms and numerical and series solutions are included.

223. ELEMENTARY DIFFERENTIAL EQUATIONS AND STATISTICS. 4-0-4.
Prerequisite: Math 221. This course includes an introduction to the solution of ordinary differential equations including linear equations with constant coefficients. Geometrical and physical applications are considered. This course also includes an introduction to probability and statistics.

Math 228. HONORS MATHEMATICS III. 4-0-4.
Prerequisite: Math 110 or 112 and permission of the instructor. This is the third semester of the Honors Mathematics program. It is a rigorous review of elementary calculus, with a detailed discussion of infinite series and the Riemann integral.

229. HONORS MATHEMATICS IV. 4-0-4.
Prerequisite: Math 228 or 221 and permission of the instructor. This is the fourth semester of the Honors Mathematics program. It is a first course in ordinary differential equations in which mathematical depth is considered substantially more important than manipulative skill. It is not, however, a theoretical course in existence proofs.

238. GENERAL CALCULUS II. 3-0-3.
Prerequisite: Math 138. This course is a continuation of Math 138. It includes applications of integral calculus and an introduction to ordinary differential equations.

329. CALCULUS IV E. 3-0-3.
Prerequisite: Math 220. This course includes most of the subject matter of Math 221 and a brief introduction to differential equations.

330. DIFFERENTIAL EQUATIONS E. 3-0-3.
Prerequisite: Math 329. This course includes most of the subject matter considered in Math 222.

331. INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS. 3-0-3.
Prerequisite: Math 222 or 330. Partial differential equations of physics and engineering. Topics include partial differentiation, Fourier series; and wave, heat, and potential equations. Solutions include separation of variables, transform methods, and numerical methods.

332. INTRODUCTION TO FUNCTIONS OF A COMPLEX VARIABLE. 3-0-3.
Prerequisite: Math 222 or 330. This designed course is as a first course in complex variables. Emphasis is placed on techniques. Topics considered include the complex plane, Cauchy-Riemann equations, geometrical aspects, residues, and poles. Proofs requiring a knowledge of advanced calculus will not be included.

333. PROBABILITY AND STATISTICS. 3-0-3.
Prerequisite: Math 221 or 329. This is essentially a course in modern probability, statistics, and statistical inference. Specific topics include discrete and continuous distributions of random variables, probability models in science, and statistical inference.

334. MATHEMATICS FOR MANAGEMENT SCIENCE. 3-0-3.
Prerequisite: Math 333. This course considers mathematical methods found especially useful in contemporary fields such as operations research and reliability engineering. Topics included are linear programming, graph theory, finite mathematics, difference equations, matrics and determinants.

335. VECTOR ANALYSIS. 3-0-3.
Prerequisite: Math 221 or 329. This course begins with a review of the algebra of vectors and develops the calculus of vectors. Applications to physical phenomena are considered throughout.

337. LINEAR ALGEBRA. 3-0-3.
Prerequisite: Math 112. This course considers matrices, determinants, systems of linear equations, vector spaces, linear transformations and related topics.

338. HONORS MATHEMATICS V. 3-0-3.
Prerequisite: Math 228 or 222 and permission of the instructor. This is an undergraduate course in complex variables with special emphasis on the evaluation of real integrals. Additional topics include conformal mapping, Reimann surfaces, special functions, and some applications to potential theory.

Math 339. HONORS MATHEMATICS VI. 3-0-3.
Prerequisite: Math 338 or 229, or Math 222 and permission of the instructor. This course is a rapid survey of classical vector analysis followed by an introduction to linear and multilinear algebra. Topics covered include the classical vector integral theorems of Green, Stokes, and Gauss; the theory of linear operations on finite dimensional vector spaces with the associated matrix theory; and modern tensor analysis.

448. HONORS MATHEMATICS VII. 3-0-3.
Prerequisite: Math 338 or 332 and permission of the instructor. This course first considers the topology and multilinear algebra needed to begin a serious consideration of tensors, differential forms, and Stokes' theorems.

449. HONORS MATHEMATICS VIII. 3-0-3.
Prerequisite: Math 448. This course is a continuation of Math 448. It extends further the multivariate analysis begun in Math 448.

491. INDEPENDENT STUDY IN MATHEMATICS. 3-0-3.
Prerequisites: Senior standing and permission of the Department. Each student will work under the direct supervision of a member of the Department of Mathematics. The work will consist primarily of a project applying the mathematical skills the student has acquired to an engineering and science oriented project.

511. INTRODUCTION TO NUMERICAL ANALYSIS. 3-0-3.
Prerequisites: Calculus, differential equations, and knowledge of at least one procedure-oriented language such as Fortran. This course is designed to familiarize students with theory and techniques of numerical methods applicable to problems in the field of engineering and the physical sciences. Attention is given to algorithms suitable for digital computer approximation in interpolation, differentiation and integration; discussion of iteration and convergence; least squares and other types of approximation; roots of algebraic and transcendental equations; and solution of ordinary differential equations.

545. ADVANCED CALCULUS I. 3-0-3.
Prerequisite: Undergraduate differential and integral calculus. This course deals with the topics of advanced calculus such as the number system, functions, continuity, differentiability, the Riemann Integral, sequences, series, and uniform convergence.

546. ADVANCED CALCULUS II. 3-0-3.
Prerequisite: Math 145 or equivalent. This course is a continuation of Math 545 and considers such topics as partial differentiation, transformations, implicit function theorem, multiple integrals, and line and surface integrals.

551. APPLIED MATHEMATICS I. 3-0-3.
Prerequisites: Undergraduate differential equations and physics. Mathematical methods useful in the analysis of engineering problems are considered. The course covers selected topics from the following: integral theorems of Green, Stokes, and Gauss; infinite series, integral transforms, and special functions.

573. DIFFERENTIAL EQUATIONS I. 3-0-3.
Prerequisite: Undergraduate differential equations. Advanced topics in ordinary differential equations with applications to engineering problems.

574. DIFFERENTIAL EQUATIONS II. 3-0-3.
Prerequisite: Math 573 or equivalent. A companion course to Math 573, dealing with partial differential equations, with emphasis on those of physics and their solution by means of Fourier Series, Bessel Functions, and Legendre Polynomials.

577. STOCHASTIC PROCESSES. 3-0-3.
Prerequisite: Undergraduate differential equations. The course begins with the development of basic probability concepts of discrete and continuous random variables. Gaussian processes, correlation functions and power

spectra are introduced. Applications include the response of linear communication systems to random input signals.

Mechanical Engineering
Engineering Graphics

Adminstrators: Edward Miller, Jerome L. Polaner

Professors: Allentuch, Herman, Hrycak, Hsieh, Levy, Miller, Polaner, Progelhof, Salamone, Smithberg, Stamper, Wilson; *Associate Professors:* Chen, Cochin, Deutschman, Droughton, Golden, Hanus, Kirchner, Martin, Pappas, Pawel, Schmerzler, Sun; *Assistant Professors:* Florio, Gaal, Jaffe, Ketzner, Rights; *Special Lecturer:* Snyder.

EG 101. ENGINEERING GRAPHICS. 1-2-2.
This course is offered as the student's first experience with the subject of graphics, the engineer's method of expression and communication. A short introduction to theory or orthographical projection through descriptive geometry is employed as a reasonable device for providing the groundwork for understanding the techniques of graphical presentation employed professionally. Assignments are provided to acquaint the student with the "language" standards of the various fields of engineering. Fundamentals of engineering design are also discussed as a logical rationale for developing graphical capability. Freehand sketching and the solution of simple design problems using graphical techniques are also presented.

202. ELEMENTS OF MECHANICAL ENGINEERING. 1-2-2.
Prerequisite: EG 101. This is an introduction to engineering design applicable to mechanical engineering. Emphasis is placed on the fundamental steps necessary in the generation of a sound design. The assignment of an engineering report is used as the vehicle to synthesize these basic concepts.

203. INDUSTRIAL ENGINEERING GRAPHICS. 1-2-2.
Prerequisite: EG 101. A graphics course for Industrial Engineering students where particular stress is given to those areas of graphical communication which relate to manufacture and production. An introduction to the understanding and use of computer graphics is an integral part of the course. The objective of this course is to provide the student with a knowledge of those graphical standards necessary to meet the requirements of present day industrial engineering practice.

204. CIVIL ENGINEERING GRAPHICS. 1-2-2.
Prerequisite: EG 101. A course in engineering design graphics for Civil Engineering students which emphasizes sketching as that medium of expression best suited to the generation of initial ideas involving unique and complex spatial concepts. It is intended that the assignments in this area will also encourage the student to develop an appreciation for the aesthetic blending of structures with the environment. The techniques and standards used in preparing commercial drawings and specifications for civil engineering applications will be covered in sufficient detail to enable the student to read and understand them.

205. ENGINEERING COMMUNICATION. 1-2-2.
Prerequisite: EG 101. The objective of this course is to provide the student with practice in written, oral and graphical communication of scientific and technical information. The precision of technical language and conciseness of expression are stressed. A survey of commercial aids and techniques applicable to publication is made, together with the means of protection by copyright and patent. Graphical and computer methods are used to analyze and present experimental data. This course is required for Electrical Engineering students.

Mechanical Engineering

ME 215. ENGINEERING MATERIAL AND PROCESSES. 2-2-3.
Prerequisite: Chem 116. A combined lecture and laboratory course relating to the study of engineering materials. The processes of forming from liquid and particle state, plastic forming, molding deformation and metal removal are all studied. The effects of heat treatment on material properties are discussed. Laboratory exercises are performed with basic machine tools, welding and gaging equipment.

231. KINEMATICS AND DYNAMICS OF MACHINERY. 3-1-3.
Prerequisite: Mech 230. The design approach is applied to machines such as: cam and follower, speed changer, geared transmission, planetary gear systems and linkages for generating a specific type of motion. Graphical, analytical and digital computer methods are used.

301. THERMODYNAMICS. 4-0-4.
Prerequisites: Math 221, Phy 111. A course in Thermodynamic fundamentals. Among those principles introduced are the first and second laws of Thermodynamics, physical properties of pure substances, entropy, availability and irreversibility, gas mixtures, and combustion.

302. HEAT TRANSFER. 3-0-3.
Prerequisites: Math 222, ME 301; Corequisite: ME 304. A study of the three fundamental modes of heat transfer: conduction, convection and radiation. A physical interpretation of the many quantities and processes in heat transfer are considered using numerical methods in the solution of problems. The theory is applied to the analysis and design of heat exchangers and other applications.

303. DESIGN OF MACHINE ELEMENTS. 3-2-4.
Prerequisites: ME 231, Mech 232. The various aspects of the design process, as well as the design of machine elements are discussed. Projects are used to introduce the student to the design procedures used in engineering practice.

304. FLUID DYNAMICS. 3-1-3.
Prerequisites: Mech 230, ME 301. Introduction to the basic principles of conservation of mass, momentum and energy as they apply to engineering systems which utilize fluids. Some of the topics studied are: dimensional analysis, theoretical and empirical analysis of one-dimensional compressible and incompressible flow, empirical analysis of external and internal flows and concepts of the hydrodynamic boundary layer.

305. INTRODUCTION TO SYSTEM DYNAMICS. 3-0-3.
Prerequisites: ME 231, Math 222. Principles of dynamic system modeling and response with emphasis on mechanical systems. Application of computer simulation techniques. Introduction to design concepts.

306. ANALYSIS AND SYNTHESIS OF MECHANICAL SYSTEMS. 3-2-4.
Prerequisites: ME 305, ME 303, ME 301. A study of the interaction of elements in the analysis and synthesis of mechanical systems. The design of mechanical, thermal and energy conversion systems are introduced. Computer simulations are included for optimizing design.

310. WORK EXPERIENCE I.
Cooperative Education Work Experience of six months providing industrial reinforcement of Academic Program. Direct exposure to industrial situations work assignments provided by and approved by Director. Prerequisite: Completion of Sophomore Year. Approval of Department and permission of Cooperative Education Director.

339. FUNDAMENTALS OF MECHANICAL DESIGN. 3-0-3.
Prerequisites: EG 203 and Mech 232. A course in mechanical design for Industrial Engineering students. Among the topics treated are kinetics of mechanisms, machine components, and a brief introduction to mechanical

vibrations. The topics are integrated to provide the student with the ability to deal with design problems from the viewpoint of the non-specialist.

ME 343. MECHANICAL LABORATORY I. 2-2-3.
Prerequisite: EE 305; Corequisite: ME 304. A laboratory and lecture course in instrumentation and measurement for mechanical engineering students. Applications for the sensing of such variables as pressure, temperature, mass flow, and displacement are covered. Particular attention is directed toward applicability and sensitivity of instruments studied.

361. THERMODYNAMICS. 3-0-3.
Prerequisites: Phys 111 and Math 221. This course for non-mechanical engineering students includes the basic laws of thermodynamics; fluid, solid, magnetic, and electrical property functions; energy analysis for open and closed systems; gas and vapor cycles; refrigeration; and an introduction to modern dynamic and static energy conversion devices.

403. MECHANICAL SYSTEMS DESIGN I. 2-2-3.
Prerequisites: ME 302, 304, 306. A lecture and project covering problem solving methodology in the design, analysis and synthesis of mechanical and thermal systems. The student's background in all subject areas is utilized together with engineering principles and topics covered in the classroom to serve as a foundation for broad engineering projects. Emphasis is placed on creative thinking and the engineering design process in projects involving the optimal conversion of resources.

404. MECHANICAL SYSTEMS DESIGN II. 2-2-3.
Prerequisites: ME 403, IE 494. A continuation of Mechanical Systems Design I from a more integrated viewpoint. Concepts in optimization and computer simulation are considered in the design and synthesis of mechanical and thermal systems. The projects are more comprehensive, emphasize creative design, and require design decisions of a more sophisticated nature.

405. MECHANICAL LABORATORY II. 1-2-2.
Prerequisites: ME 302, 343. A laboratory course for mechanical engineering students. Emphasizes the use of fundamental principles and instrumentation systems for the analysis and evaluation of mechanical devices and systems.

406. MECHANICAL LABORATORY III. 1-2-2.
Prerequisite: ME 405. An advanced laboratory course for mechanical engineering students. Includes the testing and evaluation of complete mechanical systems.

410. WORK EXPERIENCE II.
Cooperative Education Work Experience of six months, normally with same employer as ME 310. Prerequisite: ME 310 and permission of Director of Cooperative Education.

437. STRUCTURAL ANALYSIS. 3-0-3
Prerequisite: Mech 232. A course designed to acquaint mechanical engineering students with the fundamentals of structural analysis. Consideration is given to such topics as stresses and deflections of beams as well as the design of beams, columns, trusses and structural connections of steel, reinforced concrete, and timber structures.

