FIRST YEAR

1st Semester

Chem 115	Chemistry and Materials I	(3½-0-4½)
Chem 115A	Chem 115 Laboratory	(0-2-0)
EG 101	Engineering Graphics	(1-2-2)
Eng 111	English Composition	(3-0-3)
Math 111	Calculus I	(4-0-4)
Phys 111	Physics I	(3-0-3)
Phys 111A	Physics I Laboratory	(0-2-1)
PE - - -	Physical Education	(0-1-1)
Frsh Sem	Freshman Seminar	(1-0-0)

2nd Semester

Chem 116	Chemistry and Materials II	(3½-0-4½)
Chem 116A	Chem 116 Laboratory	(0-2-0)
CIS 101	Computer Programming and Problem Solving	(2-1-2)
Hum 112	Culture and History I	(3-0-3)
Math 112	Calculus II	(4-0-4)
Phys 121	Physics II	(3-0-3)
Phys 121A	Physics II Laboratory	(0-2-1)
PE - - -	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

Math 211	Calculus IIIA	(3-0-3)
CIS 105	Computer Programming (Pascal)	(1-1-1-)
Phys 230	Physics III	(4-0-3½)
Phys 230A	Physics III Lab	(0-1-½)
Hum 231	Culture and History II	(3-0-3)
Elective	(Social Science: Lower Division GUR)	(3-0-3)
Elective	(Science/Engineering)	(3-0-3)

2nd Semester

Math 222	Differential Equations	(4-0-4)
Mech 235	Statics	(3-0-3)
CIS 114	Introduction to Computer Science II	(3-1-3)
SS 201	Economics	(3-0-3)
Elective	(Science/Engineering)	(3-0-3)

THIRD YEAR

1st Semester

Math 333	Probability and Statistics	(3-0-3)
ME 435	Thermodynamics	(3-0-3)
Elective	(Science/Engineering)	(3-0-3)
Elective	(Social Science: Lower Division)	(3-0-3)
Elective	(Free)	(3-0-3)
Elective	(Free)	(3-0-3)

2nd Semester

Elective	(Mathematics)	(3-0-3)
Elective	(Hum/SS/STS)	(3-0-3) *or*
Eng 342	Technical Report Writing	(3-0-3)
Elective	(Science/Engineering)	(3-0-3)
Elective	(Contemporary Issues)	(3-0-3)
Elective	(Free)	(3-0-3)
Elective	(Free)	(3-0-3)

FOURTH YEAR

1st Semester

Elective	(Project or Thesis)	(3-0-3)
Elective	(Science/Engineering)	(3-0-3)
Elective	(Science/Engineering)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Free)	(3-0-3)

2nd Semester

Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)
Elective	(Science/Engineering)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Management: GUR)	(3-0-3)
Elective	(Free)	(3-0-3)

Electives

Social Science Lower Division General University Requirement: Choose two courses from SS 200, SS 210, SS 221, SS 231, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology. One of the two courses is taken in fulfillment of General University Requirements.

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Hum/SS/STS: Choose a second humanities or social science elective as described above, with the following exception: Eng 342, Technical Report Writing, is an acceptable alternative. See program curriculum for third year, second semester.

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

Mathematics: Any upper division course in mathematics.

Contemporary Issues: One course in contemporary issues in economics, labor studies, management, or STS, chosen from among Econ 460, HRM 415, Mgmt 498, and STS 257.

Science/Engineering: Three courses in engineering (9 credits), in addition to Mech 235 and ME 435; two courses in science (6 credits); and two courses in either science or engineering (6 credits). Two of the science courses must both be from one of the following disciplines: biology, chemistry, computer science, or physics.

Project/Thesis: A senior project or undergraduate thesis in a student's area of concentration. Students register for an approved senior project or thesis course.

Free: 18 credits in any upper division courses.

■ Accelerated Seven-Year B.S./M.D. (Medical) and B.S./D.M.D. (Dental) Programs

New Jersey Institute of Technology and the University of Medicine and Dentistry of New Jersey (UMDNJ) offer programs leading to the Bachelor of Science degree in Engineering Science and the Doctor of Medicine degree (M.D.) or Doctor of Dental Medicine degree (D.M.D.), following completion of a prescribed seven-year program of study.

Both programs require three years of full-time study at NJIT, followed by four years of full-time study at UMDNJ. The program of study at NJIT consists of an honors premedical/predental curriculum in Engineering Science, culminating in a six-credit biomedical research project. Upon successful completion of the three-year honors premedical/predental curriculum at NJIT, students will have a seat waiting for them at UMDNJ. The subsequent program at UMDNJ follows the traditional four-year medical curriculum at the New Jersey Medical School (NJMS) or the traditional four-year dental curriculum at the New Jersey Dental School (NJDS). The B.S. in Engineering Science will be awarded by NJIT upon successful completion of the first year of study at UMDNJ, and the M.D. or D.M.D. degree will be awarded three years later by UMDNJ-NJMS or UMDNJ-NJDS.

Three features distinguish these accelerated programs from comparable ones at other institutions. First, NJIT's honors premedical/predental curriculum is unusual in its emphasis on engineering science, and particularly on biomedical engineering. Second, NJIT's location close to UMDNJ-NJMS and UMDNJ-NJDS often enables students to gain valuable medical- or dental-related experience during their undergraduate years, for example by doing research or by serving as a student intern or hospital volunteer. Finally, students admitted to these accelerated programs are also admitted into the NJIT Honors Program, entitling them to special benefits which include an annual merit award of at least $1300, use of the Honors Center, and guaranteed space in a campus residence hall for the duration of their program at NJIT.

As members of the Honors Program, students in the B.S./M.D. and B.S./D.M.D. programs must fulfill all requirements for Graduation with Honors in order to be assured of admission to UMDNJ-NJMS or UMDNJ-NJDS. In particular, they must successfully complete eight lower division honors courses, an upper division honors humanities seminar, and an upper division honors STS seminar; they must attend 22 honors colloquia of their choice; and they must maintain a grade point average no lower than 3.2 in their course work at NJIT. Students whose career plans change during their course of study at NJIT may withdraw from the accelerated program in medicine or dentistry at any time without jeopardizing their status as members of the Honors Program.

Students in these programs must fulfill general university requirements at NJIT, but they are exempt from the requirements of the basic curriculum in the traditional Engineering Science degree program. Candidates should be aware that the prescribed curriculum in these accelerated programs includes some summer courses, which are not covered by annual tuition and fees. Students who enter NJIT with Advanced Placement credit, or earn more than the prescribed number of credits in particular semesters, may reduce or eliminate the need for summer course work, but under no circumstances may a student advance to UMDNJ before completing six semesters of full-time study at NJIT.

These special programs are available to outstanding high school seniors who will be United States citizens or permanent residents of the U.S. at the time of their entry into UMDNJ (students who have already graduated from high school and completed college-level work at other institutions are not eligible). Candidates must rank in the top 10 percent of their graduating high school class and must present competitive scores on the Scholastic Aptitude Test (SAT). In most cases, candidates for the accelerated medical program must have SAT scores of 1250 or higher, recorded at a single sitting. Candidates for both programs must sit for three Achievement Tests: Mathematics Level I or II; Chemistry or Biology; and English with Composition. They must also submit a 400-500 word essay on their reasons for applying to NJIT/UMDNJ for a career in medicine or dentistry. In addition, interviews are required with the NJIT Honors Premedical/Predental Committee and with the Admissions Committee at either UMDNJ-NJMS or UMDNJ-NJDS, and final admission is contingent upon a favorable decision by both the NJIT and the UMDNJ-NJMS or UMDNJ-NJDS committees.

Admission to these accelerated programs is highly competitive, and not every student who meets the eligibility requirements stated above can be accommodated. Application for admission (including the required essay) must be submitted on or before January 1 of the applicant's senior year in high school, and all required SAT and Achievement Tests should be taken before that date. All candidates will be notified of their status in April.

Additional information about these programs may be obtained from the Office of Undergraduate Admission, the Honors Program, or the Director of the Engineering Science Program.

Honors Premedical/Predental Curriculum (117 credits)

FIRST YEAR

1st Semester

Chem 115	Chemistry and Materials I (3½-0-4½)	
Chem 115A	Chem 115 Laboratory (0-2-0)	
CIS 101	Computer Programming and Problem Solving	(2-1-2)
Eng 111	English Composition (3-0-3)	
Math 111	Calculus I (4-0-4)	
Phys 111	Physics I (3-0-3)	
Phys 111A	Physics I Laboratory (0-2-1)	
PE – – –	Physical Education (0-1-1)	
Frsh Sem	Freshman Seminar (1-0-0)	

2nd Semester

Chem 116	Chemistry and Materials II (3½-0-4½)	
Chem 116A	Chem 116 Laboratory (0-2-0)	
SS 201	Economics (3-0-3)	
Hum 112	Culture and History I (3-0-3)	
Math 112	Calculus II (4-0-4)	
Phys 112	Physics II (3-0-3)	
Phys 112A	Physics II Laboratory (0-2-1)	
PE – – –	Physical Education (0-1-1)	

SUMMER I

Bio 101	General Biology I (Rutgers-Newark)	(4-0-4)
Bio 102	General Biology II (Rutgers-Newark)	(4-0-4)

SECOND YEAR

1st Semester

Chem 343	Organic Chemistry I (3-0-3)	
Hum 231	Culture and History II (3-0-3)	
Math 211	Calculus IIIA (3-0-3)	
Math 333	Probability and Statistics (3-0-3)	
Elective	(Social Science: Lower Division GUR)	(3-0-3)
Elective	(Science) (3-0-3)	

2nd Semester

Chem 344	Organic Chemistry II (4-3-5)	
Elective / Eng 342	(Hum/SS/STS) (3-0-3) *or* Technical Report Writing	(3-0-3)
STS 310	Technology and Human Values	(3-0-3)
Elective	(Engineering) (3-0-3)	
Elective	(Science) (3-0-3)	

THIRD YEAR

1st Semester

BME 569	Engineering Physiology (3-0-3)
Elective	(Management: GUR) (3-0-3)
Hum 491H-499H	Humanities Honors Seminar (3-0-3)
Elective	(Science) (3-0-3)
Elective	(Free) (3-0-3)

2nd Semester

Elective	(Honors Science, Technology & Society Seminar) (3-0-3)
Elective	(Engineering) (3-0-3)
Elective	(Science) (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)
Elective	(Free) (3-0-3)

SUMMER III

Biomedical Research (6 credits)

Electives

Suggested Engineering Electives:

BME 672	Biomaterials
ChE 223	Chemical Process Calculations I
ChE 225	Chemical Process Calculations II
ChE 476	Introduction to Biochemical Engineering
EE 405	Electrical Engineering Principles
EnE 360	Environmental Engineering
EnE 361	Environmental Problems
EnE 560	Environmental Chemistry
IE 355	Human Factors
IE 446	Law
IE 456	Introduction to Industrial Hygiene
IE 465	Patent Law
IE 475	Hospital Unit Processes
IE 476	Hospitals and Health Care Facilities Liability
ME 215	Engineering Materials and Processes
ME 671	Biomechanics of Human Structure and Motion

Suggested Science Electives:

Chem 231	Physical Chemistry I
Chem 334	Physical Chemistry II
Chem 471	Chemical Aspects of Industrial Health
Chem 472	Chemical Technology of Food and Nutrition
Chem 473	Biochemistry
Math 222	Differential Equations
Mech 235	Statics
Mech 236	Dynamics
Phys 231	Physics III
Psych 484	Physiological Psychology (Rutgers-Newark)

(One science elective must be from among the following:)

Bio 120:320	Comparative Anatomy of Vertebrates (Rutgers-Newark)
Bio 120:335	General Microbiology (Rutgers-Newark)
Bio 120:337	Medical Microbiology (Rutgers-Newark)
Bio 120:352	Genetics (Rutgers-Newark)
Bio 120:355	Cell Biology (Rutgers-Newark)
Bio 120:443	Fundamentals of Immunology (Rutgers-Newark)
Bio 120:456	Virology (Rutgers-Newark)

Social Science Lower Division General University Requirement: Choose one course from SS 200, SS 210, SS 221, SS 231, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology.

Hum/SS/STS: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English, history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: One course chosen from upper division electives in literature, history, or philosophy. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

Free: Any upper division course.

Engineering Technology

Administered by: Department of Engineering Technology. Guttenberg Information Technologies Center, Room 2100.

■ B.S. in Engineering Technology

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 Engineering Technologist, has come into being. The Engineering 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. Engineering Technologists are in demand by industry, and salary levels are high.

The engineering technology program offers an opportunity for further education to persons who have completed an appropriate associate's degree program at a community college, technical institute, or 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), and hence is available to those employed full-time in industry. Students may transfer between day and evening programs during normal semester registration periods. Students can enter the program at the beginning of the fall, spring, or summer terms. The university reserves the right to make changes in various curricula that will address accreditation requirements or strengthen the program.

The program provides advanced education in technical and management skills, together with selected humanities and social science electives. Students are able to specialize in Computer, Construction and Contracting, Electrical, Manufacturing, Mechanical or Surveying Engineering Technology. The options in Construction and Contracting, Electrical, Manufacturing, and Mechanical Engineering Technology are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET). The options in Computer and Surveying Engineering Technology are new and are not yet eligible for accreditation by TAC/ABET.

TRANSFERRING INTO ENGINEERING TECHNOLOGY

Because the B.S. in engineering technology offers only the junior and senior years of study, all students transfer into the program as juniors. Usually students complete their freshman and sophomore years at a community college or technical institute, and obtain an associate's degree in applied science from these institutions. It is strongly recommended that students talk to an academic advisor at NJIT while they are still pursuing their associate's degrees. The academic advisor will explain the transfer process in detail as well as suggest elective courses that may be beneficial. You can contact an advisor by calling the Department of Engineering Technology at (201) 596-3228.

After being admitted to NJIT, the student will meet with an academic advisor to discuss the curriculum and any special interests the student might have. The student's college transcript(s) will be reviewed to make sure all required courses have been completed with a grade of "C" or better. Normally, students need to have a minimum of 64 semester hour credits or 96 quarter hours of appropriate course work. Students who lack necessary courses will be assigned to a "bridge program" to make up the required prerequisites. Courses taken at the freshman and sophomore level at the community colleges cannot substitute for junior or senior NJIT Engineering Technology courses.

■ Computer Engineering Technology Option

The computer option is a continuation of an associate's degree program in computer or electrical engineering technology with equal emphasis on computer software and hardware. Graduates of this program will have acquired knowledge in computer programming, digital logic devices including microprocessors and computer systems, and will be employable in any of the computer fields.

Typical Computer or Electrical Engineering Technology AAS Program Students who expect to transfer to the junior year of the Bachelor of Science in Engineering Technology (B.S.E.T.) program should have successfully completed most of the following courses or equivalent in their first two years of study.

A minimum of 64 semester hour credits is required:

Communications	Computer Programming
College Algebra and Trigonometry	DC and AC Circuit Analysis
Calculus	Electronics Fundamentals
Physics I and II	Digital Circuits
Computer Science	Microprocessors
Chemistry with lab	Social Science/Humanities/ Physical Education

Computer Engineering Technology Option (65 credits)

JUNIOR YEAR

1st Semester

MNET 414	Industrial Cost Analysis	(3-0-3)
*CIS 113	Introduction to Computer Science I	(3-1-3)
Math 309	Mathematical Analysis for Technology	(3-0-3)
Eng 342	Technical Report Writing	(3-0-3)
EET 303	Circuit Measurements	(1-3-2)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)

2nd Semester

EET 300	Circuit Analysis-Transform Methods	(3-0-3)
EET 365	Digital Logic and Circuit Design	(3-0-3)
*CIS 114	Introduction to Computer Science II	(3-1-3)
HRM 305 / Elective	Supervision and Employee Relations / (Technical)	(3-0-3) *or* (3-0-3)
Math 322	Differential Equations for Technology	(3-0-3)
**Elective	(Free)	(3-0-3)

SENIOR YEAR

1st Semester

EET 305	Integrated Circuit Applications	(2-2-3)
CIS 332	Principles of Operating Systems	(3-1-3)
Math 305	Statistics for Technology	(3-0-3)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

2nd Semester

EET 408	Electrical/Computer Technology Project	(1-3-3)
EET 410	Microprocessor Applications	(2-2-3)
Mgmt 390	Principles of Management	(3-0-3)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

*Students entering the program with a strong computer science background but lacking in electrical courses may be required to substitute EET courses for CIS 113 and CIS 114.

Electives

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

**_Free:_* Consult the program coordinator. Students entering with fewer than 15 credits in humanities/social science must take an appropriate lower division course to fulfill NJIT General University Requirements. Consult your program coordinator.

Suggested Technical Electives

Chem 301	Chemical Technology	(2-2-3)
CIS 333	Introduction to the UNIX Operating System	(3-0-3)
CIS 370	Introduction to Artificial Intelligence	(3-1-3)
CIS 451	Introduction to Data Communications and Networks	(3-1-3)
EET 406	Control Systems and Transducers	(3-3-4)
EET 414	Communications Systems	(2-2-3)
EET 415	Fundamentals of Applied Telecommunications	(3-0-3)
EET 417	Fiber Optics Technology	(2-2-3)
EET 344	Numerical Computing for Engineering Technology	(2-0-2)

Co-op

Co-op courses must be approved by the faculty advisor in the student's major department. For the B.S.E.T. option in computer engineering technology, EET 395 and EET 495 are taken for additive credit.

■ Construction and Contracting Engineering Technology Option

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

Typical Civil/Construction Engineering Technology AAS Program Students who expect to transfer to the junior year of the Bachelor of Science in Engineering Technology (B.S.E.T.) program should have successfully completed most of the following courses or equivalent in their first two years of study.

A minimum of 64 semester hour credits is required:

Communications	Surveying I and II
College Algebra and Trigonometry	Strength of Materials
Calculus	Fluid Mechanics/Hydraulics
Physics I and II	Steel Design
Computer Science	Concrete Design
Engineering Graphics	Soil Mechanics
Mechanics	
Social Science/Humanities/Physical Education	

Construction and Contracting Engineering Technology Option (69 credits)

JUNIOR YEAR

1st Semester

CET 317	Construction Computing	(3-0-3)
Eng 342	Technical Report Writing	(3-0-3)
CE 343	Geology with Laboratory	(3-3-4)
CET 301	Construction Surveying	(2-3-3)
CET 313	Construction Procedures I	(4-0-4)

2nd Semester

Math 305	Statistics for Technology	(3-0-3)
CET 331	Structural Systems	(3-3-4)
CET 314	Construction Procedures II	(4-0-4)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)
*Elective	(Free)	(3-0-3)

SENIOR YEAR

1st Semester

MNET 414	Industrial Cost Analysis	(3-0-3)
MET 450	Mechanical and Electrical Systems I	(3-3-4)
CET 411	Cost Estimating and Scheduling	(3-0-3)
CET 431	Construction Testing	(2-2-3)
HRM 305	Supervision and Employee Relations	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

2nd Semester

Mgmt 390	Principles of Management	(3-0-3)
MNET 421	Contracts and Specifications	(3-0-3)
CET 435	Design of Temporary Structures for Construction	(3-3-4)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

Electives

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

**Free:* Consult the program coordinator. Students entering with fewer than 15 credits in humanities/social science must take an appropriate lower division course to fulfill NJIT General University Requirements. Consult your program coordinator.

Suggested Technical Electives

Chem 301	Chemical Technology (2-2-3)
CET 322	Hydraulic and Hydrologic Problems in Construction (3-0-3)
CET 415	Building Construction (3-0-3)
CET 416	Heavy Construction (3-0-3)
CET 441	Soils and Earthwork (3-0-3)
CET 490	Senior Project (3-0-3)
EET 309	Electric Circuits and Machinery (2-2-3)
MNET 416	Production Scheduling (3-0-3)
MNET 419	Work Measurement Techniques (3-0-3)
MatSc 311	Properties of Materials (3-0-3)
MET 303	Applied Thermodynamics (3-0-3)
MET 404	Applied Heat Transfer (3-0-3)
MET 451	Mechanical and Electrical Systems II (3-0-3)
CE 412	Construction Codes and Specifications (3-0-3)

Co-op

Co-op courses must be approved by the faculty advisor in the student's major department. For the B.S.E.T. option in construction and contracting, CET 497 is taken for additive credit.

■ Electrical Engineering Technology Option

The electrical option is designed as a continuation of an associate's degree program in electrical or electronics engineering technology, with emphasis on the application of electrical and electronics principles and devices. Electives must be chosen so that at least one course will be taken in communications electronics and at least one in electric power technology either at the AAS level or in the upper division. Minor elective areas may be developed to satisfy student needs.

A new EET concentration in Clinical Engineering Technology is now being offered. A clinical engineering technologist works with the medical instrumentation and electrical devices in a hospital or other healthcare facility. Students that have interest in his concentration should see their advisor.

Typical Electrical/Electronics Engineering Technology AAS Program Students who expect to transfer to the junior year of the Bachelor of Science in Engineering Technology (B.S.E.T.) program should have successfully completed most of the following courses or equivalent in their first two years of study.

A minimum of 64 semester hour credits is required:

Communications
College Algebra and Trigonometry
Calculus
Physics I and II
Computer Science
Chemistry with lab
Social Science/Humanities/Physical Education
DC Circuits
AC Circuits
Semiconductor Electronics I and II
Digital-Logic Circuits
Introduction to Microprocessors

Electrical Engineering Technology Option (66 credits)

JUNIOR YEAR

1st Semester

EET 303	Circuit Measurements (1-3-2)
MET 303	Applied Thermodynamics (3-0-3)
CIS 213	Introduction to Computer Science (3-0-3)
Math 309	Mathematical Analysis for Technology (3-0-3)
Eng 342	Technical Report Writing (3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR) (3-0-3)

2nd Semester

EET 300	Circuit Analysis-Transform Methods (3-0-3)
EET 344	Numerical Computing for Engineering Technology (2-0-2)
CIS 105	Computer Programming ("C" language) (1-1-1)
MNET 414	Industrial Cost Analysis (3-0-3)
Math 322	Differential Equations for Technology (3-0-3)
HRM 305	Supervision and Employee Relations (3-0-3) *or*
Elective	(Technical) (3-0-3)
*Elective	(Free) (3-0-3)

SENIOR YEAR

1st Semester

EET 305	Integrated Circuit Applications (2-2-3)
EET 410	Microprocessor Applications (2-2-3)
Elective	(Technical) (3-0-3)
Math 305	Statistics for Technology (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)

2nd Semester

EET 406	Control Systems and Transducers (3-3-4)
EET 408	Electrical/Computer Technology Project (1-3-3)
Mgmt 390	Principles of Management (3-0-3)
Elective	(Technical) (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)

Electives

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

**Free:* Consult the program coordinator. Students entering with fewer than 15 credits in humanities/social science must take an appropriate lower division course to fulfill NJIT General University Requirements. Consult your program coordinator.

Suggested Technical Electives

CIS 102	Computer Science with Problem Solving (3-1-3)
Chem 301	Chemical Technology (2-2-3)
EET 310	Introduction to Microprocessors (2-2-3)
EET 365	Digital Logic and Circuit Design (3-0-3)
EET 411	Energy Conversion Devices (3-0-3)
EET 412	Power Generation and Distribution (3-0-3)
EET 413	Pulse and Digital Circuits (3-0-3)
EET 414	Communication Systems (2-2-3)
EET 415	Fundamentals of Applied Telecommunications (3-0-3)
EET 417	Fiber Optics Technology (2-2-3)
MNET 420	Quality Control (2-2-3)
MNET 421	Contract and Specifications (3-0-3)
MET 307	Plastics Technology (2-2-3)
MET 409	Air Conditioning and Refrigeration (3-0-3)

Co-op

Co-op courses must be approved by the faculty advisor in the student's major department. For the B.S.E.T. option in electrical engineering technology, EET 395 and EET 495 are taken for additive credit.

■ Manufacturing Engineering Technology Option

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

Typical Manufacturing Engineering Technology AAS Program Students who expect to transfer to the junior year of the Bachelor of Science in Engineering Technology (B.S.E.T.) program should have successfully completed most of the following courses or equivalent in their first two years of study.

A minimum of 64 semester hour credits is required:

Communications
College Algebra and Trigonometry
Calculus
Physics I and II
Computer Science
Engineering Graphics
Social Science/Humanities/Physical Education
Computer-Aided Drafting
Mechanisms and Machines
Manufacturing Systems
Automated Manufacturing
Electricity/Electronics

Manufacturing Engineering Technology Option (68 credits)

JUNIOR YEAR

1st Semester

CIS 102	Computer Science with Problem Solving	(3-1-3)
Eng 342	Technical Report Writing	(3-0-3)
Math 309	Mathematical Analysis for Technology	(3-0-3)
MNET 315	Industrial Statistics	(2-2-3)
MNET 317	Manufacturing Operations Analysis	(2-2-3)
MNET 414	Industrial Cost Analysis	(3-0-3)

2nd Semester

MatSc 318	Engineering Materials	(3-2-4)
Math 322	Differential Equations for Technology	(3-0-3)
MNET 303	Advanced Techniques in CAD/CAM	(2-2-3)
MNET 318	Manufacturing Process Design	(2-2-3)
MNET 420	Quality Control	(2-2-3)
*Elective	(Free)	(3-0-3)

SENIOR YEAR

1st Semester

MNET 416	Production Scheduling	(3-0-3)
MNET 405	Numerical Control for Machine Tools	(2-2-3)
MNET 423	Motion and Time Study Techniques	(2-2-3)
Mgmt 390	Principles of Management	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)

2nd Semester

MNET 422	Tool Design	(2-2-3)
MNET 424	Facilities Planning	(1-2-2)
MNET 426	Manufacturing Project	(1-3-2)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

Electives

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

**Free:* Consult the program coordinator. Students entering with fewer than 15 credits in humanities/social science must take an appropriate lower division course to fulfill NJIT General University Requirements. Consult your program coordinator.