451. INTRODUCTION TO AERODYNAMICS. 3-0-3.
Prerequisites: ME 301 and 304. A first course in aerodynamics which introduces the student to the basic principles and properties of fluid flow around immersed bodies. Topics discussed include the kinematics and dynamics of fluid fields, the thin airfoil, finite wing theory, and one dimensional compressible flow.

453. ENERGY CONVERSION. 3-0-3.
Prerequisites: Undergraduate Thermodynamics and EE 305. An elective, course for engineering students dealing with the theory, analysis, and design of modern static and dynamic energy conversion devices. The ap-

plications include thermoelectrics, magnetohydrodynamics, electrohydrodynamics, fuel cells, reciprocating and rotary energy converters.

ME 455. AUTOMATIC CONTROLS. 3-0-3.
Prerequisites: ME 305. An introductory course covering the principles of automatic controls. Emphasis is placed on mechanical systems considering hydraulic, pneumatic, thermal, and displacement aspects. First and second order linear systems are studied. Various system analysis techniques such as Nyquist and Bode diagrams are introduced. These techniques are applied in System Design.

456. FLUID MACHINERY. 3-0-3.
Prerequisites: ME 301, 304 and Math 222. An introduction to the underlying principles of rotating fluid machinery. The fundamentals of gas dynamics are introduced. Analytical, graphical, and dimensional analysis methods are used in analyzing axial and centrifugal machines. Airfoil, cascade and channel flow theories are introduced.

457. ELECTRO-MECHANICAL DEVICES. 3-0-3.
Prerequisite: ME 305. An introduction to electro-mechanical systems from both an analytical and a descriptive viewpoint. The analysis and design of practical devices such as accelerometers, valves, missiles, microphones, vibrometers, and electro-static speakers are presented.

462. ENERGY CONVERSION AND THE ENVIRONMENT. 3-0-3.
Prerequisite: Undergraduate thermodynamics. The operation of energy conversion systems and their impact on the environment will be studied. Topics include current and future energy resources (including geothermal, fossil fuel, wind, tide, solar hydroelectric and nuclear), factors affecting the rate of energy consumption, energy conversion systems — their efficiency and limitations, their effect on the environment (air and thermal pollutions), methods of energy conversion, and consideration of future fuel resources.

463. APPLIED THERMODYNAMICS. 3-0-3.
Prerequisites: Math 221 and Phys 111. This course presents an introduction to work, heat, and thermodynamic principles. Energy balance analysis methods are used in the solution of applied problems in the areas of power cycles, refrigeration, engines, heat transfer, thermo-economics, solar energy, and thermal pollution. This course is for non-mechanical engineering majors.

466. AIR POLLUTION CONTROL. 3-0-3.
Prerequisite: Undergraduate thermodynamics. The course objective is to familiarize the student with the sources of air pollution caused by mechanical equipment and to investigate primary industrial contributors to the problem. Various methods of reducing air pollution will be investigated.

467. ASPECTS OF THERMAL POLLUTION. 3-0-3.
Prerequisite: Undergraduate thermodynamics. This course investigates the problems associated with the rejection of waste energy of power generating plants and other industrial heat generating equipment. The primary concern of this study will be the effects of heat rejection upon the immediate environment and how one can help mitigate the associated problems.

468. NOISE POLLUTION AND ABATEMENT. 3-0-3.
Prerequisite: Differential equations. Discussion of sources and characteristics of noise pollution; physiological effects of noise; hearing conservation; study of fundamentals of noise propagation; techniques of noise measurement; product design for abatement of industrial noise and transportation noise; and noise control legislation.

470. ENGINEERING PROPERTIES OF PLASTICS. 3-0-3.
Prerequisite: Mech 232. A study of the physical properties of the various commercial thermoset and thermoplastic resins. An introduction to linear viscoelastic theory and its relationship to measurable mechanical properties of plastics. Other engineering properties such as, flammability, chemical resistance and electrical properties will be discussed.

ME 471. INTRODUCTION TO POLYMER PROCESSING TECHNIQUES. 3-0-3.
Prerequisites: ME 302 and ME 304 or equivalent. A study of the various plastics processing techniques. Included are extrusion, injection molding, blow molding, compression molding, thermoforming, rotational molding, casting, etc. The relationship between product design and choice of process will be presented.

480. INTRODUCTION TO SOLAR ENERGY. 3-0-3.
Prerequisites: Undergraduate Thermodynamics. An elective course concerned with the use of solar energy for distillation, pool heating, domestic water heating, and space heating and cooling. The thermal processes by which solar radiation is absorbed by a surface, converted into heat, distributed, and stored, will be studied. Calculation procedures for determining the heat loss of buildings, and the development of computer models and simulation techniques will also be covered.

490. MECHANICAL ENGINEERING PROJECT A. 2-0-2.
Prerequisite: Senior standing. A mechanical engineering projects course in which the student works on one or more individually selected projects. The projects usually involve library research, design, cost analysis, planning of testing, and preparation of engineering report.

491. MECHANICAL ENGINEERING PROJECT B. 2-0-2.
Prerequisite: ME 490. A mechanical engineering projects course in which the student works on one or more selected projects. The projects usually involve library research, design, cost analysis, planning of testing and preparation of engineering report.

510. DYNAMICS OF COMPRESSIBLE FLUIDS. 3-0-3.
Prerequisites: Undergraduate differential equations, fluid mechanics, and thermodynamics. This course covers one dimensional reversible irreversible compressible fluid flow including effects of variable area, friction, mass addition, heat addition, and normal shock; two dimensional reversible subsonic and supersonic flows with an introduction to the method of characteristics; and two dimensional oblique shock.

535. COMPUTER AIDED DESIGN. 3-0-3.
Prerequisite: Course, or demonstrated competence, in computer programming. The course concerns the adaptation of the digital computer to the solution of engineering design problems. Topics treated include design morphology, simulation and modeling, algorithims, problem oriented languages, use of available software, computer graphics, automated design and the application of these concepts to specific engineering design problems.

540. COMBUSTION ENGINE EMISSIONS AND THEIR CONTROL. 3-0-3.
Prerequisite: Undergraduate thermodynamics. This course is a study of the role of gasoline and Diesel engines in air pollution. The relationship between fundamental engine design, combustion and emission formulation is traced for the homogeneous combustion process of the gasoline engine and the heterogeneous combustion process of the Diesel engine. A discussion of present and future emission control techniques is included. Experiments and/or demonstrations on fuel characteristics, engine performance and exhaust emissions are performed.

570. INTRODUCTION TO BIOMECHANICAL ENGINEERING. 3-0-3.
Prerequisites: Undergraduate thermodynamics, and statics and dynamics. This is an introductory course in biomechanical engineering designed to interpret the functioning of physiological systems in terms of mechanical engineering systems. Topics include fluid flow, structure and motion, transport and material aspects and energy balances of the body as well as the overall interaction of the body with the environment.

571. BIOMECHANICS OF HUMAN STRUCTURE AND MOTION. 3-0-3.
Prerequisites: Undergraduate statics, kinematics, and dynamics. Principles of engineering mechanics and materials science are applied to the study of the behavior of human structural and kinematic systems and to the design of prosthetic devices. Topics include anatomy; human force

systems; human motion; bioengineering materials; design of implants, supports, braces, and replacement limbs.

ME 580. POLYMER PROCESSING TECHNIQUES. 3-0-3.
Prerequisites: Undergraduate courses in Fluid Dynamics and Heat Transfer. A course dealing with the processing of plastics. Included are the fundamentals of the various processing techniques; extrusion, injection molding, compression molding, thermoforming, casting, foaming, etc.

Surveying

(The program in surveying is administered by the Department of Civil & Environmental Engineering. For course reference and faculty listing, please turn to page 71.)

CE 301S. ADVANCED SURVEYING. 3-3-4.
Prerequisite: CE 200. Plane table; barometric and precise leveling; introduction to hydrographic surveying; advanced computations; azimuth from sun observation and polaris.

302. GEODETIC SURVEYING. 3-3-4.
Prerequisites: Math 223 and CE 301S. Triangulation, precise traverse, trilateration; adjustment of geodetic figures; baseline measurement; map projections, State Coordinate Systems.

303. PHOTOGRAMMETRY I. 3-0-3.
Prerequisites: Math 223 and CE 305. Photographic principles and optics; relationship between map accuracy and altitude; general cartographic principles; each student will work with both scribing and ink. (Approximately one third of the lectures will be devoted to laboratory work.)

304. ADJUSTMENT COMPUTATIONS I. 3-0-3.
Prerequisite: Math 223. Error theory; variances and co-variances; observation equations; condition equations; introduction to least square adjustment.

402. GEODETIC ASTRONOMY. 3-0-3.
Prerequisite: CE 200. Spherical trigonometry; stellar coordinate systems; time; ephemerides; and star catalogues detemination of azimuth, latitude, longitude and time. (Approximately one-quarter of the lectures will be devoted to field observations.)

403. PHOTOGRAMMETRY II. 3-3-4.
Prerequisite: CE 303. Theory of direct projection and optical train plotters; introduction to aerotriangulation; writing and evaluating photogrammetric specifications and proposals; national map accuracy standards; introduction to terrestrial photogrammetry. (Each student will plan and write specifications for an aerial mapping project.)

404. ADJUSTMENT COMPUTATIONS II. 3-0-3.
Prerequisite: CE 302. Least squares adjustment; error ellipses; matrix methods in adjustments; solving large systems of equations.

405. HYDROGRAPHIC SURVEYING AND CHARTING. 3-0-3.
Prerequisite: Senior standing. Stream, gauging, soundings; weirs; tide gauges; electronic methods; shoreline and tideland surveys; snow surveys; preparation of maps and charts for navigation. (Approximately one quarter of the lectures will be devoted to field observations.)

421. SURVEYING LAW. 3-0-3.
Prerequisite: CE 200. Rules of evidence; resurveys; subdivisions; condominiums; riparian rights; wetlands; eminent domain; adverse possession; title; deeds; descriptions; etc. The emphasis will be on New Jersey law; however, other laws including those of the Public Land System will be considered.

CE 422. SUBDIVISION DESIGN. 3-0-3.
Prerequisite: CE 200. A design course in the preparation of major and minor subdivision plans.

423. GEODESY. 3-0-3.
Prerequisites: CE 402 and CE 404. Spherical coordinate systems; ellipsoid; geometric, satellite and gravimetric geodesy; deflection of the vertical and Laplace observations.

424. REMOTE SENSING. 3-0-3.
Prerequisites: CE 403 and CE 404. Review of remote sensing systems including infra-red scanners, side looking radar; thermal; airborne and satellite systems; introduction to digital and thematic mapping.

425. SITE PLANNING AND LAND DEVELOPMENT. 3-0-3.
Prerequisite: Junior and Senior standing. A design course in the preparation of site, land development, and related plans.

426. ANALYTICAL AEROTRIANGULATION. 3-0-3.
Prerequisites: CE 403 and CE 404. Theory and applications of analytical aerotriangulation will be stressed; investigation of existing computer software; various computer solutions will be executed by each student.

427. ELECTRONIC SURVEYING. 3-0-3.
Prerequisite: CE 200. Theory of visible light, laser, infrared and microwave measuring systems; accuracy of various equipment; atmospheric corrections and effects; long line measurements; reduction of arc distance to chord and of chord distance on the ellipsoid. (approximately one-quarter of the lectures will be devoted to field observations.)

Organizational and Social Sciences

Chairman: Roy B. Helfgott
Associate Chairman: Theodore Zaner

Distinguished Professor: Helfgott; *Professors:* Bordman, Stochaj, Zaner; *Associate Professors:* Kahng, LaVerda, Lubin, Rucker; *Assistant Professors:* Gordon, Mills, Rotter, Schachter, Sen, Spector, Spitz; *Special Lecturers:* Horowitz, Moore, Seymour.

SS 201. ECONOMICS. 3-0-3.
The nature of a market economy. Microeconomics — demand theory, production possibilities, cost and price, equilibrium analysis, and applications to decision-making in the firm. Macroeconomics — national income accounts, consumption, investment, government monetary and fiscal policy, and problems of employment and price levels. Economic analysis leading to an understanding of current developments in the United States economy and international trade and currency problems.

202. LABOR RELATIONS. 3-0-3.
Development of unionism and collective bargaining in the United States. Government regulation of labor-management relations. The labor force, wages and hours, wage structure, productivity, unemployment and inflation, equal employment opportunity, and manpower analysis. Public policy with respect to labor market problems.

210. GENERAL PSYCHOLOGY. 3-0-3.
Introduction to the study of human behavior. Topics include motivation, perception, learning, cognitive development, personality and emotion, individual differences, and biological bases of psychology, as well as methodology in psychological research.

SS 221. SOCIOLOGY. 3-0-3.
An examination of modern society and culture, analyzing the forces for stability and change. Topics to be covered are: the individual and society — socialization, conformity, alienation, class structure; social institutions — religion, law, education, family, state; social process — conflicts and harmony, cohesion and dissolution, power, authority and revolution; urbanization, industrialization and technological change.

231. POLITICAL SCIENCE. 3-0-3.
The course concerns itself with such items as the concept of the state, authority; institutions of control, monarchy, dictatorship, democracy; constitutionalism and liberty; and the relationship between the law, the state, and the individual.

301. ECONOMIC ANALYSIS: THEORY AND APPLICATIONS. 3-0-3.
Prerequisite: SS 201. Supply and demand analysis; the economics of households and firms; resource allocation; determination of product and factor prices under varying market structures; non-price sector; welfare economics. Attention is focused on public policy issues, including the effects of government intervention in the market through taxes, subsidies, price regulations and anti-trust.

310. WORK EXPERIENCE I.
Cooperative Education Work Experience of six months providing industrial reinforcement of Academic Program. Direct exposure to industrial situations work assignments provided by and approved by Director. Prerequisite: Completion of Sophomore Year. Approval of Department and permission of Cooperative Education Director.

311. INDUSTRIAL PSYCHOLOGY. 3-0-3.
Prerequisite: SS 210. The many applications of psychology to the industrial scene are studied. The course deals with industrial environments, personnel psychology, men and machines, special groups in industry, and social interaction and adjustments.

314. CONSUMER BEHAVIOR. 3-0-3.
Prerequisites: Math 105 or equivalent and either SS 210 or SS 221 or OS 261. Examines psychological, social, and economic influences on consumer behavior. Considers the application of consumer behvioral information to marketing decisions. Topics include research and measurement techniques, individual influences, environmental influences and consumer information processing and decision making. As part of the course a field research project will be undertaken.