Suggested Technical Electives

Chem 301	Chemical Technology	(2-2-3)
IE 449	Industrial Robotics	(2-2-3)
IE 465	Patent Law	(3-0-3)
IE 473	Safety Engineering	(3-0-3)
‡EET 309	Electrical Circuits and Machines	(2-2-3)
MNET 421	Contracts and Specifications	(3-0-3)
MET 303	Applied Thermodynamics	(3-0-3)
MET 304	Fluid Machinery	(2-2-3)
MET 307	Plastics Technology	(2-2-3)
MET 410	Electro-Mechanical Equipment	(3-0-3)

Co-op

Co-op courses must be approved by the faculty advisor in the student's major department. For the B.S.E.T. option in manufacturing engineering technology, MNET 395 and MNET 495 are taken for additive credit.

‡Must be taken as a technical elective unless an equivalent course was taken for an AAS degree.

■ Mechanical Engineering Technology Option

The mechanical engineering technology program offers an opportunity for further education to students who have completed an associate's degree in mechanical engineering technology at a community college, technical institute, or who have an equivalent education.

In addition to the mandatory courses as specified in the MET program, the student must take at least two cohesive electives from the approved list of MET electives.

Typical Mechanical Engineering Technology AAS Program Students who expect to transfer to the junior year of the Bachelor of Science in Engineering Technology (B.S.E.T.) program should have successfully completed most of the following courses or equivalent in their first two years of study.

A minimum of 64 semester hour credits is required.

Communications
College Algebra and Trigonometry
Calculus
Physics I and II
Computer Science
Engineering Graphics
Chemistry with lab
Mechanics I and II (Statics and Dynamics)
Social Science/Humanities/Physical Education
Strength of Materials with Lab
Kinematics/Mechanisms
DC/AC Circuits
Metallurgy
Manufacturing Processes
Computer-Aided Drafting

Mechanical Engineering Technology Option (69 credits)

JUNIOR YEAR

1st Semester

MET 301	Analysis and Design of Machine Elements I	(3-0-3)
MET 303	Applied Thermodynamics	(3-0-3)
MET 314	Dynamics of Machinery	(3-0-3)
EET 309	Electrical Circuits and Machines	(2-2-3)
Eng 342	Technical Report Writing	(3-0-3)
Math 309	Mathematical Analysis for Technology	(3-0-3)

2nd Semester

MET 302	Analysis and Design of Machine Elements II	(3-0-3)
MET 304	Applied Fluid Mechanics	(2-2-3)
Math 322	Differential Equations for Technology	(3-0-3)
Elective	(CIS/Technical Elective)	(3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)
*Elective	(Free)	(3-0-3)

SENIOR YEAR

1st Semester

MET 415	Automatic Control Systems	(3-0-3)
MET 416	Mechanical Instrumentation Laboratory	(2-2-3)
MNET 315	Industrial Statistics	(2-2-3)
MNET 414	Industrial Cost Analysis	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Technical)	(3-0-3)

2nd Semester

MET 408	Mechanical Design Project	(1-3-3)
MET 426	Mechanical Engineering Technology Laboratory	(2-2-3)
Mgmt 390	Principles of Management	(3-0-3)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

Electives

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

**Free:* Consult the program coordinator. Students entering with fewer than 15 credits in humanities/social science must take an appropriate lower division course to fulfill NJIT General University Requirements. Consult your program coordinator.

Suggested Technical Electives

Chem 301	Chemical Technology (2-2-3)
Chem 305	Chemical Technology (3-2-4)
CIS 102	Computer Science with Problem Solving (3-1-3)
MNET 303	Advanced Techniques in CAD/CAM (2-2-3)
MNET 420	Quality Control (2-2-3)
MatSc 311	Properties of Materials (3-0-3)
MET 307	Plastics Technology (2-2-3)
MET 308	Plastics Processing Techniques (2-2-3)
MET 404	Applied Heat Transfer (3-0-3)
MET 407	Structural Design (3-0-3)
MET 409	Air Conditioning and Refrigeration (3-0-3)
MET 410	Electro-Mechanical Equipment (3-0-3)
MET 439	Applied Mechanical Vibrations (3-0-3)

Co-op

Co-op courses must be approved by the faculty advisor in the student's major department. For the B.S.E.T. option in mechanical engineering technology, MET 395 and MET 495 are taken for additive credit.

■ Surveying Engineering Technology Option

Surveying involves activities such as mapping the earth above and below sea level; establishing property boundaries of private and public lands; providing information necessary for the construction of private and public works; establishing large-scale land information systems; determining facts about the size, shape and gravity field of the earth; and conducting high precision measurements for worldwide control network and for industrial applications and scientific studies. The surveyor utilizes a wide variety of techniques and equipment to perform his job. Some of the equipment is terrestrial-based, other equipment is air- and space-borne.

The surveying engineering technology curriculum stresses the technical, theoretical and legal aspects of surveying. An unprecedented number (seven) of law or law-related courses are integrated into the program in order to impart to students the legal knowledge and legal responsibility of a land surveyor.

Typical Surveying Engineering Technology AAS Program Students who expect to transfer to the junior year of the B.S.E.T. program should successfully complete most of the following courses or equivalent in their first two years of study.

A minimum of 67 semester hour credits is required.

Communications
Social Science/Humanities/Physical Education
College Algebra and Trigonometry
Calculus
Physics I and II
Computer Science
Engineering Graphics
CAD Applications in Civil Technology
Civil Engineering Drawing
Real Estate Law
Surveying I and II
Introduction to Legal Research and Writing
Business Law I and II
Evidence and Procedures for Boundary Location
Hydraulics
Urban and Suburban Development

Surveying Engineering Technology Option (72 credits)

JUNIOR YEAR

1st Semester

SET 301	Route Surveying (3-3-4)
SET 303	Photogrammetry and Aerial Photo Interpretation (3-3-4)
CIS 102	Computer Science with Problem Solving (3-1-3)
Math 305	Statistics for Technology (3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR) (3-0-3)

2nd Semester

SET 302	Geodetic Control Surveying (3-3-4)
SET 304	Adjustment Computations I (4-0-4)
SET 307	Boundaries and Adjacent Properties (3-3-4)
Eng 342	Technical Report Writing (3-0-3)
Math 309	Mathematical Analysis for Technology (3-0-3)

SENIOR YEAR

1st Semester

SET 401	Fundamentals of Geodesy (3-0-3)
SET 404	Adjustment Computations II (4-0-4)
SET 407	Boundary Line Analysis (3-3-4)
SET 435	Land Surveying Field Exercise (0-8-3)
HRM 305	Supervision and Employee Relations (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)

2nd Semester

SET 420	Land Information Systems (3-0-3)
SET 490	Senior Project in Surveying (2-0-2)
Mgmt 390	Principles of Management (3-0-3)
Elective	(Technical) (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)
*Elective	(Free) (3-0-3)

Electives

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

**Free:* Consult the program coordinator. Students entering with fewer than 15 credits in humanities/social science must take an appropriate lower division course to fulfill NJIT General University Requirements. Consult your program coordinator.

Suggested Technical Electives

CE 342	Geology (3-0-3)
CE 401	Photogrammetry (3-3-4)
CE 406	Remote Sensing (3-0-3)
CE 408	Analytical Aerotriangulation (3-0-3)
CE 450	Urban Planning (3-0-3)
CET 313	Construction Procedures I (4-0-4)

Industrial Engineering

Administered by: Department of Mechanical and Industrial Engineering, Division of Industrial and Management Engineering. Guttenberg Information Technologies Center, Room 2500.

The industrial engineering curriculum prepares engineers to design, improve, install, and operate integrated systems of people, materials, and facilities needed by industry, commerce, and society. Industrial engineers solve problems which arise in the management of systems by applying the principles of engineering science, product and process design, work analysis, human factors principles, and operations research. Industrial engineering leads to a wide variety of professional opportunities in manufacturing, service, research and development, and public service enterprises, and to graduate study in industrial engineering, management 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 engineering science. Students are also offered exposure to the more specialized areas of automated manufacturing systems, information systems, quality assurance, and safety engineering. In the freshman and sophomore years, the program concentrates on mathematics, physical science, and engineering science, an adequate background in these being essential to the courses presented in the later years. The 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.

The curriculum as described below is for students entering NJIT as freshmen in the fall of 1991 or after that date. Students entering before that date may have a different program and should consult the department to learn which curriculum applies.

■ B.S. in Industrial Engineering (141 credit minimum)

DAY PROGRAM

FIRST YEAR

1st Semester

Chem 115	Chemistry and Materials I	(3½-0-4½)
Chem 115A	Chem 115 Laboratory	(0-2-0)
*EG 101	Engineering Graphics	(1-2-2)
Eng 111	English Composition	(3-0-3)
Math 111	Calculus I	(4-0-4)
Phys 111	Physics I	(3-0-3)
Phys 111A	Physics I Laboratory	(0-2-1)
PE – – –	Physical Education	(0-1-1)
Frsh Sem	Freshman Seminar	(1-0-0)

2nd Semester

Chem 116	Chemistry and Materials II	(3½-0-4½)
Chem 116A	Chem 116 Laboratory	(0-2-0)
*CIS 101	Computer Programming and Problem Solving	(2-1-2)
Hum 112	Culture and History I	(3-0-3)
Math 112	Calculus II	(4-0-4)
Phys 121	Physics II	(3-0-3)
Phys 121A	Physics II Laboratory	(0-2-1)
PE – – –	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

IE 203	Applications of Computer Graphics in Industrial Engineering	(1-2-2)
IE 221	Introduction to Industrial Engineering	(3-0-3)
Math 211	Calculus III A	(3-0-3)
Hum 231	Culture and History II	(3-0-3)
Phys 230	Physics III	(4-0-3½)
Phys 230A	Physics III Laboratory	(0-1-½)
Elective	(Social Science: Lower Division GUR)	(3-0-3)

2nd Semester

IE 224	Production Process Design	(2-2-3)
Math 222	Differential Equations	(4-0-4)
SS 201	Economics	(3-0-3)
Mech 230	Statics and Dynamics	(4-0-4)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)

THIRD YEAR

1st Semester

IE 331	Applied Statistical Methods	(3-0-3)
IE 335	Engineering Cost Analysis and Control	(3-0-3)
IE 339	Work Measurement and Standards	(2-2-3)
Mech 232	Mechanics of Materials	(3-1-3)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

2nd Semester

IE 334	Engineering Economy and Capital Investment Analysis	(3-0-3)
IE 355	Human Factors	(3-0-3)
Math 337	Linear Algebra	(3-0-3)
EE 405	Electrical Engineering Principles	(3-0-3)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

FOURTH YEAR

1st Semester

IE 439	Deterministic Models in Industrial Engineering	(3-0-3)
IE 443	Senior Project I	(2-2-3)
IE 459	Production Planning and Control	(3-0-3)
ME 339	Fundamentals of Mechanical Design	(3-0-3)
ME 435	Thermodynamics	(3-0-3)
Elective	(Technical)	(3-0-3)

2nd Semester

IE 440	Probabilistic Models in Industrial Engineering	(3-0-3)
IE 444	Senior Project II	(1-4-3)
IE 461	Product Quality Assurance	(3-0-3)
IE 466	Materials Handling and Facilities Layout	(3-0-3)
Elective	(Management: GUR)	(3-0-3)

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

EVENING PROGRAM

FIRST YEAR

1st Semester

Chem 115	Chemistry and Materials I	(3½-0-4½)
Chem 115A	Chem 115 Laboratory	(0-2-0)
Eng 111	English Composition	(3-0-3)
Math 111	Calculus I	(4-0-4)

2nd Semester

Chem 116	Chemistry and Materials II	(3½-0-4½)
Chem 116A	Chem 116 Laboratory	(0-2-0)
Hum 112	Culture and History I	(3-0-3)
Math 112	Calculus II	(4-0-4)

SECOND YEAR

1st Semester

EG 101	Engineering Graphics	(1-2-2)
SS 201	Economics	(3-0-3)
Math 211	Calculus III A	(3-0-3)

2nd Semester

CIS 101	Computer Programming and Problem Solving	(2-1-2)
Hum 231	Culture and History II	(3-0-3)
Math 222	Differential Equations	(4-0-4)

THIRD YEAR

1st Semester

IE 224	Production Process Design	(2-2-3)
Phys 111	Physics I	(3-0-3)
Phys 111A	Physics I Laboratory	(0-2-1)