331. POLITICS, PLANNING, AND THE PUBLIC INTEREST. 3-0-3.
Prerequisite: One of the following: SS 202, 210, 221, or 231. Deals in a broad manner with issues of public policy, wealth, bureaucracy and power in the United States. Attention will be paid to the nature and causes of American political thinking, the distribution of political and economic power in the country, and the impact of these factors upon public problems in such areas as race and poverty.

402. LABOR MARKET ANALYSIS. 3-0-3.
Prerequisites: SS 201 and junior standing. Nature of a free labor market. Concepts and measurements of labor force, participation rate, employment, and unemployment. Technological and economic change and the changing structure of employment. Women and minorities in the labor market. Structure of labor markets and special problems of urban labor markets. Recruitment and development of a labor force by a firm; internal labor markets. Wage structure, sources of wage information, importance of productivity, and impact of unions and government on a firm's wage structure.

403. SOCIAL INSURANCE AND EMPLOYEE BENEFITS. 3-0-3.
Prerequisites: SS 201 and one other social science course. The causes of economic insecurity in an urban, industrial society and the personal and societal consequences. Examination of social security, unemployment insurance, workers' compensation, public assistance and other government programs, as well as private programs of employee benefits. Analysis of

trends in coverage, benefits, and benefit levels and the impact of demographic, economic, and technological developments on the viability of present and proposed programs.

SS 411. MONEY AND BANKING. 3-0-3.
Prerequisites: SS 201, SS 301. Nature and functions of money. The commercial banking system. The Federal Reserve System. Demand for money, its behavior, and relation to income. Monetary and fiscal policy. Inflation. International finance. Offered Fall semester every year.

412. THE FINANCIAL SYSTEM. 3-0-3.
Prerequisite: SS 201. A study of the Financial System with emphasis on commercial banks and their role in Industrial Organization in the United States. A look at bank lending, investments, and trust operations as well as financial intermediaries and the role of the government. A study of the technological changes that have faced the banking industry over the last 30 years. Offered Spring semester every year.

413. WORK EXPERIENCE II.
Cooperative Education Work Experience of six months, normally with same employer as SS 310. Prerequisite: SS 310 and permission of Director of Cooperative Education.

431. MUNICIPAL GOVERNMENT IN CONTEMPORARY SOCIETY: THEORY AND PRACTICE. 3-0-3.
Prerequisite: Junior standing. This course is designed to provide the municipal engineer or planner with a foundation for planning and operational efficiency based upon the concepts and problems of local government. Attention is focused on such topics as fiscal management, intergovernmental relations and planning and operation of public works.

433. MINORITIES: CULTURAL PATTERNS AND AMERICAN INSTITUTIONS. 3-0-3.
Prerequisite: One of the following: SS 202, 210, 221, or 231. Inter-ethnic relations are examined in the light of cultural patterns in selected societies and their subsequent impact on American institutions. Such institutional areas as crime, custom, law, economy, religion and ritual, and courtship, marriage and kinship, will be analyzed. Consideration is given to divergent value systems, ethical codes, linguistic psychology, and the problems which develop when persons attempt to function across cultural and racial barriers. Emphasis will be upon the Black, Chicano, European and Hispanic experience.

506. TECHNOLOGY ASSESSMENT. 3-0-3.
Prerequisites: SS 201 and a course in calculus or statistics. A framework for assessing the impact of technology on society, taking into account both present and future interactions of economic, social and environmental factors. The approach to existing problems will be multi-disciplinary, and analytical techniques for evaluation and forecasting will be utilized and demonstrated (i.e., benefit-cost analysis, cross impact matrices).

511. ECONOMICS OF ENERGY. 3-0-3.
Prerequisites: At least one course that includes micro and macroeconomics. The demand for energy, its sources and determinants (elasticity measures); trends in patterns of energy use and future prospects; international aspects. The supply of energy; alternative sources (coal, nuclear, geothermal, solar); economic analysis of shifts among sources; industrial and market structures in the energy production sector; significance for supply elasticities and energy prices. The "energy crisis" — analysis and evaluation. The economics of long-range energy decisions — new sources and conservation and environmental protection; evaluating costs and benefits; decision model for energy technology assessment; the breeder deferment decision; energy — economy interactions; energy sector share of GNP; impact of energy cuts on GNP; alternative economic techniques for reducing energy consumption.

521. URBAN SOCIAL STRUCTURE. 3-0-3.
An introduction to the city as a social system. The study of the conflict relations among various segments of the urban population; race and religion

— their implication; the changing systems, of social stratification; urban family structure; and the concept of a "culture of poverty." The impact of social and technological change upon urban society, the physical and environmental characteristics of a city as outputs of social systems as well as constraints upon behavior. Offered 1978-79 and alternate years.

ORGANIZATIONAL SCIENCE

OS 171. INDUSTRIAL ORGANIZATION AND MANAGEMENT. 3-0-3.
Not available to engineering or technology students. An introduction to business enterprise, including organization structure, basis of authority and responsibility, financial systems, marketing, and the interaction of government and business. The interrelationships of the broad economic, political, psychological and social influences upon business are discussed.

261. INTRODUCTION TO THE BEHAVIORAL SCIENCES. 3-0-3.
Prerequisites: One of the following: SS 202, 210, 221, or 231. The content, methods, and prospectus of the behavioral sciences; analysis of the needs that have emerged from organizational and human interaction in a democratic society; organization and development of formal and informal groups; interaction process analysis; the development of interdisciplinary scholarly pursuits; and a critical examination of selected behavorial studies. Emphasis will be placed upon the community and work, particularly in the urban setting.

371. SUPERVISION AND EMPLOYEE RELATIONS. 3-0-3.
The nature of supervision, particularly at the first-line. Qualifications, duties and responsibilities of supervisors. Planning the job, making work assignments, progressing, and controlling employees. Techniques of employee relations, such as conducting job instruction, maintaining discipline, appraising performance, and handling grievances. The supervisor's inter-relationships with upper management and labor union representatives. The conference method and case study techniques are utilized.

381. PERSONNEL MANAGEMENT AND INDUSTRIAL RELATIONS. 3-0-3.
Background and operating concepts governing the management of human resources in business, industry, and government. Coverage includes job study and recruitment, selection, training, motivation, wage and salary administration, employment stabilization, personnel records and research, and the management of relations with organized employees.

391. LABOR—MANAGEMENT RELATIONS. 3-0-3.
Labor-management relations. Unions, collective bargaining, management prerogatives, the settlement of disputes, and legislative controls. The role of the supervisor in dealing with his employees as members of organized groups, particularly with respect to handling employee grievances.

432. AMERICAN TRADITION OF PUBLIC ADMINISTRATION. 3-0-3.
Prerequisites: SS 201, SS 231. A survey of the role and functioning of the Federal government bureaucracy in the United States. Historical review of how presidential power has grown; administrative reform movements; important commissions of inquiry; the power of regulatory commissions and public agencies. How public administration is changing and what it will look like in the future.

451. CONTEMPORARY INTERNATIONAL ISSUES. 3-0-3.
Today's complex international crises as they relate to political, economic, military, and social developments. Sino-Soviet-US relations, the European Economic Community, the power of OPEC, and the fate of the poor nations. Developments in Africa, Asia, the Middle East, and South America. Not available to BSIA students.

452. CONTEMPORARY SOCIAL AND POLITICAL ISSUES. 3-0-3.
How social problems develop, focusing on topics such as the generation gap, poverty, demography, race relations, and urban affairs. Strains arising from conflicting demands within American society, and perspective on remedial actions. Not available to BSIA students.

453. CONTEMPORARY LABOR ISSUES. 3-0-3.
The major problems affecting the relationship of labor with management

and the total society. Topics include the problem of wages and inflation, unemployment, equal employment opportunity, manpower policy, and worker alienation.

OS 454. CONTEMPORARY ECONOMIC ISSUES. 3-0-3.
The major economic issues of the era, including the urban crisis-poverty, health, housing, mass transit, and pollution control; international trade and monetary realignment; population dynamics; economic growth and full employment; and the shortage of energy and raw materials.

455. CONTEMPORARY MANAGEMENT ISSUES. 3-0-3.
An assessment of management's evolving setting. Management and governmental regulation. Social responsibility and ecological problems. Business ethics. The growth of public organizations. Private enterprise and international competition. The role of small business and the problems of establishing new organizations. The problems of organization structure and bureaucracy in large organizations. Labor union power and emerging collective bargaining patterns.

456. CONTEMPORARY ECOLOGICAL ISSUES. 3-0-3.
Political, social, economic, and legal questions related to national and international problems and programs involving environmental action. Population increase. Living standards in the USA and the rest of the world. Natural resource consumption. Limits to growth. The present state of environmental legislation affecting pollutants: air, water, agricultural, thermal, metal, pesticides, solid wastes, and noise. Not available to BSIA students.

457. TECHNOLOGY AND SOCIETY I. 3-0-3.
Prerequisite: Two semesters of science. Critical analysis of technological progress and its impact upon society. The directions provided by modern science and research, engineering, production, distribution, and consumption. Examination of the effects of private and public policy direction and management. Discussion of the resulting problems of ecological decay and energy deployment. Not available to engineering students.

458. TECHNOLOGY AND SOCIETY II. 3-0-3.
Prerequisite: OS 457. An interdisciplinary approach to planning and utilizing human and material resources. Technological assessment which integrates the needs of business, government, the consumer, and the citizen for both the short-run and long-term. Discussion of approaches and models for solving societal problems which have resulted from technological advances. Topics include a systems approach to planning and utilizing human and material resources, the decision-making process and the use of feedback and computer applications. Not available to engineering students.

461. GROUP DEVELOPMENT AND DYNAMICS. 3-0-3.
Prerequisite: OS 371. The study of individual needs in relation to the formation of groups in business and industry. Introduction to interaction analysis and group life. A review of several major behavioral studies upon which the field of group dynamics is founded. The course includes an analysis of group process as it is applied in sensitivity training, encounter groups, and action research.

471. MANAGEMENT PRACTICES. 3-0-3.
Not available to students who have taken OS 472. The concepts and programs of modern management with emphasis upon the role of the engineer at all levels of responsibility. Organization, motivation and morale; scientific management and human relations; the functions of planning, directing, and controlling; the influence of industrial engineering, labor unions, staff personnel departments, and research.

472. MANAGEMENT AND ORGANIZATIONAL BEHAVIOR. 3-0-3.
Not available to students who have taken OS 471. The concepts and programs of modern management with emphasis upon technological progress and its effect upon organizational behavior. Coverage includes structure of industrial organization, leadership styles, labor-management relations, in-

novation, and decision-making. The course will introduce methods and findings of the behavioral sciences as these apply to management and organizational behavior.

OS 473. EMPLOYEE-MANAGEMENT COMMUNICATION. 3-0-3.
Prerequisite: OS 371. The establishment and maintenance of effective channels of both formal and informal oral and written communication among and between management and workers, including attention to the technical essentials of impressive presentation of ideas. Techniques for handling supervisory conferences and reports. The preparation, use, and revision of handbooks and various directives, instructions and manuals of information.

474. HUMAN RESOURCES MANAGEMENT. 3-0-3.
Not available to students who have taken OS 471 or OS 472. An examination of selected problems in human resources management related to the role of the Industrial and/or Management Engineer. Operating with labor contract provisions, arbitration awards, wage incentive plans, performance appraisal systems, and management by objectives. The process of establishing and maintaining progressive programs of industrial relations. The needs of supervisors at all levels to participate in decision-making. Case studies and participative techniques are utilized.

481. JOB AND WAGE ANALYSIS. 3-0-3.
Prerequisite: SS 201. Investigation of the renumeration of groups of workers and study of formulation of policy or decisions which must take into account numerous economic and organizational relationships which are part and parcel of the practical problems of wage and job control. Particular emphasis is placed on job evaluation techniques. The nature of incentives, particularly for jobs in highly mechanized production operations, is studied. Multiple factor incentive plans are analyzed.

482. TRAINING AND DEVELOPMENT. 3-0-3.
Analysis of programs of manpower planning and development to strengthen the organization's capability by improving its human resources. Planning employee and management development programs to provide the individual the opportunity for advancement consonant with the requirements of the organization. The process involved in identifying training needs, the design of training programs, simulations and use of evaluation systems for determining the effectiveness of training programs.

484. ADMINISTRATION OF EQUAL EMPLOYMENT OPPORTUNITY PROGRAM. 3-0-3.
Prerequisites: OS 471, OS 472, or OS 474. Organizational programs and problems in the field of Equal Employment Opportunity and Affirmative Action. The fundamental laws, regulations guiding principles relative to EEO and AA. Management's responsibilities in handling discrimination complaints. The impact of EEO and AA on organizational selection and testing programs. Affirmative action: program planning and development goals, time tables, progress, and evaluation procedures. Case studies and role-playing utilized.

490. PROJECT AND SEMINAR I. 3 credits.
Prerequisite: Senior standing in the "Industrial Administration" program with an elective concentration in industrial relations. A comprehensive experience with practical problems in industrial relations. The student must become intimately involved in one or more of the industrial relations functions in a public or private organization in areas such as recruitment and placement, equal employment opportunity and affirmative action, labor relations, wage and classification, training, and overall industrial relations organization and evaluation. Attendance at appropriate seminars required. Student progress evaluated through written reports or oral conferences with instructing staff. The student required to submit a comprehensive report summarizing accumulated experiential data in relation to professional growth.

491. PROJECT AND SEMINAR II. 3 credits.
A continuation of OS 490.

Physics

Chairman (Acting): Leon D. Landsman
Associate Chairman: Leon J. Buteau, Jr.

Professors: Buteau, Capecelatro, Sagurton, Salzarulo; *Associate Professors:* Farber, Fink, Gautreau, Kuharetz, Landsman, Natapoff, Neidhardt, Russo, Savin, Stevenson, Towfik; *Assistant Professors:* Aaron, Giordano, Jermakian, Kingery, Reisman, Reiziss.

Phys 100. INTRODUCTORY PHYSICS. 3-2-4.
This course is designed for students who have not had high school physics and for those who wish to review the subject. It may be taken in the summer preceding the Freshman year or in the first semester of the Freshman year. It consists of a survey of introductory physics with special emphasis on those portions of the subject matter which are most useful to engineering students.

102. GENERAL PHYSICS. 3-2-4.
Prerequisite: Satisfactory completion of 2 units of high school mathematics and 2 units of high school science. This course is intended for students in pre-architecture. It is an elementary course in statics dynamics and beginning topics in electricity. Subjects discussed are kinematics, Newton's laws of motion, energy and momentum, conservation principles, mechanical properties of matter, simple harmonic motion, waves, Coulomb's law, the electric field, and Kirchhoff's laws..

103. GENERAL PHYSICS. 3-2-4.
Prerequisite: Phys 102. This course is intended for students in pre-architecture. Topics discussed are electricity, heat, thermodynamics, optics and topics in modern physics.