2nd Semester

IE 221	Introduction to Industrial Engineering	(3-0-3)
Phys 121	Physics II	(3-0-3)
Phys 121A	Physics II Laboratory	(0-2-1)

FOURTH YEAR

1st Semester

IE 334	Engineering Economy and Capital Investment Analysis (3-0-3)
Math 337	Linear Algebra (3-0-3)
Mech 230	Statics and Dynamics (4-0-4)

2nd Semester

IE 335	Engineering Cost Analysis and Control (3-0-3)
IE 339	Work Measurement and Standards (2-2-3)
Elective	(Social Science: Lower Division GUR) (3-0-3)

FIFTH YEAR

1st Semester

IE 203	Applications of Computer Graphics in Industrial Engineering (1-2-2)
IE 331	Applied Statistical Methods (3-0-3)
IE 459	Production Planning and Control (3-0-3)

2nd Semester

IE 355	Human Factors (3-0-3)
Phys 230	Physics III (4-0-3½)
Phys 230A	Physics III Laboratory (0-1-½)
Elective	(Hum/SS/STS: Upper Division GUR) (3-0-3)

SIXTH YEAR

1st Semester

IE 439	Deterministic Models in Industrial Engineering (3-0-3)
Mech 232	Mechanics of Materials (3-1-3)
Elective	(Technical) (3-0-3)

2nd Semester

IE 440	Probabilistic Models in Industrial Engineering (3-0-3)
ME 339	Fundamentals of Mechanical Design (3-0-3)

SEVENTH YEAR

1st Semester

IE 461	Product Quality Assurance (3-0-3)
ME 435	Thermodynamics (3-0-3)
Elective	(Management: GUR) (3-0-3)

2nd Semester

IE 466	Materials Handling and Facilities Layout (3-0-3)
Elective	(Technical) (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)

EIGHTH YEAR

1st Semester

IE 443	Senior Project I (2-2-3)
EE 405	Electrical Engineering Principles (3-0-3)
Elective	(Technical) (3-0-3)

2nd Semester

IE 444	Senior Project II (1-4-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)

Electives

Social Science Lower Division General University Requirement: Choose one course from SS 200, SS 210, SS 221, SS 231, HRM 308, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology.

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

Areas of Specialization (Technical Electives) Students in industrial engineering may pursue a general industrial engineering program of study and select nine credits of technical electives from a wide variety of elective courses or concentrate their choice of nine credits of technical electives in one of the designated technical areas of specialization. A course from another department may be used to substitute for one technical elective. The student must consult with the undergraduate advisor for a list of qualified courses and obtain approval. Those students choosing a specialization must obtain the advisor's approval of their entire choice of area electives prior to registering for their first technical elective course.

Listed below are four areas of specialization and suggested technical electives for each area:

Automated Manufacturing Systems

IE 441	Information and Knowledge Engineering Systems
IE 445	Industrial Simulation
IE 449	Industrial Robotics
IE 453	Computer Integrated Manufacturing
IE 469	Reliability in Engineering Systems

Information Systems

IE 441	Information and Knowledge Engineering Systems
IE 445	Industrial Simulation
IE 469	Reliability in Engineering Systems

Quality Assurance

IE 450	Product Engineering Standards
IE 451	Industrial Measuring Systems
IE 469	Reliability in Engineering Systems

Safety Engineering

IE 447	Legal Aspects of Engineering
IE 450	Product Engineering Standards
IE 451	Industrial Measuring Systems
IE 456	Introduction to Industrial Hygiene
IE 469	Reliability in Engineering Systems
IE 472	Product Liability Engineering
IE 473	Safety Engineering

Refer to the General University Requirement section of this catalog for further information on electives.

Co-op

Two co-op courses taken in sequence replace a technical elective. In industrial engineering, IE 310 is taken for additive credit, and IE 411 is taken for degree credit, with IE 310 as a prerequisite.

*Information Processing Systems

Administered by: Department of Computer and Information Science. Guttenberg Information Technologies Center, Room 4400.

Computer science is the study of information: its structure, its representation, and its utilization. This includes the theory, analysis, design, efficiency, 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. The dramatic use 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 are also 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 Bachelor of Arts in Information Processing Systems, a joint degree program with Rutgers-Newark, provides the student with a solid foundation in applying the principles of computing and information systems to business problems in areas such as accounting, finance, management, and marketing.

All students with majors in the Department of Computer and Information Science are required to prepare a Program of Study Form, an approved copy of which must be on file with the department. The form should be prepared as early as possible in the student's career. Students should enroll in CIS 113 and CIS 114 in the freshman year.

The curriculum as described below is for students entering NJIT as freshmen in the fall of 1991 or after that date. Students entering before that date may have a different program and should consult the department to learn which curriculum applies.

■ B.A. in Information Processing Systems*

(125 credit minimum)

FIRST YEAR

1st Semester

CIS 113	Introduction to Computer Science I	(3-1-3)
Math 111	Calculus I	(4-0-4)
Eng 111	English Composition	(3-0-3)
Econ 265	Microeconomics	(3-0-3)
Elective	(Science)	(3-1-4)
PE - - -	Physical Education	(0-1-1)
Frsh Sem	Freshman Seminar	(1-0-0)

2nd Semester

CIS 114	Introduction to Computer Science II	(3-1-3)
Math 105	Elementary Probability and Statistics	(3-0-3)
Hum 112	Culture and History I	(3-0-3)
Econ 266	Macroeconomics	(3-0-3)
Elective	(Science)	(3-1-4)
PE - - -	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

CIS 231	Machine and Assembly Language Programming	(3-1-3)
R640:237	Discrete Structures and Combinatorics	(3-0-3)
Acct 115	Principles of Accounting I	(3-0-3)
Hum 231	Culture and History II	(3-0-3)
Elective	(Social Science: Lower Division GUR)	(3-0-3)

2nd Semester

CIS 280	Programming Language Concepts	(3-0-3)
Acct 116	Principles of Accounting II	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(General)	(3-0-3)
Elective	(General)	(3-0-3)

THIRD YEAR

1st Semester

CIS 365	Computer Applications to Commercial Problems	(2-2-3)
Fin 315	Principles of Financial Management	(3-0-3)
Elective	(Management: GUR)	(3-0-3)
Elective	(CIS)	(3-0-3)
Elective	(General)	(3-0-3)

2nd Semester

CIS 390	Requirements Analysis and Systems Design	(3-0-3)
HRM 301	Organizational Behavior	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(CIS)	(3-0-3)
Elective	(General)	(3-0-3)

FOURTH YEAR

1st Semester

CIS 431	Introduction to Database Systems	(3-0-3)
Elective	(CIS)	(3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)
Elective	(General)	(3-0-3)
Elective	(General)	(3-0-3)

2nd Semester

CIS 465	Computer Techniques for Management Information Systems	(3-0-3)
Elective	(CIS)	(3-0-3)
Elective	(General)	(3-0-3)
Elective	(General)	(3-0-3)
Elective	(General)	(3-0-3)

*A name change to B.A. in Information Systems is pending the approval of the New Jersey Department of Higher Education.

Electives

Social Science Lower Division General University Requirement: Choose one course from SS 200, SS 210, SS 221, SS 231, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology.

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

CIS: The department strongly recommends and will accept courses chosen from CIS 251, CIS 332, CIS 333, CIS 370, CIS 438, CIS 451, CIS 455, CIS 461, CIS 490, and CIS 491. Students considering other courses should consult an advisor before registering.

General: Of the 9 elective courses in this category, at least seven must be in the areas of CIS and/or Management, with at least two courses from CIS and at least two in management-related areas. In management, it is strongly recommended that students enroll in Mrkt 330 (Principles of Marketing) and OM 475 (Production Planning and Control I). Students must consult with an advisor for the selection and approval of these electives.

Science: A two-course sequence (8 credit minimum) of laboratory science in physics, chemistry, biology, or as approved by advisor; both from same field.

Refer to the General University Requirement section of this catalog for further information on electives.

Co-op

In information processing systems, CIS 310 and CIS 410 are taken for additive credit. With departmental approval, students may extend the project developed in CIS 410 to be used as an individual research project in CIS 491.

Management

Administered by: School of Industrial Management. Weston Hall, Room 200.

The B.S. in Management emphasizes the application and management of technology to improve decision-making and competitiveness in organizations. The School of Industrial Management provides degree programs which reflect NJIT's strengths in architecture, computing applications, engineering, technology, and entrepreneurship.

The undergraduate program provides analytical tools for a broad range of management positions in business, government and non-profit organizations. The program also can be used as the foundation for graduate study in management, public administration or law.

Of the 129 credits required for the B.S. in Management, 18 credits must be in a major field of specialization. Students may specialize in areas such as financial management, human resource management, information systems management, marketing management, operations management, and management science.

The finance option is designed for students interested in the dynamics of monetary and risk management, capitalization, investment analysis, and the banking industry. Representative career opportunities for financial management include budget analyst, financial planner, and investment analyst.

The human resources specialization has great value for students who envision careers related to the management of people within an organizational setting, such as human resource manager, training specialist, compensation and benefits analyst and labor-management specialist. The curriculum provides a broad-based process view of human activities and how they contribute to the overall success of the organization.

Information systems specialists enter a growing field which focuses on computer processing of organizational information where they serve as data processing manager, systems analyst, computer center manager, and system project manager.

The marketing specialization provides students with an understanding of the market process, product planning, distribution, pricing, promotion, and related market activities as they exist in a variety of organizations. Graduates should find careers such as marketing research analyst, sales executive, and marketing manager.

The operations management specialization focuses on the efficient operation of the manufacturing process. This includes the acquisition of raw materials, inventory management, measurement and control, and using a variety of tools to assure optimum resource utilization in the manufacturing environment. With increasing emphasis on productivity, men and women educated in operations management will find a rapidly growing demand for their expertise in inventory control and purchasing.

Utilizing quantitative methods and the computer, management scientists help to solve management problems by formulating and analyzing mathematical models of appropriate systems. Models can be used to predict the consequences of alternative decisions and often specify what actions should be taken to achieve objectives. Typical job assignments include forecasting, production planning, and computer simulation.

TRANSFERRING INTO MANAGEMENT

The B.S. in Management 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's degree at a county college or similar institution.

The School of Industrial Management will accept for transfer credit lower division (100 and 200 level) management courses taken elsewhere without challenge for equivalent lower division (100 and 200 level) courses offered as part of the management program at NJIT. A grade of C or better is required for all courses accepted for transfer.

Lower division (100 and 200 level) management courses taken elsewhere which the School of Industrial Management offers as upper division (300 and 400 level) courses will be accepted for upper division transfer credit provided that the courses are passed with grades of C or better, and validated by achieving grades of C or better in upper division (300 and 400 level) courses in the appropriate fields. All transfer credit is awarded on a one-for-one basis.

The curriculum as described below is for students entering NJIT as freshmen in the fall of 1991 or after that date. Students entering before that date may have a different program and should consult the department to learn which curriculum applies.

■ B.S. in Management (129 credit minimum)

FIRST YEAR

1st Semester

Acct 115	Principles of Accounting I (3-0-3)
Eng 111	English Composition (3-0-3)
*Math 138	General Calculus I (3-0-3) *or*
*Math 121	Calculus I for Management (4-0-4)
CIS 103	Computer Science with Business Problems (3-1-3) *or*
CIS 113	Introduction to Computer Science I (3-1-3)
Econ 265	Microeconomics (3-0-3)
PE – – –	Physical Education (0-1-1)
Frsh Sem	Freshman Seminar (1-0-0)

2nd Semester

Acct 116	Principles of Accounting II (3-0-3)
Hum 112	Culture and History I (3-0-3)
Econ 266	Macroeconomics (3-0-3)
MIS 246	Microcomputer Applications for Managers (3-0-3)
*Math 238	General Calculus II (3-0-3) *or*
*Math 122	Calculus II for Management (4-0-4)
PE – – –	Physical Education (0-1-1)

SECOND YEAR

1st Semester

Hum 231	Culture and History II (3-0-3)
Eng 200	Communicating in Organizations (3-0-3)
*Math 105	Elementary Probability and Statistics (3-0-3) *or*
*Math 333	Probability and Statistics (3-0-3)
Elective	(Engineering Technology) (3-0-3)
Elective	(Science) (3-0-3)

2nd Semester

Mgmt 290	Legal Environment of Business (3-0-3)
Mgmt 216	Business Statistics (3-0-3)
Elective	(Science with Lab) (3-1-4)
Hum 251	Ethical Issues in Business (3-0-3)
Elective	(Free) (3-0-3)

THIRD YEAR

1st Semester

HRM 301	Organizational Behavior (3-0-3)
Mrkt 330	Principles of Marketing (3-0-3)
MIS 345	Management Information Systems (3-0-3)
Fin 315	Principles of Financial Management (3-0-3)
Mgmt 390	Principles of Management (3-0-3)
Elective	(Mgmt Specialization) (3-0-3)

2nd Semester

Acct 317	Managerial Accounting (3-0-3)
OM 375	Management Science (3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR) (3-0-3)
Elective	(Mgmt Specialization) (3-0-3)
Elective	(Free SIM) (3-0-3)

FOURTH YEAR

1st Semester

Mgmt 491	International Business (3-0-3)
Elective	(Mgmt Specialization) (3-0-3)
Elective	(Mgmt Specialization) (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)
Elective	(Social Science: Upper Division) (3-0-3)
Elective	(Free) (3-0-3)

2nd Semester

Mgmt 492	Business Policy (3-0-3)
Elective	(Mgmt Specialization) (3-0-3)
Elective	(Mgmt Specialization) (3-0-3)
Elective	(Lit/Hist/Phil: GUR) (3-0-3)
Elective	(Free SIM) (3-0-3)

Math Sequence

*The math sequence for management specializations (finance, human resources, and marketing) is Math 138, Math 238, and Math 105. The math sequence for decision support specializations (information systems, operations and management science) is Math 121, Math 122, and Math 333. Placement is dependent on previous math background, SAT scores, and Basic Skills Test scores.