105. PHYSICS A. 3-2-4.
Corequisite: Math 111. This course constitutes a study of elementary mechanics. Emphasis is on the fundamental laws of mechanics and conservation laws. Topics include scaler and vector quantities, rectilinear motion, equilibrium and Newton's Laws of Motion, friction, work and energy, impulse and momentum.

106. PHYSICS B. 3-2-4.
Prerequisite: Phys 105. This course is an extension of Physics A in the area of mechanics and an Introduction to electricity and magnetism. Topics discussed will include circular motion, moment of inertia and radius of gyration, angular motion, DC circuits, electric fields and magnetic fields.

107. PHYSICS C. 3-2-4.
Prerequisite: Phys 106. This course is a continuation of Physics B and includes relationships between electric and magnetic fields, magnetic properties of matter and simple AC circuits.

111. PHYSICS I. 3-2-4.
Corequisite: Math 111. This course deals with the study of elementary mechanics. Emphasis is placed on the fundamental concepts and laws of mechanics, especially the conservation laws. Topics discussed are: scalar and vector quantities of mechanics; rectilinear, and circular motion; equilibrium and Newton's laws of motion; work, energy, momentum; the conservation laws; and elements of heat. Correlated experiments and computations run concurrently with lectures and recitations.

112. PHYSICS IH. 3-2-4.
Corequisite: Math 111. This is the first semester of a three-semester program in Honors Physics. This course covers the material taken up in Phys I, but topics are treated more comprehensively and in greater depth. More extensive use of mathematics is made in Phys 1H.

121. PHYSICS II. 3-2-4.
Prerequisite: Phys 111 or 112 and Math 111. This course deals with an in-

troduction to electricity and magnetism. Topics discussed include simple DC circuits, the electric field, the magnetic field, relationships between electric and magnetic fields, magnetic properties of matter, and simple AC circuits. Correlated experiments and computations are assigned concurrently with lectures and recitations.

Phys 122. PHYSICS IIH. 3-2-4.
Prerequisites: Phys 111 or 112, Math 111. This is the second semester of a three-semester program in Honors Physics. The course covers the material given in Phys 121. Greater use is made of vector analysis. In addition, an introduction to Maxwell's equations for the electromagnetic field and their application to physical problems are discussed.

201. CONCEPTS OF PHYSICAL SCIENCE. 3-0-3.
Prerequisites: Admission to B.S.I.A. Program. This course is intended for B.S.I.A. students only. It presents a summary and outline of physical concepts through the historical development of physics. Topics to be covered include the contributions of the Ancient Greeks, Galileo, Newton and the men of more recent times.

230. PHYSICS III. 4-1-4.
Prerequisites: Phys 121, Math 111. This course is intended for students in Chemical Engineering only. Elements of heat, simple harmonic motion, wave motion, geometric and physical optics are treated. Modern theories of matter and radiation are discussed. The equivalence of mass and energy is also discussed.

231. PHYSICS III. 4-2-5.
Prerequisites: Phys 121, Math 111. Elements of heat, simple harmonic motion, wave motion, geometric and physical optics are considered. The wave and particle duality of nature is emphasized and made plausible by an examination of the important experiments and theories which lead to the modern concepts of matter and radiation. The conservation laws are now broadened to include the law of equivalence of mass and energy. Experiments complement lectures and recitations.

232. PHYSICS III H. 4-2-5.
Prerequisites: Phys 121 or 122, Math 112. This is the third semester of a three semester program in Honors Physics. This course covers the material given in Phys 231. Physical optics is treated in greater detail. Modern physics includes a greater number of topics, with special emphasis on the wave-particle duality in nature.

310. INTRODUCTION TO ATOMIC AND NUCLEAR PHYSICS. 3-0-3.
Prerequisites: Phys 231, Math 222. Selected topics in atomic physics including the Pauli Exclusion Principle and the Atomic Shell Model will be discusssed. In nuclear physics, the two body problem, nuclear models, alpha, beta, and gamma rays will be studied. Accelerators and nuclear detectors will also be treated.

320. ASTRONOMY. 3-0-3.
Prerequisites: Phys 102, 201, or 111. A survey of the astronomy of the solar system, the stars, the Galaxy, and galaxies in general with an emphasis on the physical principles involved.

390. SELECTED TOPICS OF CURRENT INTEREST IN PHYSICS. 1-0-1.
Prerequisites: Phys 230, 231 or 232. This is a seminar course covering topics that are currently in the forefront of physics. The lecture series offers exposure to such topics as nuclear physics, solid state physics, plasma physics and the special and general theory of relativity, and the history and philosophy of science.

441. MODERN PHYSICS. 3-0-3.
Prerequisites: Phys 231, Math 222. After a brief review of classical physics and kinetic theory, the course considers nuclear and atomic structure. Key experiments illustrating the wave particle duality are discussed and elements of wave mechanics are introduced, followed by applications of two-state quantum systems. The motion of an electron in a periodic lattice

is then discussed, leading to a consideration of the band theory of solids. The electrical, thermal, and magnetic properties of solids follow. The course terminates with a semi-quantative description of plasmas and superfluid systems.

Phys 442. **INTRODUCTION TO QUANTUM MECHANICS. 3-0-3.**
Prerequisites: Phys 230, 231 or 232, Math 222. After a brief review of the experiments leading to the development of quantum mechanics, the course deals with matter waves, Schrodinger's wave equation, Heisenberg's uncertainty principle, operations, and commutators. This leads to the concept of standing waves applied to particles bound in potential wells, the harmonic oscillator, the hydrogen atom, potential barriers, and angular momentum. This is followed with the concepts of degeneracy, composite states, and the general properties of eigenfunctions.

443. **OPTICS. 3-0-3.**
Prerequisites: Phys 230, 231 or 232, Math 222. This course deals with geometrical and physical optics. Geometric optics includes thick lenses and lens design. Physical optics is based on the electromagnetic theory of light and includes dispersion, absorption, optical activity, Fresnel and Fraunhofer diffraction, resolution of optical instruments, and phase contrast microscropy. Time permitting, elements of fiber optics and non-linear optics will be introduced.

444. **THEORETICAL PHYSICS I. 3-0-3.**
Prerequisites: Phys 230, 231 or 232, Math 222. This is a course in the physics of particles. It begins with a study of single particles and extends to an analysis of a collection of particles. Included in the course are Newtonian mechanics, Lagrange's equations, Hamilton's and other variational principles.

445. **THEORETICAL PHYSICS II. 3-0-3.**
Prerequisites: Phys 230, 231 or 232, Math 222. This is a course in the physics of fields. The concepts of fields are applied to elastic media and wave propagation in such media, fluid dynamics, heat and the electromagnetic field, concluding with Maxwell's equations. Topics of special interest to students and instructor will terminate the course.

446. **SOLID STATE PHYSICS. 3-0-3.**
Prerequisite: Phys 441. This course is an introduction to modern concepts of the solid state. Topics include crystal structure and diffraction, crystal binding and elastic properties, thermal properties, dielectric phenomena, band theory of solids and Fermi surfaces, electrical conductors, semiconductors, magnetism and super-conductivity.

447. **THERMODYNAMICS. 3-0-3.**
Prerequisites: Math 222 or 330, Phys 231. An integrated approach to thermodynamics, encompassing classical and quantum properties of matter. An essential aspect of the course is that macroscopic properties of matter are derived from its microscopic properties. Examples from many fields, including gases, liquids, solid, liquid and gaseous conductors, and magnetic materials are used extensively to show the universality of the application of thermodynamic analysis. The course provides a useful thermodynamic background for many fields of science and engineering.

448. **SEMICONDUCTOR PHYSICS. 3-0-3.**
Prerequisite: EE 212. The physics of semiconductors is examined and applied to problems of interest to the electrical engineer. The course includes the following topics: the band theory of solids, conduction in solids, hole and electron statistics, and P-N junction theory with emphasis placed upon low-level and high-level injection. Metal semiconductor contacts and P-N-P transistor theory are also discussed.

449. **ADVANCED PHYSICS LABORATORY. 0-6-3.**
Prerequisites: Senior standing and permission of the Department. The student will draw on his previous studies to examine experimentally the interaction of photons and particles. These interactions will be examined by optical and spectroscopic methods involving non-monochromatic as well as

laser light, by electrical and electronic devices, using vacuum, thin film and Hall-measurement techniques, by nuclear irradiations involving a sub-critical reactor and the necessary associated measuring techniques, and by means of plasmas using resonance and microwave methods. Independent study, library research, and data reduction involving advanced error analysis form an integral part of the course.

Phys 540. **MODERN PHYSICS. 3-0-3.**
Prerequisite: Differential equations. The course deals with wave and particle nature of light, matter, and energy; experimental determination of the values of important physical constants; particle beams in electric and magnetic fields; the special theory of relativity; assemblies of particles, wave-particle experiments leading to quantum concepts and wave mechanics; the Schroedinger equation applied to simple problems; atomic structure and spectra; molecules; binding and energy bands in solids; and electrical, thermal, and magnetic properties of solids.

NUCLEAR ENGINEERING

NE 407. **NUCLEAR ENGINEERING. 3-0-3.**
Prerequisites: Math 222, Phys 230 or 231 or 232. The basic concepts of nuclear engineering practice are *introduced and developed in ways that suit their ultimate* applications to the design of a nuclear reactor. Topics include nuclear instability and radioactive decay, nuclear interactions, nuclear fission, neutron slowing down, and reactor criticality.

408. **NUCLEAR ENGINEERING. 2-2-3.**
Prerequisite: NE 407. The course includes basic experiments in nuclear instrumentation and experiments with a sub-critical reactor. The experiments performed are of such a nature as to assist the nuclear engineer in the general area of reactor design.

409. **NUCLEAR REACTOR THEORY. 3-0-3.**
Prerequisite: NE 407. Selected topics in the analysis, design and construction of nuclear reactors including neutron diffusion, one, two, and multi-energy-group as well as Fermi age calculations, reactor kinetics, poisoning, reactor control, temperature effects, and numerical calculations.

410. **NEUTRON TRANSPORT THEORY. 3-0-3.**
Prerequisites: Math 222, Phys 230, 231 or 232. A geometric approach to problems dealing with the ways in which neutrons distribute themselves in various regions of space is presented for situations that have exact analytic solutions. The mathematical laws which describe these neutron distributions are developed. Solutions of the mathematical equations, both exact and those using various numerical approximations are compared to provide an understanding of how neutrons are distributed in various regions of a nuclear reactor and a radiation shield.

MATERIALS SCIENCE

MtSc 311. **PROPERTIES OF MATERIALS. 3-0-3.**
Prerequisite: 2 semesters of College Physics or Equivalent. This course is intended for bachelor of technology students and is an introduction to the principal metallic and non-metallic engineering materials, including their physical properties, response to heat treatment, corrosion resistance, machining characteristics, surface finishing and extrusion processes.

318. **ENGINEERING MATERIALS. 3-2-4.**
Prerequisites: Chem 116, Phys 231. This course introduces the student to such engineering materials as metals, viscoelastic materials, ceramics, polymers and semiconductors. The approach is interdisciplinary with stress upon the structure of materials. Various mechanical and thermal treatments are discussed and related to the stability of the resultant properties. The laboratory sessions implement and emphasize the effects of these mechanical and thermal treatments on the materials.

MtSc 319. ENGINEERING MATERIALS. 3-0-3.
Prerequisites: Chem 116, Phys 231. This lecture course is identical to MatSc 318, with the laboratory omitted.

450. ELECTRON MICROSCOPY. 2-2-3.
Prerequisites: Chem 116, Phys 231. This course combines the lecture and laboratory in introducing the field of electron microscopy. Topics include magnetic electron lenses, electron optical systems, selected area diffraction, sample preparation, thin foil techniques and photography.

451. X-RAY DIFFRACTION. 2-2-3.
Prerequisites: Chem 116, Phys 231. This course combines the lecture and laboratory in introducing the methods of X-ray diffraction. Topics include directions and intensities of diffracted beams, diffractometer methods, Laue methods, powder photographs, reciprocal lattice constructions and the rotating crystal method.

452. MATERIALS SCIENCE. 3-0-3.
Prerequisites: Chem 116, Phys 231, ME 361 or Chem 345 or Phys 447. This course emphasizes the structure and properties of materials and the relationships between them. The primary topics include the thermodynamics of solid, fracture mechanisms, diffusion, elasticity, plasticity, fatigue strength, viscosity and creep. Applications are included whenever practicable.

453. MATERIALS SCIENCE II. 3-4-5.
Prerequisites: Phy 448 or Phy 446 or EE 461 and ME 361 or ChE 345 or Phys 447. This course emphasizes the electronic properties of materials in conjunction with an introduction to ceramics. Topics included are semiconductors, thermoelectricity, magnetism, conductivity, dielectric, optical properties, and an introduction to the properties and behavior of ceramics.