Electives

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Social Science Upper Division: Must be a 300 or 400 level course.

Engineering Technology: Refer to the General University Requirements section of this catalog for further information on available options.

Science with a Lab: Students are free to choose a laboratory science course.

Science: Students are free to choose a science course.

Free SIM: An upper division course offered by the School of Industrial Management.

Free: Students select courses in consultation with program advisor.

Refer to the General University Requirement section of this catalog for further information on electives.

Note:

SS 201 does not satisfy economics requirement for management majors.

Co-op

Co-op courses bearing degree credit replace a technical elective or another course approved by the School of Industrial Management. Mgmt 310 is taken for additive credit and Mgmt 410 is taken for degree credit.

Areas of Specialization Students majoring in management must choose an area of specialization. At present, six areas of management specialization exist, each of which requires at least 18 credits of "Mgmt specialization courses" for completion. The area of specialization planned in consultation with the student's advisor may include courses in more than one college or department, but should be selected with a career objective in mind. Students whose career objectives lie in financial management, human resource management, information systems management, marketing management, operations management, or management science may find the following selection of courses the most appropriate to their interests.

FINANCIAL MANAGEMENT SPECIALIZATION

Required (9 Credits)

Fin 315	Principles of Financial Management	(3-0-3)
Fin 320	Money and Banking	(3-0-3)
Fin 321	The Financial System	(3-0-3)

Electives (9 Credits)

Fin 317	Investment Analysis	(3-0-3)
Fin 322	Public Finance	(3-0-3)
Fin 416	Corporate Finance	(3-0-3)
Fin 417	Advanced Portfolio Analysis	(3-0-3)
Fin 420	Monetary Theory and Policy	(3-0-3)
Fin 422	International Finance	(3-0-3)
Fin 423	Risk Management	(3-0-3)
Fin 424	Financial Simulation Seminar	(3-0-3)
Fin 428	Seminar in Special Topics in Finance	(3-0-3)
Econ 421	Commercial Banking	(3-0-3)
Econ 463	International Economics	(3-0-3)

HUMAN RESOURCE MANAGEMENT SPECIALIZATION

Required (9 Credits)

Mgmt 499	Employee-Management Communications	(3-0-3)
HRM 303	Human Resource Management	(3-0-3)
HRM 308	Labor Economics and Industrial Relations	(3-0-3)

Electives (9 Credits)

HRM 304	Industrial Safety Administration	(3-0-3)
HRM 305	Supervision and Employee Relations	(3-0-3)
HRM 307	Industrial Psychology	(3-0-3)
HRM 402	Administration of Equal Employment Opportunity Programs	(3-0-3)
HRM 405	Organizational Strategies for Productivity Improvement	(3-0-3)
HRM 406	Wage and Salary Analysis	(3-0-3)
HRM 407	Social Insurance and Employee Benefits	(3-0-3)
HRM 410	Group Development and Dynamics	(3-0-3)
HRM 411	Training and Development	(3-0-3)
HRM 412	Labor-Management Relations	(3-0-3)
HRM 413	Industrial Relations Policy	(3-0-3)
HRM 414	Labor Market Analysis	(3-0-3)

INFORMATION SYSTEMS MANAGEMENT SPECIALIZATION

Required (12 Credits)

CIS 114	Introduction to Computer Science	(3-1-3)
CIS 431	Introduction to Database Systems	(3-0-3)
MIS 390	Requirements Analysis and Systems Design	(3-0-3)
MIS 450	Seminar on MIS Application	(3-0-3)

Electives (6 Credits)

CIS 365	Computer Applications to Commercial Problems	(2-2-3)
CIS 451	Introduction to Data Communications and Networks	(3-0-3)
CIS 455	Computer Systems Management	(3-0-3)

MANAGEMENT SCIENCE SPECIALIZATION

Required (18 Credits)

OM 380	Introduction to Operations Research I	(3-0-3)
OM 381	Introduction to Operations Research II	(3-0-3)
OM 475	Production Planning and Control I	(3-0-3)
Math 344	Regression Analysis	(3-0-3)
IE 445	Industrial Simulation	(3-0-3)
Econ 360	Managerial Economics	(3-0-3)

MARKETING MANAGEMENT SPECIALIZATION

Required (9 Credits)

Mrkt 331	Consumer and Buyer Behavior	(3-0-3)
Mrkt 430	Marketing Research	(3-0-3)
Mrkt 431	Strategic Marketing Management	(3-0-3)

Electives (9 Credits)

Mrkt 332	Advertising Theory and Techniques	(3-0-3)
Mrkt 336	Marketing Communications: Promotion Persuasion and Public Relations	(3-0-3)
Mrkt 337	Marketing Distribution Channels	(3-0-3)
Mrkt 338	Product Development and Management	(3-0-3)
Mrkt 339	Selling and Sales Management	(3-0-3)
Mrkt 433	Services Marketing	(3-0-3)
Mrkt 434	Industrial Marketing	(3-0-3)
Mrkt 435	International Marketing	(3-0-3)

OPERATIONS MANAGEMENT SPECIALIZATION

Required (9 Credits)

OM 475	Production Planning and Control I	(3-0-3)
OM 476	Quality Control	(3-0-3)
OM 477	Work Measurement Techniques	(3-0-3)

Electives (9 Credits)

IE 445	Simulation Modeling of Industrial Systems	(3-0-3)
CIS 461	Systems Simulation	(3-0-3)
OM 377	Introduction to Manufacturing Management	(3-0-3)
OM 378	Purchasing and Materials Management	(3-0-3)
OM 480	Production Processes/Production Planning and Control	(2-2-3)
OM 484	Production Planning and Control II	(3-0-3)

Manufacturing Engineering

Administration: Manufacturing engineering is an interdisciplinary program. It is overseen by the director of manufacturing engineering programs. Guttenberg Information Technologies Center, Room 2400.

Manufacturing engineering is the discipline which addresses the ways in which the production of goods and services can be made efficient and effective, while simultaneously achieving quality, cost and timeliness goals. The program emphasizes the interrelationships among manufacturing equipment, processes and controls and their integration into production factories. The program also includes the new technologies of robotics, microprocessors and computer-integrated manufacturing and indicates their application in automated production, automated inspection and automated packaging. The program culminates in two project courses, where industrial problems are solved by the student, with faculty and industrial input.

The curriculum as described below is for students entering NJIT as freshmen in the fall of 1991 or after that date. Students entering before that date may have a different program and should consult the director of manufacturing engineering programs to learn which curriculum applies.

B.S. in Manufacturing Engineering

(140 credit minimum)

DAY PROGRAM

FIRST YEAR

1st Semester

Chem 115	Chemistry and Materials I	(3½-0-4½)
Chem 115A	Chem 115 Laboratory	(0-2-0)
*EG 101	Engineering Graphics	(1-2-2)
Eng 111	English Composition	(3-0-3)
Math 111	Calculus I	(4-0-4)
Phys 111	Physics I	(3-0-3)
Phys 111A	Physics I Laboratory	(0-2-1)
PE - - -	Physical Education	(0-1-1)
Frsh Sem	Freshman Seminar	(1-0-0)

2nd Semester

Chem 116	Chemistry and Materials II	(3½-0-4½)
Chem 116A	Chem 116 Laboratory	(0-2-0)
*CIS 101	Computer Programming and Problem Solving	(2-1-2)
Hum 112	Culture and History I	(3-0-3)
Math 112	Calculus II	(4-0-4)
Phys 121	Physics II	(3-0-3)
Phys 121A	Physics II Laboratory	(0-2-1)
PE - - -	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

Hum 231	Culture and History II	(3-0-3)
IE 203	Applications of Computer Graphics in Industrial Engineering	(1-2-2)
Math 211	Calculus IIIA	(3-0-3)
Mech 230	Statics and Dynamics	(4-0-4)
Phys 231	Physics III	(4-0-4)
Phys 231A	Physics III Laboratory	(0-2-1)

2nd Semester

CIS 213	Introduction to Computer Science	(3-0-3)
EE 305	Electrical Engineering Principles	(3-2-4)
Math 222	Differential Equations	(4-0-4)
Mech 232	Mechanics of Materials	(3-1-3)
SS 201	Economics	(3-0-3)

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

THIRD YEAR

1st Semester

MnE 351	Materials for Manufacturing	(2-2-3)
MnE 371	Manufacturing Processes for Metals	(2-2-3)
Math 333	Probability and Statistics	(3-0-3)
ME 339	Fundamentals of Mechanical Design	(3-0-3)
Elective	(Social Science: Lower Division GUR)	(3-0-3)

2nd Semester

MnE 320	Manufacturing System Dynamics and Control	(3-0-3)
MnE 360	Manufacturing Instrumentation	(2-2-3)
MnE 372	Manufacturing Processes for Plastics	(2-2-3)
ME 435	Thermodynamics	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)

FOURTH YEAR

1st Semester

MnE 401	Design for Manufacturability	(2-2-3)
MnE 481	Manufacturing Systems Integration	(2-2-3)
MnE 491	Manufacturing Engineering Project A	(2-2-3)
IE 449	Industrial Robotics	(2-2-3)
IE 453	Computer Integrated Manufacturing	(2-2-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

2nd Semester

MnE 492	Manufacturing Engineering Project B	(2-2-3)
**IE 436	Cost Analysis and Engineering Economics	(3-0-3)
IE 460	Measurement Techniques and Quality Control	(3-0-3)
Elective	(Manufacturing Engineering)	(3-0-3)
Elective	(Management: GUR)	(3-0-3)

EVENING PROGRAM Consult the program director for information on the evening curriculum for manufacturing engineering.

**pending approval

Electives

Social Science Lower Division General University Requirement: Choose one course from SS 200, SS 210, SS 221, SS 231, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology.

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

Manufacturing Engineering: Consult the program director.

Refer to the General University Requirement section of this catalog for further information on electives.

Co-op

Co-op courses bearing degree credit replace a technical elective or another course approved by the faculty advisor in the student's major department. In manufacturing engineering, MnE 310 is taken for additive credit and MnE 410 is taken for degree credit.

Materials Science and Engineering

(Pending Approval)

Administration: Materials science and engineering is an interdisciplinary program. It is administered by a director in the Department of Physics. Tiernan Hall, Room 463.

The materials science and engineering degree program, currently under development, focuses on the properties and applications of engineering materials. The professional in this field produces materials to meet the demands of, for example, the designers of jet and rocket motors, microelectronic devices, biomedical devices and reactors.

A scientifically oriented program, the planned curriculum includes the laws and principles that govern the structure of the solid state to produce optimum mechanical and physical properties. Option sequences in the curriculum provide for specialization in metallurgical engineering, electronic materials, polymer science and engineering, and structural materials.

The program is designed to produce engineers and scientists who have specialization coupled with a broad background in materials.

Typical courses include biomaterials, corrosion, solid state chemistry, surface modification, and mechanical and physical properties. Laboratories containing modern and sophisticated equipment are available for senior projects.

Mechanical Engineering

Administered by: Department of Mechanical and Industrial Engineering. Mechanical Engineering Center, Room 204.

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

The first two years of the curriculum provide a foundation for the 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. CAD/CAM systems are used extensively throughout the curriculum.

The mechanical engineering curriculum prepares the student for professional work as well as graduate study in engineering or in such areas as medicine, law and business.

The curriculum as described below is for students entering NJIT as freshmen in the fall of 1991 or after that date. Students entering before that date may have a different program and should consult the department to learn which curriculum applies.