Eberhardt Hall -- a designated historical landmark

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Aaron, David, Assistant Professor of Physics (1962). Brooklyn College, B.S., 1939; M.S., 1952.
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Allentuch, Arnold, Professor of Mechanical Engineering and Associate Dean for Research in the Graduate Division (1966). Worcester Polytechnic Institute, B.S., 1953; Cornell University, M.S., 1959; Polytechnic Institute of Brooklyn, Ph.D., 1962. Executive Director of The Foundation at NJIT.
Andersen, L. Bryce, Professor of Chemical Engineering (1963). University of Minnesota, B.S., 1950; M.S., 1951; M.A., 1952; University of Illinois, Ph.D., 1954. ★
Anderson, Robert E., Professor of Electrical Engineering (1949). Newark College of Engineering, B.S., 1939; University of New Hampshire, M.S., 1948. ★
Andrushkiw, Roman I., Associate Professor of Mathematics (1964). Stevens Institute of Technology, B.E., 1959; Newark College of Engineering, M.S.E.E., 1964; University of Chicago, M.S., 1967; Stevens Institute of Technology, Ph.D., 1973.
Abd-El-Bary, Mahmoud F., Assistant Professor of Chemical Engineering (1977). Alexandria University, B.S., 1960; Massachusetts Institute of Technology, M.S., 1964; Lehigh University, Ph.D., 1969.
Ayoub, Henry R., Associate Professor of Electrical Engineering (1957). Alexandria University, B.S., 1947; M.S., 1948; Newark College of Engineering, M.S., 1959. ★
Badenhausen, Otto P., Assistant Professor of History (1967). Hamilton College, A.B., 1954; Berlin Free University, M.A., 1959.
Baer, Adrian, Assistant Professor of Computer and Information Science (1977). Federal Institute of Technology, Zurich, Diploma of Architecture, 1970.
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Berliner, Armand, Assistant Professor of Mathematics (1963). Rutgers University, B.A., 1963; Newark College of Engineering, M.A., 1965.
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Giordano, Joseph, Assistant Professor of Physics (1955). Wagner, B.S., 1951; Newark College of Engineering, M.S., 1963.
Glickman, Frederick R., Assistant Professor of Industrial Engineering (1978). New York University, B.E.I.E., 1969; M.A., 1974.
Goldberg, Hayden B., Associate Professor of English (1961). Bowdoin College, A.B., 1949; Columbia University, M.A., 1952.
Golden, Robert G., Associate Professor of Engineering Graphics (1959). Little Rock College, A.B., 1951; Newark College of Engineering, B.S., 1956; Seton Hall University, A.M., 1962; New Brunswick Theological Seminary, M. Div., 1973. ★
Goldstein, Irving R., Professor of Management Engineering (1947). Newark College of Engineering, B.S., 1939; Stevens Institute of Technology, M.S., 1947. ★
Golub, Eugene, Professor of Civil and Environmental Engineering (1968) and Chairman of the Department. Cooper Union, B.C.E., 1962; Columbia University, M.S., 1964; Polytechnic Institute of Brooklyn, Ph.D., 1969. ★
Gordon, Arthur, Assistant Professor in Organizational Sciences (1950). Newark College of Engineering, B.S., 1943; M.S., 1950.
Granik, Gerald, Professor of Applied Mechanics (1952). Newark College of Engineering, B.S., 1950; M.S., 1954; Stevens Institute of Technology, M.S. (Math), 1958; Sc.D., 1965.
Greenberg, Arthur, Assistant Professor of Chemistry (1977). Fairleigh Dickinson University, B.S., 1967; Princeton University, A.M.; Ph.D., 1971.
Greenstein, Teddy, Associate Professor of Chemical Engineering (1967). City College of New York, B.Ch.E., 1960; M.Ch.E., 1962; New York University, Ph.D., 1967.
Grow, James M., Assistant Professor of Chemistry (1977). University of Illinois, B.S., 1968; University of Wisconsin, M.S., 1972; Oregon State University, Ph.D., 1975.
Hanesian, Deran, Professor of Chemical Engineering and Chairman of the Department of Chemical Engineering and Chemistry (1963). Cornell University, B.Ch.E., 1952; Ph.D., 1961. ★
Hanus, John J., Associate Professor of Engineering Graphics (1953). Marietta College, B.A., 1950; Bradley University, M.A., 1952.
Hatch, C. Richard, Associate Professor in Architecture (1975). Harvard College, A.B., 1955; University of Pennsylvania, B. Arch., 1963; University of Rome, graduate studies, 1961. †
Hausser, Paul C., Director of Health Services, Associate Professor and Associate Director of Physical Education and Athletics (1952). Panzer College, B.S., 1950; Cert. in Physical Therapy, 1951; M.A., 1954; Columbia University, Professional Diploma, 1955. New Jersey Licensed Physical Therapist.
Helfgott, Roy B., Distinguished Professor of Economics and Chairman of the Organizational and Social Sciences Department (1968). City College of New York, B.S., 1948; Columbia University, M.A., 1949; New School for Social Research, Ph.D., 1957.
Herman, Harry, Professor of Mechanical Engineering (1964) and Assistant Chairman for Graduate Studies and Research. The Cooper Union, B.M.E., 1948; Columbia University, M.S., 1956; Polytechnic Institute of Brooklyn, Ph.D., 1964. ★
Hodge, Elizabeth J., Assistant Professor of English and Philosophy (1969). New York University, B.A., 1958; M.A., 1960; Ph.D., 1975.
Horwitz, Lawrence B., Associate Professor of Industrial Engineering (1977). City College of New York, B.E., 1965; New York University, M.S., 1966; Ph.D., 1968. ★ A
Hrycak, Peter, Professor of Mechanical Engineering (1965). University of Minnesota, B.S., 1954; M.S. 1955; Ph.D., 1960. ★
Hsieh, Jui S., Professor of Mechanical Engineering (1960). Wuhan University, B.E., 1943; University of Kentucky, M.S., 1950; Ohio State University, Ph.D., 1955. ★
Hsu, Thomas C.T., Assistant Professor of Civil and Environmental Engineering (1978). Cheng-Kung University, B.S.E., 1964; McGill University, M.E., 1969; Yale University, M.S., 1972; McGill University, Ph.D., 1974.

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Jackson, Barry, Associate Professor and Acting Dean of the New Jersey School of Architecture (1977). Rensselaer Polytechnic Institute, B. Arch., 1958; University of California, Berkeley, M. Arch., 1965.†
Jaffe, Gerald, Assistant Professor of Mechanical Engineering (1960). City College of New York, B.M.E., 1947; M.M.E., 1954; Newark College of Engineering, M.S., 1965. ★
Jermakian, Armen, Assistant Professor of Physics (1966). Stevens Institute of Technology, B.S.E., 1959; M.E., 1960.
Johnson, Clarence S., Associate Professor of English (1956). Montclair State College, B.A., 1949; M.A., 1951; Rutgers University, Ed.D., 1966.
Kahng, Anthony, Associate Professor in Industrial Relations (1964). Kwansei-Gakuin University (Japan), L.L.B., 1954; Kansai University (Japan), L.L.M., 1956; Tulane University, M.C.L., 1958; Yale Law School, L.L.M., 1962.
Kappraff, Jay M., Assistant Professor of Mathematics (1974). Polytechnic Institute of Brooklyn, B.Ch.E., 1958; Iowa State University, M.S., 1960; New York University, Ph.D., 1974.
Katzen, Martin, Associate Professor of Mathematics (1963). City College of New York, B.S., 1960; M.S., 1964; City University of New York, Ph.D., 1968.
Kebbekus, Barbara B., Associate Professor of Chemistry (1974). Rosemont College, B.S., 1960; Pennsylvania State University, Ph.D., 1964.
Ketzner, Robert S., Assistant Professor of Engineering Graphics (1961). Indiana State Teachers College, B.S., 1953; Indiana State University, M.S., 1960.
Khera, Raj P., Associate Professor of Civil and Environmental Engineering (1966). Ohio State University, M.S.; Northwestern University, Ph.D., 1967. ★
Kimmel, Howard S., Professor of Chemistry (1966) and Associate Chairman of the Department. Brooklyn College, B.S., 1959; West Virginia University, M.S., 1961; City University of New York, Ph.D., 1967.
Kingery, Bernard, Assistant Professor of Physics (1952). Georgia Southern, B.S., 1948; Columbia University, M.S., 1949.
Kirchner, Robert P., Associate Professor of Mechanical Engineering (1962). Newark College of Engineering, B.S., 1962; M.S., 1964; Rutgers University, Ph.D., 1968. ★
Klapper, Jacob, Professor of Electrical Engineering (1967). City College of New York, B.S., 1956; Columbia University, M.S., 1958; New York University, Ph.D., 1965. ★
Konon, Walter, Assistant Professor in Civil Engineering and Construction Technology (1974). City College of New York, B.C.E., 1966; City University of New York, M.S.C.E., 1970. ★
Konove, Carl, Professor of Mathematics (1937) and Associate Chairman of Mathematics Department. Newark College of Engineering, B.S.Ch.E., 1937; Montclair State College, M.A., 1941.
Kopf, Joseph E., Assistant Professor of Manufacturing Technology (1975) and Associate Dean for Engineering Technology. Newark College of Engineering, B.S., 1957; M.S., 1962. ★
Krantz, Charles K., Associate Professor of History (1968). City College of New York, B.A., 1956; University of Connecticut, M.A., 1958; University of Rochester, Ph.D., 1964.
Kristol, David S., Associate Professor of Chemistry (1966). Brooklyn College, B.S., 1958; New York University, M.S., 1966; Ph.D., 1969.
Kuharetz, Boris, Associate Professor of Physics (1959). Columbia University, B.S., 1951; M.S., 1961.
Kuo, Marshall, Professor of Electrical Engineering (1965). National Taiwan University, B.S., 1953; Texas A & M, M.S., 1958; University of Michigan, Ph.D., 1964.
Kuperstein, Ira S., Assistant Professor of Civil and Environmental Engineering (1970). City College of New York, B.C.E., 1963; M.C.E., 1968; New York University, Ph.D., 1973. ★
Lambert, Donald G., Associate Professor of Chemistry (1967). Oklahoma State University, B.S., 1956; Virginia Polytechnic Institute, M.S., 1963; Ph.D., 1965.

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Landsman, Leon D., Associate Professor of Physics and Acting Chairman of the Department (1958). Columbia University, B.A., 1951; M.A., 1956.
LaSalle, Anita, Assistant Professor of Computer and Information Science and Associate Chairman of the Department (1974). Newark College of Engineering, B.S., 1964; M.S. 1971.
La Verda, Michael J., Associate Professor in Economics (1956). Upsala College, B.B.A., 1952; Rutgers University, M.B.A., 1954.
Lee, Alfred M., Assistant Professor of English (1967). Yale University, B.A., 1960; University of Iowa, M.F.A., 1963.
Lehman, Frederick G., Distinguished Professor of Civil Engineering (1947). City University of New York, B.C.E., 1938; Massachusetts Institute of Technology, S.M., 1939; Sc.D., 1960. ★
Lei, George Y., Assistant Professor of Chemistry (1975). Ordnance Engineering College of Taiwan, B.S., 1952; University of Windsor, M.S., 1965; Polytechnic Institute of Brooklyn, Ph.D., 1970.
Levy, Martin J., Professor of Mechanical Engineering (1958). Pennsylvania State University, B.S.M.E., 1957; Newark College of Engineering, M.S.M.E., 1956; Stevens Institute of Technology, D. Sc., 1963. ★
Lewandowski, Gordon, Assistant Professor of Chemical Engineering (1977). Polytechnic Institute of Brooklyn, B.S., 1965; M.S., 1966; Columbia University, Eng. Sc. D., 1970. ★
Lieb, Murray, Associate Professor of Mathematics (1961). Newark College of Engineering, B.S.E.E., 1961; M.S.E.E., 1963; New York University, M.S, 1965; Brooklyn Polytechnic Institute, Ph.D., 1970. ★
Linn, Karl, Associate Professor of Architecture (1977). Kadoorie Agriculture School, Palestine, Diploma in Agriculture, 1941; Psycho-technical Institute, Zurich, Switzerland, Diploma in Psychology, 1948; New School of Social Research, M.A., 1956.††
Lione, Michael, Associate Professor of Mathematics (1954). University of Newark, B.A., 1942; New York University, M.S., 1950.
Liskowitz, John W., Professor of Civil and Environmental Engineering (1970). Rutgers University, B.S., 1952; Ph.D., 1962.
Lubin, James L., Associate Professor in Industrial Relations (1948). Montclair State College, B.S., 1948; M.A., 1950.
Lynch, Robert E., Associate Professor of English and Associate Chairman of the Humanities Department (1967). St. Francis College, B.A., 1962; New York University, M.A., 1963; Ph.D., 1971.
Lyngstad, Sverre, Professor of English (1962). University of Oslo, B.A. (Eng., 1943, Hist. 1946); University of Washington, M.A., 1949; New York University, Ph.D., 1960.
Martin, James L., Associate Professor of Mechanical Engineering (1965). Virginia Military Institute, B.S.C.E., 1952; Rutgers University, M.S., 1957; Pennsylvania State University, Ph.D., 1964. ★
McCormick, John E., Professor of Chemical Engineering (1962), and Associate Chairman of the Department of Chemical Engineering. Iowa State University, B.Sc., 1948; University of Cincinnati, Ph.D., 1957. ★
McHugh, James, Assistant Professor of Computer and Information Science (1977). Fordham University, A.B., 1965; Courant Institute, Ph.D., 1970.
McMillan, Robert, Associate Professor of Electrical Engineering (1964). Louisiana State University, B.S., 1942; California Institute of Technology, M.S., 1950; Newark College of Engineering, Ph.D., 1970. ★
Meola, Robert R., Professor of Electrical Engineering and Associate Chairman of the Department (1947). Newark College of Engineering, B.S., 1946; Stevens Institute of Technology, M.S., 1949. ★
Meyer, Andrew U., Professor of Electrical Engineering (1965). Studies in Germany, B.S.; Northwestern University, M.S., 1958; Ph.D., 1961. ★
Mihalasky, John, Professor of Industrial Engineering (1956). Newark College of Engineering, B.S., 1951; M.S., 1954; Rutgers University, M.B.A., 1956; New York University, M.B., 1960; D.Ed., 1973. ★
Miller, Edward, Professor of Mechanical Engineering (1948) and Department Administrator, Newark College of Engineering, B.S., 1948; University of Delaware, M.M.E., 1949; Columbia University, M.A., 1951; Stevens Institute of Technology, M.S., 1952; New York University, M.Aero.E., 1959. ★