■ B.S. in Mechanical Engineering (140 credit minimum)

DAY PROGRAM

FIRST YEAR

1st Semester

Chem 115	Chemistry and Materials I	(3½-0-4½)
Chem 115A	Chem 115 Laboratory	(0-2-0)
*EG 101	Engineering Graphics	(1-2-2)
Eng 111	English Composition	(3-0-3)
Math 111	Calculus I	(4-0-4)
Phys 111	Physics I	(3-0-3)
Phys 111A	Physics I Laboratory	(0-2-1)
PE - - -	Physical Education	(0-1-1)
Frsh Sem	Freshman Seminar	(1-0-0)

2nd Semester

Chem 116	Chemistry and Materials II	(3½-0-4½)
Chem 116A	Chem 116 Laboratory	(0-2-0)
*CIS 101	Computer Programming and Problem Solving	(2-1-2)
Hum 112	Culture and History I	(3-0-3)
Math 112	Calculus II	(4-0-4)
Phys 121	Physics II	(3-0-3)
Phys 121A	Physics II Laboratory	(0-2-1)
PE - - -	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

Math 211	Calculus III A	(3-0-3)
Math 225	Survey of Probability and Statistics	(1-0-1)
Mech 235	Statics	(3-0-3)
**ME 215	Engineering Materials and Processes	(2-2-3)
Hum 231	Culture and History II	(3-0-3)
Phys 230	Physics III	(4-0-3½)
Phys 230A	Physics III Laboratory	(0-1-½)

2nd Semester

ME 202	Elements of Mechanical Engineering	(1-2-2)
ME 231	Kinematics of Machinery	(3-1-3)
Math 222	Differential Equations	(4-0-4)
Mech 232	Mechanics of Materials	(3-1-3)
Mech 236	Dynamics	(2-0-2)
**SS 201	Economics	(3-0-3)

THIRD YEAR

1st Semester

EE 405	Electrical Engineering Principles	(3-0-3)
ME 311	Thermodynamics I	(3-0-3)
ME 314	Dynamic Analysis of Machines	(3-0-3)
ME 315	Stress Analysis	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Social Science: Lower Division GUR)	(3-0-3)

2nd Semester

ME 304	Fluid Mechanics	(3-1-3)
ME 305	Introduction to System Dynamics	(3-0-3)
ME 312	Thermodynamics II	(3-0-3)
ME 316	Machine Design	(3-0-3)
ME 343	Mechanical Laboratory I	(2-2-3)
Elective	(Management: GUR)	(3-0-3)

FOURTH YEAR

1st Semester

ME 403	Mechanical Systems Design I	(2-2-3)
ME 405	Mechanical Laboratory II	(1-2-2)
ME 407	Heat Transfer	(3-0-3)
Elective	(ME)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Technical)	(3-0-3)

2nd Semester

ME 406	Mechanical Laboratory III	(1-2-2)
ME 408	Mechanical Systems Design II	(1-2-2)
Elective	(ME)	(3-0-3)
Elective	(ME)	(3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)
Elective	(Technical)	(3-0-3)

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

EVENING PROGRAM

FIRST YEAR
1st Semester

Chem 115	Chemistry and Materials I	(3½-0-4½)
Chem 115A	Chem 115 Laboratory	(0-2-0)
Math 111	Calculus I	(4-0-4)

2nd Semester

Chem 116	Chemistry and Materials II	(3½-0-4½)
Chem 116A	Chem 116 Laboratory	(0-2-0)
Eng 111	English Composition	(3-0-3)
Math 112	Calculus II	(4-0-4)

SECOND YEAR
1st Semester

Phys 111	Physics I	(3-0-3)
Phys 111A	Physics I Laboratory	(0-2-1)
Hum 112	Culture and History I	(3-0-3)
Math 211	Calculus III A	(3-0-3)

2nd Semester

Phys 121	Physics II	(3-0-3)
Phys 121A	Physics II Laboratory	(0-2-1)
CIS 101	Computer Programming and Problem Solving	(2-1-2)
Math 222	Differential Equations	(4-0-4)

THIRD YEAR
1st Semester

Math 225	Survey of Probability and Statistics	(1-0-1)
EG 101	Engineering Graphics	(1-2-2)
SS 201	Economics	(3-0-3)
Mech 235	Statics	(3-0-3)

2nd Semester

Phys 230	Physics III	(4-0-3½)
Phys 230A	Physics III Laboratory	(0-1-½)
ME 202	Elements of Mechanical Engineering	(1-2-2)

FOURTH YEAR
1st Semester

ME 215	Engineering Materials and Processes	(2-2-3)
Mech 236	Dynamics	(2-0-2)
Elective	(Social Science: Lower Division GUR)	(3-0-3)

2nd Semester

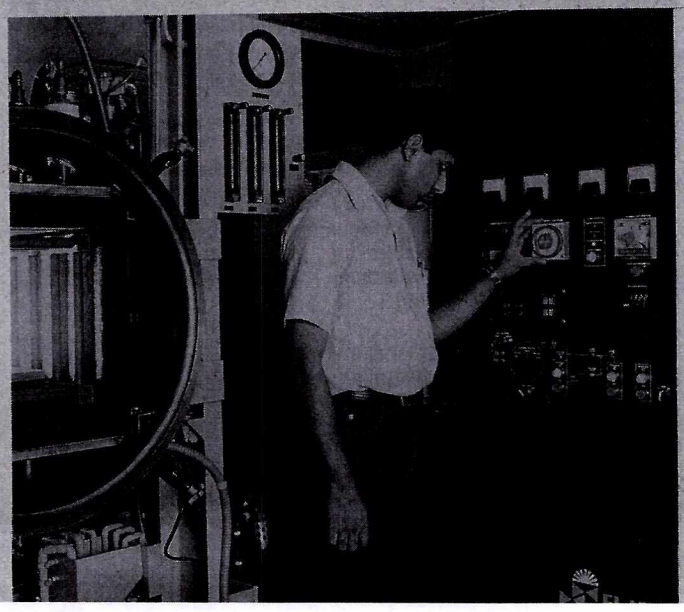
ME 231	Kinematics of Machinery	(3-1-3)
Hum 231	Culture and History II	(3-0-3)
Mech 232	Mechanics of Materials	(3-1-3)

FIFTH YEAR
1st Semester

ME 311	Thermodynamics I	(3-0-3)
ME 314	Dynamic Analysis of Machines	(3-0-3)
EE 405	Electrical Engineering Principles	(3-0-3)

2nd Semester

ME 304	Fluid Mechanics	(3-1-3)
ME 312	Thermodynamics II	(3-0-3)
ME 315	Stress Analysis	(3-0-3)



SIXTH YEAR
1st Semester

ME 316	Machine Design	(3-0-3)
ME 343	Mechanical Laboratory I	(2-2-3)

2nd Semester

ME 305	Introduction to System Dynamics	(3-0-3)
ME 407	Heat Transfer	(3-0-3)
Elective	(Management: GUR)	(3-0-3)

SEVENTH YEAR
1st Semester

ME 403	Mechanical Systems Design I	(2-2-3)
ME 405	Mechanical Laboratory II	(1-2-2)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

2nd Semester

ME 406	Mechanical Laboratory III	(1-2-2)
ME 408	Mechanical Systems Design II	(1-2-2)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

EIGHTH YEAR
1st Semester

Elective	(ME)	(3-0-3)
Elective	(Hum/SS/STS: Upper Division GUR)	(3-0-3)
Elective	(Technical)	(3-0-3)

2nd Semester

Elective	(ME)	(3-0-3)
Elective	(ME)	(3-0-3)
Elective	(Technical)	(3-0-3)

Note

Eligible students may substitute Math 213H for the combination of Math 211 and Math 225.

Electives

Social Science Lower Division General University Requirement: Choose one course from SS 200, SS 210, SS 221, SS 231, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology.

Hum/SS/STS Upper Division General University Requirement: A humanities or social science elective numbered 300 or higher. Acceptable course designations include anthropology, arts, economics, English (except Eng 342), history, humanities, literature, philosophy, political science, psychology, sociology, and STS (science, technology and society).

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

ME: Must be chosen from a list of courses available from the mechanical and industrial engineering department.

Technical: Must be chosen from a list of courses available from the mechanical and industrial engineering department.

Refer to the General University Requirement section of this catalog for further information on electives.

Co-op

Co-op courses bearing degree credit replace a technical elective or another course approved by the faculty advisor in the student's major department. In mechanical engineering, ME 310 is taken for additive credit and ME 410 is taken for degree credit, with ME 310 as a prerequisite.

Science, Technology and Society (STS)

Administered by: Department of Social Science and Policy Studies. Cullimore Hall, Room 501. The STS major is offered cooperatively by NJIT and Rutgers-Newark, and is overseen by a program director at NJIT.

The Bachelor of Science degree program in STS offers a liberal education for our technological age. STS explores the foundations and impact of science and technology by examining the values, language, history, politics, and economics of modern technological society. It prepares the student to integrate the scientific and technical disciplines with the humanities and social sciences. Through its multidisciplinary approach, STS explores the interrelated worlds of the scientist, engineer, politician, and citizen. Furthermore, the global, multicultural, and environmental perspective of STS develops ethical awareness and public responsibility.

STS graduates are in demand in many areas. Employment is found in fields such as law, medicine, technical communications, government, corporate planning, business management, public policy and administration, urban development, transportation, technology assessment, and environmental planning. The STS major can provide excellent preparation for graduate study in any of these fields, as well as in liberal arts disciplines such as history and political science.

The STS major at NJIT is enriched by a number of special features and opportunities. Major environmental and technological issues are discussed by faculty and students at monthly STS colloquia. NJIT's Center for Technology Studies, which is closely affiliated with the STS program, sponsors a series of workshops and lectures to which STS students are invited, and maintains a resource library of STS-related books, journals, and video tapes that students are encouraged to use. Opportunities exist for internships, which enable students to develop and apply their knowledge and skills in corporate and government settings. Qualified STS students may participate in the Cooperative Education program; the combined B.S./M.S. program; the Honors program; and the Environmental Scholars program. Because STS is a cooperative program with Rutgers-Newark, STS students have full access to a wide array of Rutgers courses in addition to those at NJIT. Beginning in fall 1991, qualified students also have access to new STS courses being offered at the graduate level.

The STS major consists of three main components: core courses, major specialization courses, and the senior seminar.

Core courses, which introduce students to the fundamental connections between civilization, technology, and the global environment, focus on historical and cultural foundations, basic ideas and values, dominant institutions, environmental viewpoints, policy formation, and sustainable development. Core courses comprise 27 credits and include STS 257, STS 258, STS 304, STS 308, STS 310, R790:310 (or STS 412), STS 395, and any two courses selected from Hist 485, Hist 486, R512:395, R512:396, or appropriate Honors Humanities Seminars in the history of science and technology.

Major specialization courses allow students to concentrate in one of six areas. Working closely with a faculty advisory, each student selects 18 credits of course work comprising a coherent program of study designed to fulfill personal interests and potential career goals. Courses may be selected from different disciplines at NJIT and Rutgers-Newark, and qualified students may take graduate-level NJIT courses in STS.

The six areas of specialization are: (1) Environmental studies: the role of science and technology in environmental planning, sustainable development, and ecological preservation; (2) Communications: the study of discourse and its communities, with emphasis on writing, editing, oral presentations, and media studies; (3) Science and technology policy (pre-law): the beliefs, arguments, and strategies employed by government (legal and regulatory) to achieve socially desirable ends; (4) Medicine and society (pre-medical): the role of science and technology in modern medicine; medical ethics; health policy; (5) Urban studies: the social and technological aspects of city building and rural settlement in the making of the modern world; (6) History and philosophy of technology: the interaction of science and technology in history, culture, and thought.

The Senior Seminar (STS 490 and STS 491) marks the culmination of the STS curriculum. In this 6-credit capstone course sequence, topics that are of critical importance to each student's undergraduate program and professional future are investigated in depth. Students work closely with the seminar director and a faculty advisor to identify a subject, research it thoroughly, and compose a senior thesis.