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Misra, Raj, Professor of Electrical Engineering (1962). Massachusetts Institute of Technology, B.S., 1941; Cornell University, M.S., 1945; Ph.D., 1955.
Moiseenko, Oleg, Special Assistant in Physical Education (1972). Newark College of Engineering, B.S., 1967; Montclair State, M.A., 1974. ★
Monahan, Edward J., Professor of Civil Engineering (1958). Newark College of Engineering, B.S.C.E., 1958; M.S.C.E., 1961; Oklahoma State University, Ph.D., 1968. ★
Moshos, George J., Professor of Computer and Information Science, and Chairman of the Department (1968). University of Michigan, B.S., 1949; M.S., 1949; Case Institute of Technology, Ph.D., 1965.
Napier, James J., Professor of English (1955). University of Pennsylvania, A.B., 1949; A.M., 1950; Ph.D., 1959.
Natapoff, Marshall, Associate Professor of Physics (1956). Cornell University, B.S., 1956; New York University, M.S., 1956; Stevens Institute of Technology, Ph.D., 1968.
Neidhardt, Walter J., Associate Professor of Physics (1962). Stevens Institute of Technology, B.S.M.E., 1956; M.S., 1958; Ph.D., 1962.
O'Connor, John E., Associate Professor of History (1969). St. Johns University, B.A., 1965; Queens College, M.A., 1967; City University of New York, Ph.D., 1974.
Olenik, Thomas J., Associate Professor of Civil and Environmental Engineering (1970). Newark College of Engineering, B.S.C.E., 1968; M.S.C.E., 1970; Rutgers University, Ph.D., 1974. ★
Olsen, George W., Major, U.S.A.F., Assistant Professor of Aerospace Studies (1979). University of New York at Buffalo, B.S.M.E., 1965; University of Florida, M.S.M.E., 1966; University of West Florida, M.B.A., 1975. ★
Padalino, Joseph J., Professor of Electrical Engineering (1947). Newark College of Engineering, B.S., 1944; University of Pennsylvania, M.S., 1947; Brooklyn Polytechnic Institute, Ph.D., 1963. ★
Pappas, Michael J., Associate Professor of Mechanical Engineering (1964). Newark College of Engineering, B.S., 1959; M.S., 1964; Rutgers University, Ph.D., 1970. ★
Parker, Richard C., Associate Professor of Chemistry (1966). California State College at Long Beach, B.S., 1962; University of Washington, Ph.D., 1966.
Parsa, Zohreh Joanne, Assistant Professor of Physics (1977). Delaware State College, B.S., 1969; New York University, M.S., 1971; Polytechnic Institute of New York, Ph.D., 1977.
Pattinson, John P., Professor of English and Chairman of the Humanities Department (1965). Cambridge University, B.A., 1947; M.A., 1949; New York University, Ph.D., 1968.
Pawel, Hans E., Associate Professor of Mechanical Engineering (1964). Newark College of Engineering, B.S., 1956; M.S., 1966; Rutgers University, Ph.D., 1974. ★
Peck, Charles F., Jr., Professor of Civil Engineering (1970). Massachusetts Institute of Technology, B.S., 1941; M.S., 1943; D. Sc., 1947. ★
Perez, Manuel, Associate Professor of Mathematics (1971). City College of New York, B.M.E., 1961; New York University, M.M.E., 1963; City University of New York, Ph.D., 1968. ★
Perlmutter, Howard D., Associate Professor of Chemistry (1965). Lehigh University, B.A., 1959; New York University, M.S., 1962; Ph.D., 1963.
Perna, Angelo J., Professor of Chemical and Environmental Engineering (1967). Clemson University, B.S., 1957; M.S., 1962; University of Connecticut, Ph.D., 1967.
Pfafflin, James R., Associate Professor of Civil and Environmental Engineering (1977). Indiana State University, B.S., 1952; Johns Hopkins University, B.E.S., 1956; M.S., 1957; University of Windsor, Ph.D., 1972. ★
Plastock, Roy, Assistant Professor of Mathematics (1975). Brooklyn College, B.S., 1966; Yeshiva University, Ph.D., 1972.
Philipoff, Wladimir, Foundation Research Professor of Rheology (1972). Berlin Technical University, B.S., 1928; M.S., 1932; Ph.D., 1934.

★ Licensed Professional Engineer
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Progelhof, Richard C., Professor of Mechanical Engineering (1967). Newark College of Engineering, B.S., 1958; Stanford University, M.S., 1959; Lehigh University, Ph.D., 1962. ★

Raghu, Dorairaja, Assistant Professor of Civil and Environmental Engineering (1977). Annamalai University, India, B.S., 1961; Madras University, India, M.S., 1962; University of Kentucky, M.S., 1972; Texas Tech University, Ph.D., 1975. ★

Ram, Gerson L., Professor of Chemistry (1947). Upsala, B.A., 1941; Rutgers University, M.S., 1947; John Hopkins University, Sc.D., 1953. Licensed Health Officer, State of New Jersey.

Rausen, John, Associate Professor of Mathematics (1966). City College of New York, B.Ch.E., 1944; Columbia University, M.A., 1948; Ph.D., 1966.

Reisman, Otto, Associate Professor of Physics (1962). City College of New York, B.S., 1958; New York University, M.S., 1961; Ph.D., 1973.

Reisman, Stanley S., Associate Professor of Electrical Engineering (1967). Brooklyn Polytechnic Institute, B.S., 1962; Massachusetts Institute of Technology, M.S., 1963; Brooklyn Polytechnic Institute, Ph.D., 1974. ★

Reiziss, Daniel, Assistant Professor of Physics (1955). City College of New York, B.M.E., 1944; Newark College of Engineering, M.S.E.E., 1960.

Rigassio, James, Professor of Industrial Engineering and Chairman of the Department (1958). Newark College of Engineering, B.S., 1948; Yale University, M.E., 1949. ★

Rights, Robert M., Assistant Professor of Engineering Graphics (1954). Bathany College, B.A., 1950; Montclair State, M.A., 1952.

Rips, Ervine M., Associate Professor of Electrical Engineering (1958). Massachusetts Institute of Technology, B.S., 1942; Carnegie Institute of Technology, M.S., 1947. ★

Roche, Edward C., Jr., Professor of Chemical Engineering (1967). Stevens Institute of Technology, M.E., 1954; Sc.D., 1967; Harvard University, M.S., 1958. ★

Rose, Robert H., II., Associate Professor of Electrical Engineering (1947). Newark College of Engineering, B.S., 1944; Stevens Institute of Technology, M.S., 1966.

Rosenstark, Solomon, Assistant Professor of Electrical Engineering (1968). City College of New York, B.E.E., 1958; New York University, M.E.E., 1961; Ph.D., 1966. ★

Rotter, Naomi G., Assistant Professor in Social Sciences (1977). Skidmore College, B.A., 1963; New York University, Ph.D., 1974.

Rucker, Maurice, Associate Professor in Industrial Relations (1962). Brooklyn College, B.A., 1953; New York University, M.P.A., 1956; Columbia University, Ed.D., 1975.

Ruffolo, Joseph P., Jr., Capt., U.S.A.F., Assistant Professor of Aerospace Studies (1979). Pennsylvania State University, B.S., 1973; University of Utah, M.B.A., 1977.

Russell, Frederick Arthur, Distinguished Professor of Electrical Engineering and Special Assistant to the President for Institutional Research (1937). Newark College of Engineering, B.S., 1937; Stevens Institute of Technology, M.S., 1941; Columbia University, D. Engr. Sc., 1953. ★

Russo, O. Louis, Associate Professor of Physics (1963). Clarkson Institute of Technology, B.S.E.E., 1952; Stevens Institute of Technology, M.S.E.E., 1963; New Jersey Institute of Technology, Ph.D., 1975. ★

Ryon, John W., III, Assistant Professor of Computer and Information Science (1974). Massachusetts Institute of Technology, B.S., 1962; Stevens Institute of Technology, M.S., 1968; Ph.D., 1970.

Sagurton, James, Professor of Physics (1946). Seton Hall University, B.S., 1942; Columbia University, M.S., 1945; Institute of St. Thomas, Ph.D., 1958.

Salamon, Robert G., Professor of Engineering Graphics (1947). Newark College of Engineering, B.S., 1945; Stevens Institute of Technology, M.S., 1948. ★

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Salek, Franklin, Associate Professor of Civil and Environmental Engineering (1968). Worcester Polytechnic Institute, B.S.C.E., 1959; Rutgers University, M.S.C.E., 1967; Ph.D., 1969. ★
Salzarulo, Leonard, Professor of Physics (1953). Newark College of Engineering, B.S.Ch.E., 1951; M.S., 1953; Brooklyn Polytechnic Institute of Technology, Ph.D., 1966. ★
Sarian, Edward, Assistant Professor of Computer and Information Science (1977). Niagara University, B.S., 1964; University of Michigan, M.S., 1967; Stevens Institute of Technology, Ph.D., 1977.
Savin, William, Associate Professor of Physics and Associate Director of the Foundation at NJIT (1960). Newark College of Engineering, B.S.E.E., 1960; M.S., 1962; Rutgers University, Ph.D., 1968.
Schachter, Hindy L., Assistant Professor of Social Sciences (1979). Brooklyn College, B.A., 1966; New York University, M.A., 1968; Columbia University, Ph.D., 1978.
Scher, Julian, Associate Professor of Computer and Information Sciences (1971). Brooklyn College, B.A.; New York University, M.S., 1967; Ph.D., 1971.
Schmerzler, Lawrence J., Associate Professor of Mechanical Engineering (1953). University of Texas, B.S., 1948; Newark College of Engineering, M.S., 1956. ★
Sen, Chiranjib, Assistant Professor of Economics (1978). Presidency College, B.A., 1967; Delhi School of Economics, M.A., 1969; Stanford University, M.A., 1975; Ph.D., 1978.
Sher, Doris, Assistant Professor of History (1970). City College of New York, B.A., 1965; Columbia University, M.A., 1967.
Shilman, Avner, Professor of Chemistry (1963). American University of Beirut, Ph.C., 1945; Columbia University, M.S., 1953; M.A., 1957; Polytechnic Institute of Brooklyn, Ph.D., 1961.
Simon, J. Malcolm, Associate Professor of Physical Education (1955). Panzer College, B.S., 1954; Columbia University, M.A., 1956.
Smithberg, Eugene H., Professor of Mechanical Engineering, (1950) and Dean of the Graduate Division (1950). College of the City of New York, B.M.E., 1943; Polytechnic Institute of Brooklyn, M.M.E., 1949; New York University, D.Eng.Sc., 1961.
Snyder, William H., Professor of Chemistry (1963). Temple University, A.B., 1952; University of Pennsylvania, Ph.D., 1961.
Sohn, Kenneth, Associate Professor of Electrical Engineering (1966). Upsala, B.S., 1957; Stevens Institute of Technology, M.S., 1959; Ph.D., 1967. ★
Spector, Marion, Assistant Professor in Organizational Sciences (1974). Brooklyn College, B.A., 1962; City College, Baruch School, M.B.A., 1966; Columbia University, M.A., 1968; New York University, Ph.D., 1974.
Spitz, Herbert, Assistant Professor in Social Sciences (1964). Brooklyn College, B.A., 1947; New School for Social Research, M.A., 1963.
Stamper, Eugene, Professor of Mechanical Engineering and Assistant Dean for Academic Affairs (1952). College of City of New York, B.M.E., 1948; New York University, M.M.E., 1952. ★
Steffen, Nancy L., Assistant Professor of English (1971). Stanford University, B.A., 1965; Brandeis University, M.A., 1969; Ph.D., 1977.
Steinberg, Abraham H., Professor of English (1956). Brooklyn College, B.A., 1937; Columbia University, M.A., 1939; New York University, Ph.D., 1955.
Stevenson, Benjamin H., Jr., Associate Professor of Physics (1965). Newark College of Engineering, B.S.M.E., 1962; Cornell University, M.S., 1966; New York University, Ph.D., 1971.
Stochaj, John M., Professor in Economics (1955). Boston University, B.A., 1951; Rutgers University, M.A., 1956; New York University, Ph.D., 1963.
Stone, Gerald, Associate Professor of Industrial Engineering (1966). City College of New York, B.Ch.E., 1939; Temple University, Cert. in E.E., 1941; M.Ad.E. in Industrial Eng., 1944; New York University, Sc.Eng.D., 1949. ★
Strano, Joseph J., Professor of Electrical Engineering (1959). Newark College of Engineering, B.S., 1959; M.S., 1961; Rutgers University, Ph.D., 1969. Chairman of the Department. ★

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Strauss, William, Assistant Professor of Architecture (1974). Purdue, B.S.C.E., 1972; University of Illinois at Urbana, B. Arch., 1965; University of Pennsylvania, M. Arch., 1969.†

Suchow, Lawrence, Professor of Chemistry (1964). City College of New York, B.S., 1943; Polytechnic Institute of Brooklyn, Ph.D., 1951.

Sun, Benedict C., Associate Professor of Mechanical Engineering (1967) and Assistant Chairman for Mechanical Technology. National Taiwan University, B.S., 1955; Kansas State University, M.S., 1959; University of Illinois, Ph.D., 1967.★

Swanson, Robert, Professor of Physical Education and Director of Division of Health, Physical Education and Athletics (1948). Panzer College, B.S.C. Ed., 1947; Rutgers University, M.Ed., 1952.

Tassios, Dimitrios, Professor of Chemical Engineering (1966). National Technical University (Athens, Greece), Diploma, 1960; University of Texas, M.S., 1964; Ph.D., 1967.

Tavantzis, John, Assistant Professor of Mathematics (1976). Columbia College, B.A., 1962; Columbia School of Engineering, M.S., 1966; New York University, Ph.D., 1976.

Taylor, Ralph, Assistant Professor in Applied Mechanics (1957). Newark College of Engineering, B.S., 1956; M.S., 1960.

Thomas, Gary L., Professor of Electrical Engineering, and Vice President of Academic Affairs (1980). University of California-Berkeley, B.S., 1960; M.A., 1962; Ph.D., 1967.

Thomas, Stan S., Associate Professor of Industrial Engineering (1972). University of Akron, B.S., 1950; Cornell University, M.S., 1955; Purdue University, Ph.D., 1967.★

Thomason, Jimmie D., Captain, U.S.A.F., Assistant Professor of Aerospace Studies (1979). University of Massachusetts, B.A., 1971; Golden Gate University, M.B.A., 1978.

Thomasson, Stanley, Associate Professor of Architecture (1967). Tulane University, B. Arch., 1961; Pratt Institute, M. Arch., 1978..†

Tobias, Norman, Associate Professor of History (1965). Rutgers University, B.A., 1959; M.S., 1965; Ph.D., 1969.

Tomkins, Reginald P.T., Assistant Professor of Chemistry (1977). Institute of Education, University of London, Diploma Ed., 1959; Birkbeck College, University of London, B.Sc., 1963; Ph.D., 1966.

Towfik, Nissim, Associate Professor of Physics (1955). Bombay University, B.S., 1949; Columbia University, A.M., 1953.

Trattner, Richard B., Professor of Chemistry and Environmental Science (1967). City College of New York, B.S., 1959; Brooklyn College, M.A., 1961; City University of New York, Ph.D., 1967.

Turoff, Murray, Professor of Computer and Information Sciences (1973). University of California, B.A., 1958; Brandeis University, Ph.D., 1965.

Voronka, Roman W., Associate Professor of Mathematics (1962). Newark College of Engineering, B.S.E.E., 1962; M.S.E.E., 1964; New York University, M.S., 1967; Ph.D., 1974.

Wall, Donald, Associate Professor of Architecture (1974). University of Manitoba, B. Arch., 1958; Cornell University, M. Arch., 1959; Catholic University, D. Arch., 1970.

Weisman, Leslie, Associate Professor of Architecture (1975). Wayne State University, B.F.A., 1967; University of Detroit, M.A., 1973.

West, Troy, Associate Professor of Architecture (1975). Carnegie Institute of Technology, B. Arch., 1958; M. Arch., 1965.†

Wexler, Allan, Assistant Professor of Architecture (1975). Rhode Island School of Design, B.F.A., 1971; B. Arch., 1972; Pratt Institute, M. Arch., 1975.†

Whitman, Gerald, Associate Professor of Electrical Engineering (1970). Queens College, B.S., 1963; Columbia University, B.E.E., 1963; Polytechnic Institute of Brooklyn, M.S., 1967; Ph.D., 1970.