■ B.S. in Science, Technology and Society

(124 credit minimum)

FIRST YEAR

1st Semester

Eng 111	English Composition	(3-0-3)
*Math 111	Calculus I	(4-0-4) *or*
*Math 138	General Calculus I	(3-0-3)
SS 200	Understanding Technological Society	(3-0-3)
*CIS 104	Computer Programming and Graphics Problems	(2-1-2) *or*
*CIS 113	Introduction to Computer Science I	(3-1-3)
Elective	(Science with lab)	(3-1-4)
PE - - -	Physical Education	(0-1-1)

2nd Semester

Hum 112	Culture and History I	(3-0-3)
Math 105	Elementary Probability and Statistics	(3-0-3)
SS 201	Economics	(3-0-3)
Elective	(Science with lab)	(3-1-4)
Elective	(Free)	(3-0-3)
PE - - -	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

Hum 231	Culture and History II	(3-0-3)
STS 257	Technology and Society I	(3-0-3)
Elective	(Social Science)	(3-0-3)
Elective	(Science or Technology)	(3-0-3)
Elective	(Free)	(3-0-3)

2nd Semester

STS 258	Technology and Society II	(3-0-3)
STS 304	Writing about STS	(3-0-3)
Elective	(Social Science)	(3-0-3)
Elective	(Science or Technology)	(3-0-3)
Elective	(Free)	(3-0-3)

THIRD YEAR

1st Semester

STS 308	Technology and Global Development	(3-0-3)
STS 412	Technology and Policy in Contemporary America	(3-0-3) *or*
R790:310	Science, Technology and Public Policy	(3-0-3)
Elective	(History of Science or Technology)	(3-0-3)
Elective	(Major Specialization)	(3-0-3)
Elective	(Free)	(3-0-3)

2nd Semester

STS 310	Technology and Human Values	(3-0-3)
STS 395	Theories of Science, Technology and Society	(3-0-3)
Elective	(History of Science or Technology)	(3-0-3)
Elective	(Major Specialization)	(3-0-3)
Elective	(Free)	(3-0-3)

FOURTH YEAR

1st Semester

STS 490	Project and Seminar I	(3-0-3)
Mgmt 390	Principles of Management	(3-0-3)
Elective	(Major Specialization)	(3-0-3)
Elective	(Major Specialization)	(3-0-3)
Elective	(Free)	(3-0-3)

2nd Semester

STS 491	Project and Seminar II	(3-0-3)
Elective	(Major Specialization)	(3-0-3)
Elective	(Major Specialization)	(3-0-3)
Elective	(Free)	(3-0-3)
Elective	(Free)	(3-0-3)

*The combination of these courses must equal at least 6 credits.

Electives

Social Science: Two courses comprising a full year sequence in a single social science discipline (i.e., anthropology, geography, political science, psychology, sociology).

History of Science or Technology: Two courses chosen from among Hist 485 Technology and Society in Western Europe, Hist 486 Technology in American History, R512:395 History of Science I, R512:396 History of Science II, and Honors Humanities Seminars in the history of science and technology (Hum 491H-Hum 499H). Fulfills NJIT Lit/Hist/Phil: General University Requirement.

Science with lab: Students select two appropriate electives in consultation with an advisor.

Science or Technology: Students select two appropriate electives in consultation with an advisor.

Free (24 credits): Students select appropriate electives in consultation with an advisor.

Major Specialization (18 credits): Students select appropriate electives in consultation with an advisor. Courses may be selected from different disciplines but must comprise a coherent program of study within an area of specialization.

Refer to the General University Requirement section of this catalog for further information on electives.

Co-op

Co-op courses replace electives with approval of advisor. In Science, Technology, and Society, STS 311 and STS 411 are taken for degree credit.

Statistics and Actuarial Science

Administered by: Department of Mathematics. Cullimore Hall, Room 606.

The mathematics department offers the B.S. degree in statistics and actuarial science. Students may specialize in either statistics or actuarial science. The curriculum offered by the mathematics department has been designed to provide a strong mathematical foundation in conjunction with a broad liberal arts education which will enable the graduate to pursue a professional career in statistics or actuarial science.

Statistics is the study of the collection and analysis of numerical data for the purpose of solving problems. The statistician might help a scientist design an experiment so that the data obtained lend themselves to clear and meaningful analysis, design a sampling and polling technique for a company to determine which features are popular with consumers, or compile data to help predict future trends. Statisticians become adept in the techniques of sampling—the careful analysis of a small population to predict how a much larger population will behave.

Actuarial science is concerned with the application of mathematical probability to the design of financially sound insurance and pension programs which satisfy the public's needs. Actuaries forecast probable development in areas such as life expectancy and pension plans. Career advancement is heavily dependent upon passing a series of examinations sponsored by the professional actuarial societies. The Society of Actuaries gives examinations for the life and health insurance fields. The Casualty Actuarial Society gives examinations for the property and liability field. The curriculum leading to the B.S.S.A.S. (specializing in actuarial science) prepares the graduate for three of these examinations which are common and jointly sponsored by both societies and one exam in actuarial mathematics administered by the Society of Actuaries.

The curriculum as described below is for students entering NJIT as freshmen in the fall of 1991 or after that date. Students entering before that date may have a different program and should consult the department to learn which curriculum applies.

■ B.S. in Statistics and Actuarial Science

ACTUARIAL SCIENCE OPTION (129 credit minimum)

FIRST YEAR

1st Semester

Math 111	Calculus I	(4-0-4)
Math 141	Introduction to Actuarial Science	(3-0-3)
CIS 113	Introduction to Computer Science I	(3-1-3)
Eng 111	English Composition	(3-0-3)
Elective	(Science)	(3-0-3)
PE – – –	Physical Education	(0-1-1)
Frsh Sem	Freshman Seminar	(1-0-0)

2nd Semester

Math 112	Calculus II	(4-0-4)
SS 201	Economics	(3-0-3)
CIS 114	Introduction to Computer Science II	(3-1-3)
Hum 112	Culture and History I	(3-0-3)
Elective	(Science with Lab)	(3-1-4)
PE – – –	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

Math 213	Calculus IIIB	(4-0-4)
Math 226	Discrete Analysis	(4-0-4)
Math 337	Linear Algebra	(3-0-3)
Hum 231	Culture and History II	(3-0-3)
Elective	(Social Science: Lower Division GUR)	(3-0-3)

2nd Semester

Math 222	Differential Equations	(4-0-4)
Math 244	Introduction to Probability	(3-0-3)
Econ 360	Managerial Economics	(3-0-3)
CIS 105	Computer Programming (APL)	(1-1-1)
Elective	(Science, Technology and Society)	(3-0-3)
Elective	(Free)	(3-0-3)

THIRD YEAR

1st Semester

Math 334	Mathematics for Management Science	(3-0-3)
Math 340	Applied Numerical Methods and Optimization	(3-0-3)
Math 341	Statistical Methods I	(3-0-3)
CIS 461	Systems Simulation	(3-0-3)
Elective	(Management: GUR)	(3-0-3)

2nd Semester

Math 342	Statistical Methods II	(3-0-3)
Math 344	Regression Analysis	(3-0-3)
Math 346	Mathematics of Finance	(3-0-3)
Fin 423	Risk Management	(3-0-3)
Elective	(Free)	(3-0-3)

FOURTH YEAR

1st Semester

Math 441	Actuarial Mathematics I	(3-0-3)
Math 446	Topics in Applied Statistics	(3-0-3)
Elective	(Fin/Acct)	(3-0-3)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

2nd Semester

Math 442	Actuarial Mathematics II	(3-0-3)
Math 493	Seminar in Actuarial Science	(3-0-3)
HRM 407	Social Insurance and Employee Benefits	(3-0-3)
Elective	(Technical)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)

Electives

All electives are to be selected in consultation with an advisor.

Social Science Lower Division General University Requirement: Choose one course from SS 200, SS 210, SS 221, SS 231, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology.

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

Science, Technology and Society: One upper division STS course.

Fin/Acct: One course in finance or accounting.

Science: Students choose a science course.

Science with lab: Students choose a laboratory science course.

Technical: Consult the advisor.

Free: Consult the advisor.

Refer to the General University Requirement section of this catalog for further information on electives.

Co-op

Co-op courses bearing degree credit replace a technical elective or another course approved by the faculty advisor in the student's major department. In actuarial science, Math 310 and Math 410 are taken for degree credit.

STATISTICS OPTION (129 credit minimum)

FIRST YEAR

1st Semester

Math 111	Calculus I	(4-0-4)
CIS 113	Introduction to Computer Science I	(3-1-3)
Eng 111	English Composition	(3-0-3)
SS 201	Economics	(3-0-3)
Elective	(Science)	(3-0-3)
PE - - -	Physical Education	(0-1-1)
Frsh Sem	Freshman Seminar	(1-0-0)

2nd Semester

Math 112	Calculus II	(4-0-4)
CIS 114	Introduction to Computer Science II	(3-1-3)
Hum 112	Culture and History I	(3-0-3)
Econ 360	Managerial Economics	(3-0-3)
Elective	(Science with Lab)	(3-1-4)
PE - - -	Physical Education	(0-1-1)

SECOND YEAR

1st Semester

Math 213	Calculus IIIB	(4-0-4)
Math 226	Discrete Analysis	(4-0-4)
Math 337	Linear Algebra	(3-0-3)
CIS 105	Computer Programming (APL)	(1-1-1)
Hum 231	Culture and History II	(3-0-3)
Elective	(Social Science: Lower Division GUR)	(3-0-3)

2nd Semester

Math 222	Differential Equations	(4-0-4)
Math 244	Introduction to Probability	(3-0-3)
CIS 105	Computer Programming (FORTRAN)	(1-1-1)
Elective	(Science, Technology and Society)	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Free)	(3-0-3)

THIRD YEAR

1st Semester

Math 334	Mathematics for Management Science	(3-0-3)
Math 341	Statistical Methods I	(3-0-3)
Math 545	Advanced Calculus I	(3-0-3)
CIS 461	Systems Simulation	(3-0-3)
Elective	(Free)	(3-0-3)

2nd Semester

Math 342	Statistical Methods II	(3-0-3)
Math 344	Regression Analysis	(3-0-3)
Math 546	Advanced Calculus II	(3-0-3)
Elective	(Lit/Hist/Phil: GUR)	(3-0-3)
Elective	(Free)	(3-0-3)

FOURTH YEAR

1st Semester

Math 443	Statistical Methods III	(3-0-3)
Math 445	Introduction to Experimental Design	(3-0-3)
Math 446	Topics in Applied Statistics	(3-0-3)
Elective	(Management: GUR)	(3-0-3)
Elective	(Free)	(3-0-3)

2nd Semester

Math 444	Applied Sampling Methods	(3-0-3)
Math 577	Introduction to Stochastic Processes	(3-0-3)
Elective	(Technical)	(3-0-3)
Elective	(Free)	(3-0-3)
Elective	(Free)	(3-0-3)

Electives

All electives are to be selected in consultation with an advisor.

Social Science Lower Division General University Requirement: Choose one course from SS 200, SS 210, SS 221, SS 231, or approved introductory courses offered by Rutgers-Newark in anthropology, political science, psychology, and sociology.

Lit/Hist/Phil General University Requirement: Two courses chosen from upper division electives in literature, history, or philosophy, but it is recommended that both not be from the same field. Qualified students may take Honors Seminars in the Humanities (Hum 491H-499H) to fulfill all or part of this requirement.

Management General University Requirement: Choose IE 492 or Mgmt 390. AS 333 may be substituted only by those students taking the aerospace option.

Science, Technology and Society: One upper division STS course.

Science: Students choose a science course.

Science with lab: Students choose a laboratory science course.

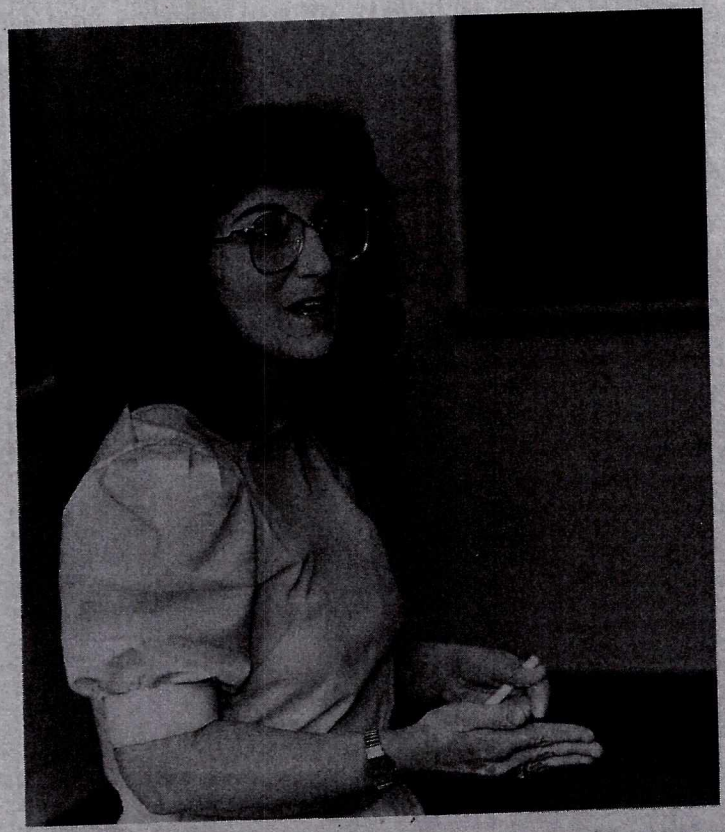
Technical: Consult the advisor.