Wilson, Charles E., Professor of Mechanical Engineering (1956). Newark College of Engineering, B.S., 1953; M.S., 1958; New York University, M.S.E.M., 1962; Polytechnic Institute of Brooklyn, Ph.D., 1970.★

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Winston, Joseph, Associate Professor of Electrical Engineering (1949). Newark College of Engineering, B.S., 1943; Stevens Institute of Technology, M.S., 1949.
Winters, Stanley B., Professor of History (1957). New York University, A.B., 1948; Columbia University, A.M., 1950; Rutgers University, Ph.D., 1966.
Wise, James N., Associate Professor of English (1955). College of Wooster, B.A., 1941; Columbia University, M.A., 1948.
Wolf, Carl, Professor of Management Engineering (1961). City College of New York, B.B.A., 1951; Columbia University, M.S., 1954; New York University, Ph.D., 1971. ★
Zambuto, Mauro H., Distinguished Professor of Electrical Engineering (1962). University of Rome & Padua, Italy, Ph.D., 1938-1944.
Zames, Frieda, Assistant Professor of Mathematics (1966). Brooklyn College, B.S., 1954; New York University, M.S., 1966; Ph.D., 1972.
Zaner, Theodore, Professor of Industrial Relations (1965). City College of New York, B.S., 1940; Columbia University, M.A., 1949; Ed.D., 1955. Associate Chairman of Department of Organizational and Social Sciences.
Zatzkis, Henry, Distinguished Professor of Mathematics and Chairman of the Department (1953). Ohio State University, B.S., 1942; Indiana University, M.S., 1944; Syracuse University, Ph.D., 1950.
Zdepski, M. Stephen, Associate Professor of Architecture (1974). Syracuse University, B. Arch., 1969; University of Pennsylvania, M. Arch., 1970.†

ADJUNCT FACULTY

Agbaosi, Joseph D., Adjunct Professor in Industrial Engineering (1979). New Jersey Institute of Technology, B.S.I.E., 1975; Rutgers University, M.S., 1977.
Baum, Stanley V., Special Lecturer in English (1972). Harvard University, B.A., 1948; Columbia University, M.A., 1950.
Bellatty, Thomas, Adjunct Professor in Civil and Environmental Engineering (1975). Renesselaer Polytechnic Institute, B.C.E., 1951; Columbia University, M.S.C.E., 1961
Bober, Vincent E., Adjunct Professor in Computer Science. Newark College of Engineering, B.S., 1969; M.S., 1970.
Boswell, William, Adjunct Professor in Civil and Environmental Engineering (1973). Fairleigh Dickinson University, B.A., 1953; New Jersey Institute of Technology, B.S.C.E., 1966; M.S.C.E., 1974.
Byrne, Michael J., Adjunct Professor in Industrial Engineering (1977). Notre Dame University, B.S.M.E., 1959; Newark College of Engineering, M.S.M.E., 1963. ★
Campbell, Joseph E., Adjunct Staff (1976). Glassboro State, B.A., 1967; M.A., 1970.
Cheng, Shirley, Adjunct Professor in Chemistry (1977). Saint Francis College, B.S., 1963.
Cheu, Peter, Adjunct Professor in Civil and Environmental Engineering (1979). National Taiwan University, B.S., 1962; University of South Carolina, M.E.C.E., 1966; Rutgers University, Ph.D., 1978.
Ciborski, John M., Special Lecturer in Management Engineering (1968). Purdue University, B.S., 1939; Harvard University, M.S., 1940; Purdue University, D.Eng., 1968.
Corcoran, John M., Adjunct Professor in Industrial Engineering (1977). St. Peter's College, B.S., 1957. Certified Public Accountant.
Cuozzi, William F., Special Instructor in Economics (1976). Seton Hall University, B.S., 1942; Rutgers University, LL.B., 1945.
Czerwienski, Gregory, Adjunct Professor in Chemistry (1978). New Jersey Institute of Technology, B.S.Ch. E., 1972.

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Daifuku, Jon, Adjunct Faculty in Architecture (1977). Rhode Island School of Design, B. Env. Design, 1971; B. Arch., 1972.
Danco, George J., Special Lecturer in Industrial Engineering (1974). Newark College of Engineering, B.S., 1945.
Darack, Faye B., Adjunct Professor in Chemistry (1979). Yeshiva University, B.A., 1968; M.A., 1971.
DeKelbaum, George J., Adjunct Professor in Computer Science. Newark College of Engineering, B.S., 1970; M.S., 1972.
De Nesia, Kenneth, Special Lecturer in Economics (1976). Wayne State University, B.A., 1968; Long Island University, M.A., 1971.
Dios, Rose, Special Lecturer in Mathematics (1979). New Jersey Institute of Technology, B.S.E.S., 1977; New York University, M.S., 1979.
Elk, Seymour, Special Lecturer in Mathematics (1978). Yale University, B.S., 1954; Purdue University, M.S., 1957; Washington University, M.S., 1970.
Emanuele, Anthony, Special Instructor in Mechanical Engineering (1977). Newark College of Engineering, B.S., 1952.
Engler, Peter E., Adjunct Professor in Mechanical Engineering (1976). McGill University, B.E.E., 1957; Cornell University, M.S.E.E., 1961; University of New York at Buffalo, Ph.D., 1974.
Fairfield, Richard, Special Instructor in Social Sciences (1977). University of Akron, B.A., 1967; New School, M.A., 1973.
Fanelli, Anthony J., Adjunct Professor in Chemistry (1977). Brooklyn College, A.B., 1962; Polytechnic Institute of Brooklyn, Ph.D., 1971.
Fisher, Adam, Special Instructor in Mechanical Engineering (1978). Newark College of Engineering, B.S., 1965. ★
Franklin, Wallace, Adjunct Professor in Mechanical Engineering (1967). The College of the City of New York, B.M.E., 1948; Columbia University, M.S., 1954.
Garner, Sidney, Special Instructor in Mechanical Engineering (1977). Stevens Institute of Technology, M.E., 1943.
Gile, William, Special Lecturer of Theatre Arts (1970). Boston University, B.F.A., 1965; Cornell University, M.F.A., 1970.
Githens, Herb, Adjunct Faculty in Architecture (1977). Clemson University, B.A., 1973; Columbia University, Graduate School of Architecture and Planning, M.S.
Goodheart, Alan, Special Lecturer in Architecture (1977). Harvard College, A.B., 1962; Harvard Graduate School of Design, M.L.A., 1967.
Grunes, Robert L., Adjunct Professor in Chemistry (1974). Polytechnic Institute of Brooklyn, B.S., 1965; Ph.D., 1970.
Harrington, Christopher P., Adjunct Professor in Chemistry (1974). New Jersey Institute of Technology, B.S., 1974; M.S., 1978.
Herits, Thomas J., Adjunct Professor of Surveying (1977). Newark College of Engineering, B.S.C.E., 1972; Purdue University, M.S.C.E.
Hollein, Helen, Adjunct Professor in Chemistry (1978). University of South Carolina, B.S.Ch.E., 1966; New Jersey Institute of Technology, M.S., 1979.
Holt, Anne, Special Lecturer in Chemical Engineering (1977). Newark College of Engineering, B.S., 1973; University of London, M.S., 1977.
Horowitz, Avery, Special Lecturer in Economics (1979). Brooklyn College, B.A., 1971; M.A., 1973.
Jampathom, Sompoppol, Special Lecturer in Physics (1977). New Jersey Institute of Technology, B.S.M.E., 1976; M.S.M.E., 1977.
Juliano, Thomas M., Adjunct Professor in Mechanical Engineering (1979). Newark College of Engineering, B.S., 1967; M.S., 1970; D.Eng.Sc., 1979. ★.
Kelley, James B., Special Lecturer (1977). Marquette University, B.S., 1937; New York University, M.S., 1941; D. Eng'g Sc., 1949. ★
Kinkade, Merwin, Adjunct Staff (1970). Babson College, B.S., 1962; New York University, M.A., 1967.
Kleidon, Joanne, Adjunct Lecturer in English (1977). City College of New York, B.A., 1971; M.A., 1973; Columbia University, M. Ph., 1976.
Kononenko, Oleg K., Special Lecturer in Chemistry (1976). State University, Kharkov, Ukraine, Chemist, 1939; Ukr. Technical University, Munich. M.S., 1948; Ph.D., 1949.
Koff, Joseph, Adjunct Professor in Industrial Engineering (1977). City College of New York, B.S., 1935; Stevens Institute of Technology, M.S., 1953.

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Korn, Alfred E., Adjunct Professor in Chemistry (1976). Newark College of Engineering, B.S.Ch.E., 1953; University of Northern Iowa, M.A., 1970.
Korn, Carol R., Adjunct Professor in Chemistry (1979). University of Buffalo, B.S.Ch.E., 1959; Montclair State College, M.A., 1971.
Kornhaber, Robert, Special Instructor in Social Sciences (1977). City College of New York, B.A., 1967; Kent State University, M.A., 1970; Ph.D., 1973.
Law, Doris, Adjunct Professor in Chemistry (1979). Adelphi University, A.B., 1951; Montclair State College, M.A.T., 1975.
Levine, Dana B., Special Lecturer in Chemistry (1977). Barnard College, A.B., 1962; Columbia University, Ph.D., 1967.
MacFadyen, Kenneth A., Adjunct Professor in Civil and Environmental Engineering (1975). Newark College of Engineering, B.S., 1930.
Morse, Mitchael J., Adjunct Professor in Computer Science. Newark College of Engineering, B.S., 1969; M.S., 1970.
Mortimer, James J. Jr., Special Lecturer in Civil and Environmental Engineering (1979). Manhattan College, B.S.C.E.,. 1968.
Mulvaney, James M., Adjunct Professor in Management Engineering (1977). Seton Hall University, B.A., 1969; J.D.,1975.
Ostuni, Lawrence J., Adjunct Professor in Industrial Engineering (1975). Polytechnic Institute of Brooklyn, B.Chem.E., 1957; M.S.I.E., 1969.
Pan, Chin, Adjunct Professor in Mechanical Engineering (1977). National Pei-Yang University, B.S.M.E., 1948; Oklahoma State University, M.S.M.E., 1962.
Paschedag, Allan E., Adjunct Professor in Mechanical Engineering (1977). New Jersey Institute of Technology, B.S., 1975; M.S., 1978.
Pancharoen, Ura, Special Lecturer in Chemical Engineering (1979). New Jersey Institute of Technology, B.S. Ch.E. 1975.
Pekarsky, Joseph, Special Lecturer in Industrial Engineering (1966). City College of New York, B.B.A., 1956; M.B.A., 1962.
Peller, Rosalyn, Adjunct Professor in Chemistry (1979). Boston University, A.B., 1958; University of Pittsburgh, M.S., 1961.
Percival, William R., Special Lecturer in Industrial Engineering (1976). ★
Price, Elizabeth, Adjunct Professor of Civil and Environmental Engineering (1978). Duke University, B.S., 1956; New Jersey Institute of Technology, M.S.; 1976.
Pusillo, Anthony J. Jr., Adjunct Professor in Industrial Engineering (1978). Newark College of Engineering, B.S.I.E., 1971; New Jersey Institute of Technology, M.S.E.M., 1975.
Rastogi, Anil, Special Lecturer in Chemical Engineering (1978). University of Roorkee, India, B.S. Ch.E., 1973; New Jersey Institute of Technology, M.S. Ch.E., 1977.
Reisz, Peter, Adjunct Professor in Industrial Engineering (1975). Northeastern University, B.S.E.E., 1960; Fairleigh Dickenson University, M.B.A., 1972.
Ribe, Floyd, Adjunct Professor in Mechanical Engineering (1977). Newark College of Engineering, B.S., 1974; M.S., 1976.
Rock, Joel J., Adjunct Research Professor in Mechanical Engineering (1979). Wagner College, B.S., 1966; Philadelphia College of Osteopathic Medicine, D.O., 1970.
Samely, Jack A., Adjunct Professor in Computer Science. Milwaukee School of Engineering, B.S., 1964; Stevens Institute of Technology, M.S., 1974.
Sellitto, Benjamin F., Jr., Special Instructor in Organizational Sciences (1976). Newark College of Engineering, B.S., 1974.
Sereico, Peter, Adjunct Professor of Civil and Environmental Engineering (1973). Newark College of Engineering, B.S.C.E., 1961; M.S.C.E., 1971.
Seymour, Charles, Special Lecturer on Industrial Relations (1978). Rutgers University, B.S., 1954; Fairleigh Dickinson University, M.B.A., 1965.
Sheih, Mung Shium, Adjunct Professor of Civil and Environmental Engineering (1976). Tiwan Cheng-Kung University, B.S., 1969; University of Rhode Island, M.S., 1974; New Jersey Institute of Technology, D.Sc., 1979.
Shih, Thomas T., Adjunct Professor of Chemical Engineering (1977). National Taiwan University, B.S., 1965; University of California at Berkeley, M.S., 1972; Ph.D., 1975.

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Siegell, Jeffrey H., Adjunct Professor of Chemical Engineering (1977). City College of New York, B.S., 1973; M.S., 1974; New York University, Ph.D., 1976.
Snyder, Herman, Special Lecturer in Mechanical Engineering (1977). Newark College of Engineering, B.S., M.S. ★
Somma, Dominick L., Adjunct Professor in Civil and Environmental Engineering (1972). Newark College of Engineering, B.S., 1943; Polytechnic Institute of Brooklyn, M.S., 1949.
Song, Leila, Adjunct Professor in Chemistry (1979). National Taiwan University, B.S.Ch.E., 1970; State University of New York at Plattsburgh, M.A., 1973.
Sparta, William, Adjunct Professor in Industrial Engineering (1977). Newark College of Engineering, B.S.I.E., 1971; M.S., 1975. ★
Tomasula, Margaret, Special Lecturer in Chemical Engineering (1979). Seton Hall, B.S.Ch.E., 1976.
Travisano, Fred, Adjunct Faculty in Architecture (1977). Cooper Union, B. Arch., 1967.†
Tuttle, Marion R., Special Lecturer in Management Engineering (1972). Ladycliff College, B.A., 1960; St. John's University, J.D., 1964.
Viviani, Albert S., Adjunct Professor in Industrial Engineering (1976). Rutgers University, B.A., 1968; Stevens Institute of Technology, M.S., 1971; Newark College of Engineering, M.S.I.E., 1975.
Walsh, Daniel S., Adjunct Professor in Industrial Engineering (1974). Newark College of Engineering, B.S.M.E., 1963; Fairleigh Dickenson University, M.B.A., 1969; New Jersey Institute of Technology, M.S.I.E., 1974.
Webb, Michael, Special Lecturer in Architecture (1978). Regent Street Polytechnic, London, Diploma.
Welland, Stanley, Adjunct Professor in Mechanical Engineering. Newark College of Engineering, B.S., 1964; M.S., 1968; Sc.D., 1970.
Werder, Walter, Adjunct Professor in Industrial Engineering (1976). Rutgers University, B.S.C.E., 1949; Stevens Institute of Technology, M.S., 1953.
Wilchins, Sidney, Adjunct Research Professor. Rutgers University, B.A., 1961; Georgetown University, M.D., 1965; Fellow American College of Surgeons, 1967; Fellow International College of Surgeons, 1972. ★
Zagor, Herbert I., Visiting Professor of Management Engineering (1977). New York University, B.A., 1938; M.A., 1939; Ph.D., 1943.
Zoldos, John, Special Lecturer in Architecture (1976). Rutgers University, B.C.E., 1948. ★

EMERITUS FACULTY

Bauder, Frederick W., Professor of Chemistry (1932). Worcester Polytechnic Institute, B.S., 1920; Stevens Institute of Technology, M.S., 1945. ★
Bertsch, Carl V., Professor of Physics (1946). University of Michigan, B.S., 1928; M.S., 1931; Ph.D., 1937.
Bishop, John A., Professor of Chemistry (1947). Harverford College, B.S., 1929; New York University, M.S., 1931.
Branin, M. Lelyn, Professor of Chemistry and Chairman of the Department (1946). Purdue University, B.S., 1923; Columbia University, A.M., 1930; University of Michigan, M.S., 1933; Ph.D., 1934.
Cambreleng, Paul L., Professor in Personnel Relations (1937). Dana College, B.A., 1935; Columbia University, M.A., 1946.
Carlson, Carl W., Professor of Chemistry (1947). Northland College, B.A., 1929; University of Chicago, M.S., 1936; Michigan State University, Ph.D., 1946.
DiMatteo, John E., Associate Professor of Mechanical Engineering (1966). Cooper Union, B.S., 1931; Stevens Institute of Technology, M.S., 1950. ★

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Duursema, Charles H., Associate Professor of Physics (1946). Newark College of Engineering, B.S., 1933; Montclair State College, M.S., 1936.
Entwisle, Frank N., Professor of Physics and Director of the Counseling Center (1922). Princeton, C.E., 1912.
Felmly, Lloyd M., Professor of English and Chairman of the Department (1959). Lafayette College, B.Ph., 1916; Litt.D., 1943; Rutgers University, D.H.L., 1956.
Hazell, William, Jr., President (1933). Newark College of Engineering, B.S., 1930; M.Eng.Ed., 1960; Jersey City State College, Dr. of Letters, 1963.
Hoffman, Paul O., Distinguished Professor of Physics and Chairman of the Department (1933). Newark College of Engineering, B.S., 1933; Columbia University, A.M., 1938; New York University, Ph.D., 1950.
Jaffe, William J., Distinguished Professor in Industrial Engineering (1946). New York University, B.S., 1930; Columbia University, M.A., 1931; M.S., 1941; New York University, Engr.Sc.D., 1953. ★
Joffe, Joseph, Distinguished Professor of Chemical Engineering and Chairman of the Department (1932). Columbia University, A.B., 1929; B.S., 1930; M.A., 1931; Ph.D., 1933. ★
Jordan, William III, Professor of Electrical Engineering (1929). University of Pennsylvania, B.S., 1927; Stevens Institute of Technology, M.S., 1942. ★
Karsten, Henry, Assistant Professor of Engineering Drawing (1956). New York University, B.S., 1929; M.A., 1933.
Keables, Nelson C., Associate Professor of English (1945). Middlebury College, A.B., 1938; New York State College, M.A., 1939.
Keeffe, George C., Professor of Chemical Engineering and Associate Chairman of the Department (1936). Newark College of Engineering, B.S., 1932; Ch.E., 1935; New York University, M.S., 1936. ★
Kiehl, Robert E., Professor in Personnel Relations and Chairman of the Department (1946). Columbia University, B.A., 1932; Teachers College, M.A., 1947; Rutgers University, Ed.D., 1957.
Koren, Charles J., Professor of Mathematics (1956). New York City College, B.S., 1930; Columbia University, M.A., 1931; Ed.D., 1933.
Kreps, Saul I., Professor of Chemical Engineering (1949). City College of New York, B.S., 1937; University of Illinois, M.S., 1938; University of Pennsylvania, Ph.D., 1941; Polytechnic Institute of Brooklyn, B.Ch.E., 1948.
LaLonde, William S., Jr., Distinguished Professor of Civil Engineering and Chairman of the Department (1929). Massachusetts Institute of Technology, B.S., 1923; University of Michigan, M.S., 1938. ★
Lord, Anthony J., Associate Professor in Social Sciences (1956). Hamilton College, B.A., 1949; University of Pennsylvania, M.A., 1950; New York University, M.B.A., 1953.
Mainardi, Pompey, Professor of Mathematics and Associate Chairman of the Department (1935). Newark College of Engineering, B.S., 1933; Montclair State College, M.A. in Math., 1943. ★
Mangasarian, Richard D., Professor of Civil Engineering (1946). City College of New York, B.S.E., 1935; M.C.E., 1937. ★
Mangnall, David H., Registrar (1946). Newark College of Engineering, B.S.M.E., 1942; Stevens Institute of Technology, M.S., 1949. ★
Mantell, Charles L., Professor of Chemical Engineering and Chairman of the Department (1948). New York City College, B.A., 1918; Columbia University, M.A., 1924; Ph.D., 1928. ★
Monack, Albert J., Professor of Applied Mechanics (1954). West Virginia University, B.S., 1927; University of Illinois, M.S., 1929; New York University, Ph.D., 1962. ★
Nielsen, Paul E., Professor of Civil Engineering (1937). University of Illinois, B.S., 1927; M.S., 1932. ★
Noyes, Leonard, Assistant Professor of Organizational and Social Sciences (1948). Cornell University, M.E., 1931; Columbia University, M.S., 1953.
Ramberg, Elvind G.F., Distinguished Professor of Civil Engineering and Acting Vice President for Business Affairs (1942). Polytechnic Institute of Brooklyn, B.C.E., 1937; M.C.E., 1941. ★
Reff, Israel, Professor of Physics (1954). Cooper Union, B.S.Ch.E., 1938; Indiana University, A.M., 1951; Ph.D., 1953.

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Rich, Joseph A., Jr., Professor of Management Engineering (1941). Rutgers University, B.S., 1941; M.S., 1948; D Jur., 1952. Licensed Attorney, New Jersey Bar and Federal Bar.
Robbins, James M., Distinguished Professor of Civil Engineering and Chairman of the Department (1929). Massachusetts Institute of Technology, S.B., 1923; S.M., 1924. ★
Salamone, Jerome J., Professor of Chemical Engineering (1948). City College of New York, B.Ch.E., 1942; New York University, M.Ch.E., 1947; Engr. Sc.D., 1954. ★
Schneider, Theodore A., Associate Professor of Mechanical Engineering (1942). Newark College of Engineering, B.S., 1941; Stevens Institute of Technology, M.S., 1956. ★
Shukur, Arthur, Associate Professor of Physics (1958). Newark College of Engineering, B.S., 1958; M.S., 1959. Acting Dean of Student Services.
Smith, H. Hunter, Professor of Physics (1946). Davidson College, B.S., 1926; North Carolina State College, M.S., 1930.
Stephans, Clarence H., Professor in Industrial Relations, Director of Relations with Industry, Director of Continuing Education Engineering Studies (1932). Newark College of Engineering, B.S., 1932. ★
Thom, George B., Professor of Mechanical Engineering and Chairman of the Department (1949). Lehigh University, M.E., 1920; M.S., 1932; M.A., 1935. ★
Van Houten, Robert W., President (1930). Newark College of Engineering, B.S., 1930; C.E., 1932; Rider College, D.Sc., 1955; Stevens Institute of Technology, D.Eng., 1955; Clarkson College of Technology, Sc.D., 1956; Newark State College, Litt. D., 1961; Seton Hall University, LL.D., 1966; Newark College of Engineering, D.Eng., 1970. ★
Wacker, Robert L., Associate Professor of English (1954). Northwestern University, B.A., 1947; Columbia University, M.A., 1948.
Weller, Monroe R., Associate Professor of Physics (1946). Upsala, B.A., 1935; Montclair State College, M.A., 1937.
Wenish, Werner J., Associate Professor of Chemistry (1963). Massachusetts Institute of Technology, B.S., 1943; New York University, M.S., 1949; Ph.D., 1955.
Wittes, Leo, Assistant Professor of Applied Mechanics (1953). Rutgers University, B.S., 1928; University of Maryland, M.S., 1931.
Workman, Samuel, Distinguished Professor of English and Chairman of the Department of Humanities (1961). Kenyon College, B.A., 1926; Ohio State University, M.A., 1927; Princeton University, Ph.D., 1935.

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Erie-Lackawanna* — from suburban communities north and west of Newark. E-L station is within walking distance of campus

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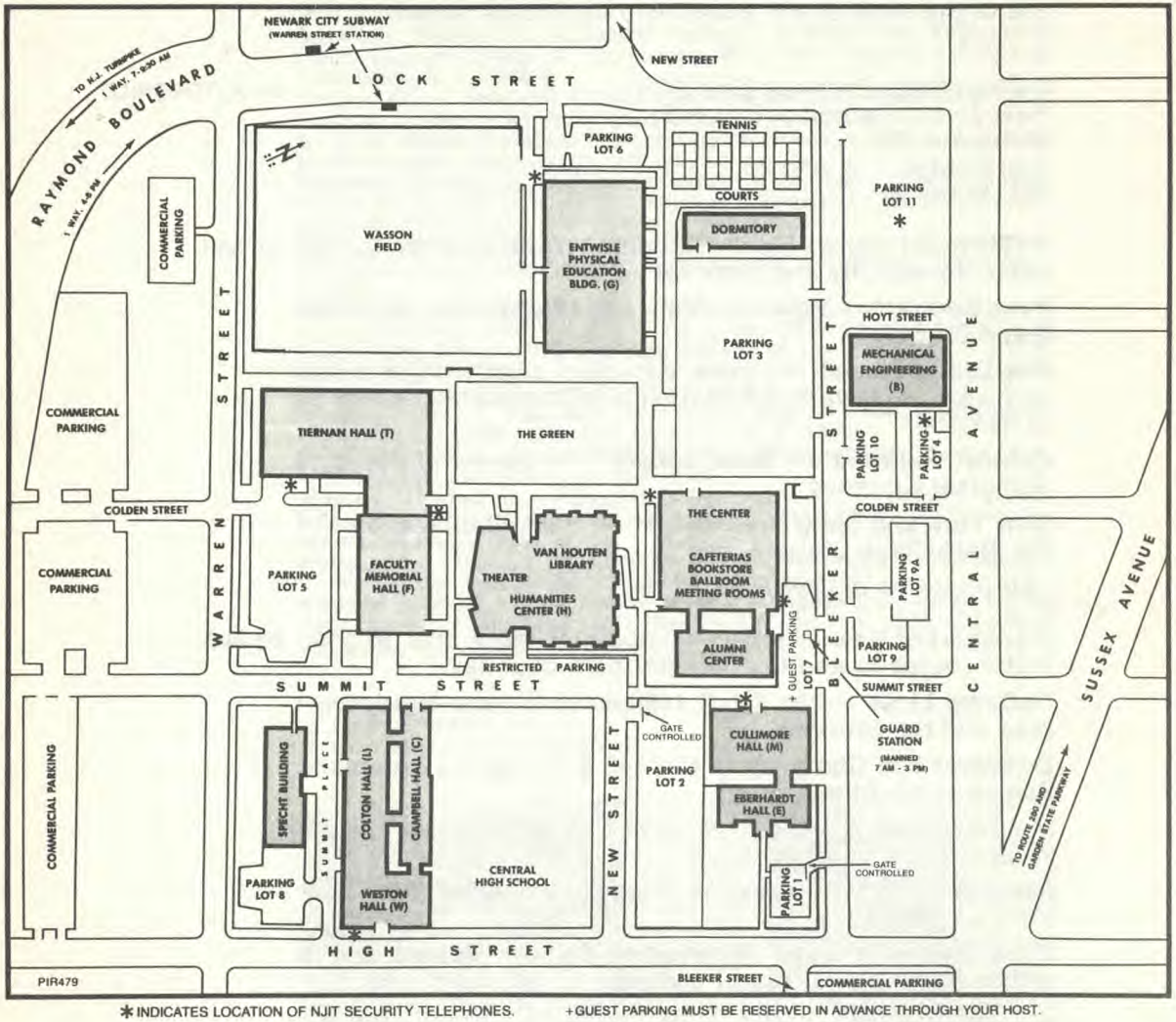

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Admissions Office
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Aerospace Studies
Room 210F
Alumni Association
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School of Architecture
4th Floor, Campbell Hall
Bookstore — The Center,
Lower Level
Cafeteria — The Center,
Ground Level
Campbell Hall
110 Summit Street
The Center
150 Bleeker Street
Chemical Engineering
Room 151T
161 Warren St.
Chemistry
Room 151T
161 Warren St.
Civil Engineering
Room 214C
Colton Hall
17 Summit Street
Computing Center
Room 1W
Cooperative Education
Room 210M
Counseling Center
Room 37E
Cullimore Hall
70 Summit Street
Dean of Engineering
Room 210M
Dean of Students
Room 33E
Division of Continuing
Education
Room 30E
Division of Technology
Room 210M
Eberhardt Hall
323 High Street
Electrical Engineering
Room 150T
Faculty Memorial Hall
111 Summit Street
Financial Office
Room 206M
Foundation at NJIT
215 Central Avenue
Graduate Division
Room 32E
Health, Physical Education
and Athletics
80 Lock Street
Humanities
Room 314M
Industrial and Management
Engineering
Room 502W
Organizational and
Social Sciences
Room 402M
Information
Switchboard
Room 112M — Dial "O"
Library
99 Summit Street
Mailroom
Room 110M
Mathematics
Room 305M
Mechanical Engineering
Room 403W
Personnel Office
Room 211M
Physical Plant Office
120 Summit Street
Physics
Room 463T
Placement Office
Room 212M
President's Office
Room 28E
Public Relations
Room 215M
Registrar's Office
Room 11E
Security Office
120 Summit Street
Seminar Rooms
The Center
150 Bleeker Street
Special Services
Room 114M
The Theater
99 Summit Street
Weston Hall
367 High Street

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The business and administrative offices of the Institute are open between the hours of 8:30A.M. and 4:30P.M., Monday through Friday, during the school year. Students are advised to contact the offices in advance to determine any change in days or hours during the course of the year as in the case, for example, of the summer program which differs from the above.

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New Jersey Institute of Technology
323 High Street
Newark, New Jersey 07102

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