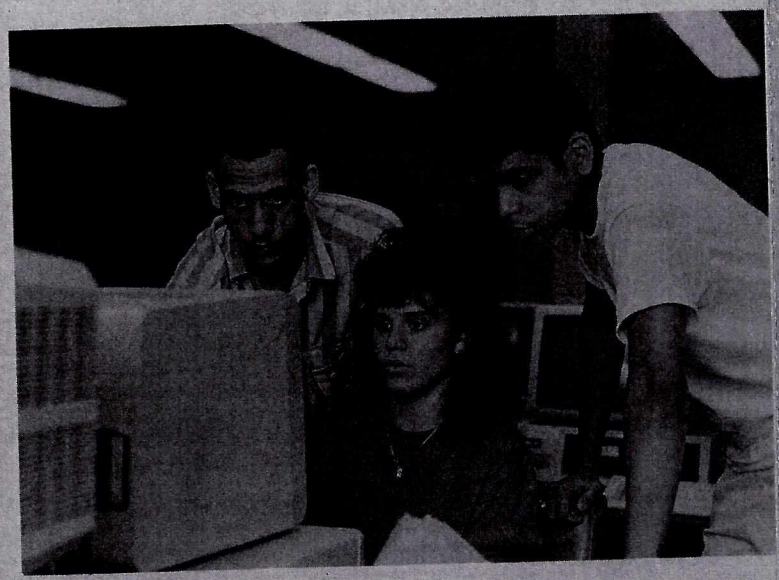
Free: Consult the advisor.

Refer to the General University Requirement section of this catalog for further information on electives.

Co-op

Co-op courses bearing degree credit replace a technical elective or another course approved by the faculty advisor in the student's major department. In statistics, Math 310 and Math 410 are taken for degree credit.





Bachelor's Degree Programs: Academic Minors

Students at NJIT may choose to earn a minor in a field other than their major field. At present, NJIT offers minors in the following areas: applied mathematics; chemistry; communication arts; computer engineering; computer science; drama/theatre; economics; finance; history; human resources management; information systems; literature; management; manufacturing engineering; marketing; physics; science, technology and society; scientific computing and statistics. An aerospace option is also available.

General rules on administration of minors appear on page 22.

APPLIED MATHEMATICS (23 credit minimum)

Administered by: Department of Mathematics. Cullimore Hall, Room 606. See page 30 to learn about the applied mathematics discipline.

Part A. *Take all courses except as noted.*

Math 112	Calculus II (4-0-4)
Math 211	Calculus IIIA (3-0-3) *or*
Math 213	Calculus IIIB (4-0-4)
Math 222	Differential Equations (4-0-4)
Math 333	Probability and Statistics (3-0-3)
Math 337	Linear Algebra (3-0-3)

Part B. *Two of the following:*

Math 331	Introduction to Partial Differential Equations (3-0-3)
Math 332	Introduction to Functions of a Complex Variable (3-0-3)
Math 334	Mathematics for Management Science (3-0-3)
Math 335	Vector Analysis (3-0-3)
Math 336	Applied Abstract Algebra (3-0-3)
Math 340	Applied Numerical Methods and Optimization (3-0-3)

CHEMISTRY

Administered by: Department of Chemical Engineering, Chemistry and Environmental Science. Tiernan Hall, Room 151. See page 29 to learn about the applied chemistry discipline.

CHEMISTRY MINOR OPEN TO ALL STUDENTS
(18 credit minimum)

Part A. *Take all courses.*

Chem 335	Physical Chemistry II (3-4-5)
Chem 344	Organic Chemistry II (3-4-5)
Chem 484	Modern Analytical Chemistry (1-4-3)

Part B. *A choice of two related courses from the following:*

Chem 336	Physical Chemistry III (3-0-3)
Chem 412	Inorganic Reactions and Processes (2-2-3)
Chem 440	Fundamentals of Polymers (3-0-3)
Chem 443	Polymer Laboratory (1-4-3)
Chem 448	Preparation and Analysis of Organic Compounds (0-4-2)
Chem 473	Biochemistry (3-0-3)
Chem 491	Research and Independent Study I (3-0-3)
Chem 492	Research and Independent Study II (3-0-3)
Chem 502	Advanced Organic Chemistry I (3-0-3)
Chem 552	Laser Chemistry (3-0-3)

CHEMISTRY MINOR NOT OPEN TO CHEMICAL ENGINEERING MAJORS (21.5 credit minimum)

Part A. *Take all courses.*

Chem 116	Chemistry and Materials II (3½-0-4½)
Chem 116A	Chem 116 Laboratory (0-2-0)
Chem 484	Modern Analytical Chemistry (1-4-3)

Part B. *Choose one set.*

Chem 231	Physical Chemistry I (3-0-3)
Chem 335	Physical Chemistry II (3-4-5) *or*
Chem 343	Organic Chemistry I (3-0-3)
Chem 344	Organic Chemistry II (3-4-5)

Part C. *A choice of two related courses from the following:*

*Chem 231	Physical Chemistry I (3-0-3)
*Chem 335	Physical Chemistry II (3-4-5)
Chem 336	Physical Chemistry III (3-0-3)
*Chem 343	Organic Chemistry I (3-0-3)
*Chem 344	Organic Chemistry II (3-4-5)
Chem 412	Inorganic Reactions and Processes (2-2-3)
Chem 440	Fundamentals of Polymers (3-0-3)
Chem 443	Polymer Laboratory (1-4-3)
Chem 448	Preparation and Analysis of Organic Compounds (0-4-2)
Chem 473	Biochemistry (3-0-3)
Chem 502	Advanced Organic Chemistry I (3-0-3)
Chem 552	Laser Chemistry (3-0-3)

Any suitable 500- or 600-level chemistry course with permission of the instructor.

*If not used in Part B.

COMMUNICATION ARTS (21 credits)

Administered by: Department of Humanities. Cullimore Hall, Room 515.

The minor in communication arts enhances the capacity to think clearly and critically and the ability to communicate effectively. These attributes have never been in greater demand than in the complex technological and scientific world of today, and those who possess them have a considerable competitive edge over those who do not.

Students taking this minor elect a series of courses drawn from several different areas of communications, including journalism, advanced composition, oral communications, and technical report writing. Independent study is available to students who opt to study one or more of these fields at a more advanced level. Communication arts minors are also encouraged to become involved in related extracurricular activities, such as writing for the *Vector* student newspaper and participating in the Forensics Team.

Core courses in the main disciplines of communications teach specific communications skills within a broadly humanistic context. Thus, students pursuing the minor in communication arts not only learn state-of-the-art techniques for preparing documents, articles, technical reports, and speeches, but also learn to promote the humanistic values essential to informed leadership in any field of endeavor.

Part A. *Take both courses.*

Hum 112	Culture and History I (3-0-3)
Hum 231	Culture and History II (3-0-3)

Part B. *Three of the following:*

Eng 238	Advanced Composition (3-0-3)
Eng 339	Practical Journalism (3-0-3)
Eng 340	Oral Presentations (3-0-3)
Eng 342	Technical Report Writing (3-0-3)
STS 304	Writing about Science, Technology and Society (3-0-3)
Hum 401	Independent Study (3-0-3)
Hum 402	Independent Study (3-0-3)

Appropriate Communications Courses at Rutgers-Newark

Part C. *Two upper division literature or philosophy electives in related areas such as:* Hist 445 Communication Through the Ages and Lit 480 Philosophy of Language; or other upper division humanities electives approved by faculty coordinator.

COMPUTER ENGINEERING (21 credit minimum)

Administered by: Department of Electrical and Computer Engineering. Tiernan Hall, Room 150.

Computer engineering is an interdisciplinary program, overseen by a director in the Department of Electrical and Computer Engineering. The computer engineering minor for CIS majors emphasizes hardware design and experimentation. The minor for other students is similar to the computer engineering major. See page 35 to learn more about the computer engineering discipline.

COMPUTER ENGINEERING MINOR OPEN TO CIS MAJORS ONLY

EE 232	Circuits and Systems II (3-0-3)
EE 251	Digital Design (3-0-3)
EE 271	Electronic Circuits I (3-0-3)
EE 291	Electrical Engineering Lab I (0-3-1)
EE 372	Electronic Circuits II (3-0-3)
CoE 391	Computer Engineering Lab I (1-3-2)
CoE 392	Computer Engineering Lab II (1-3-2)
CoE 493	Computer Engineering Lab III (2-4-4)

COMPUTER ENGINEERING MINOR NOT OPEN TO ELECTRICAL ENGINEERING AND COMPUTER SCIENCE MAJORS

Part A. *Take all courses.*

EE 251	Digital Design (3-0-3)
CIS 105	Computer Programming (Pascal) (1-1-1)
CIS 332	Principles of Operating Systems (3-1-3)
CIS 335	Data Structures and Algorithm Design (3-0-3) *or*
CIS 114	Introduction to Computer Science (3-1-3)
CoE 351	Computer Systems Organization (3-0-3)
CoE 391	Computer Engineering Lab I (1-3-2)
CoE 451	Computer Architecture (3-0-3)

Part B.
One CoE or CIS 400-level elective.

COMPUTER SCIENCE (24 credits)

Administered by: Department of Computer and Information Science. Guttenberg Information Technology Center, Room 4400. See page 36 to learn more about the computer science discipline.

Part A. *Take all courses listed.*

CIS 114	Introduction to Computer Science II (3-1-3)
CIS 231	Machine and Assembly Language Programming (3-1-3)
CIS 251	Computer Organization (3-0-3)
CIS 332	Principles of Operating Systems (3-1-3)

Part B.
A minimum of four 300- and 400-level electives in CIS. Two of these must be at the 400 level.

DRAMA/THEATRE (21 credits)

Administered by: Department of Humanities. Cullimore Hall, Room 515.

The minor in drama/theatre combines the study of the dramatic arts as literature with training in the nature and practice of live theatre. Through this balance of academic investigation and hands-on experience, students gain an unusually broad perspective on this exciting field of the performing arts.

To achieve this balance, students electing a minor in drama/theatre take at least two courses in dramatic literature and at least two courses in theatre arts. Students electing this minor participate in actual productions staged in the joint theatre season of NJIT and Rutgers-Newark. Their roles in these productions, whether behind or in front of the curtain, teach valuable lessons in communication, responsibility, teamwork, self-confidence, and self-esteem.

Part A. *Take all courses.*

Hum 112	Culture and History I (3-0-3)
Hum 231	Culture and History II (3-0-3)
Arts 334	Elements of the Theatre (3-0-3)

Part B.
Students take an approved course in theatre arts such as Arts 435 Advanced Theatre Workshop, Hum 401 Independent Study, or an appropriate elective in the theatre arts department at Rutgers-Newark.

Part C. *Two of the following:*

Lit 456	Modern Continental and British Drama (3-0-3)
Lit 459	20th Century American Drama (3-0-3)
Lit 460	Non-Western Drama (3-0-3)
Lit 461	Contemporary Ethnic and Minority Drama (3-0-3)
Lit 475	Shakespeare (3-0-3)

Part D.
One upper division elective in history or philosophy chosen with approval of faculty coordinator.

ECONOMICS (18 credits)

Administered by: School of Industrial Management. Weston Hall, Room 200.

The minor in economics is designed to equip students with the quantitative and analytical tools and skills required to solve the wide range of resource allocation problems associated with a complex modern society.

SS 201	Economics (3-0-3)
Econ 360	Managerial Economics (3-0-3)
Econ 463	International Economics (3-0-3)
Econ 465	Mathematical Foundations of Economic Theory (3-0-3)
Econ 466	The Economics of Consumption (3-0-3)
Econ 467	Aggregate Economics (3-0-3)

FINANCE (18 credits)

Administered by: School of Industrial Management. Weston Hall, Room 200. See page 51 to learn more about the finance discipline.

Acct 115	Principles of Accounting I (3-0-3)
SS 201	Economics (3-0-3)
Fin 317	Investment Analysis (3-0-3)
Fin 320	Money and Banking (3-0-3)
Fin 321	The Financial Systems (3-0-3)
Econ 421	Commercial Banking (3-0-3)

HISTORY (21 credits)

Administered by: Department of Humanities. Cullimore Hall, Room 515.

The minor in history provides an opportunity to enrich one's cultural perspective through the study of the past and present. Students consider large themes of context and chronology and learn to understand how societies and institutions change and adapt over time. By confronting historical problems, they are taught a liberal appreciation for other cultures as well as meaningful insights into their own. They also learn specific practical skills, such as the ability to analyze and clearly and concisely discuss written documents.

The core of the history minor consists of four electives that each student chooses from among the large number of upper level history courses offered at NJIT. Some of these courses cover the history of specific regions during particular time periods of special interest, such as ancient Greece and the Persian Empire, modern Russian civilization, United States foreign policy in the 20th century, and contemporary Europe. Others treat the contributions of specific groups, such as African-American culture. Still other courses study special historical problems and topics, such as cities in history, war and modernization, modern thought, technology and society in Europe, technology in American history, communication through the ages, population and history, and history through film. Qualified students may also apply toward the core requirement in history appropriate Honors Seminars in the Humanities and advanced independent course work.

Part A. *Take both courses.*

Hum 112	Culture and History I (3-0-3)
Hum 231	Culture and History II (3-0-3)

Part B.
Four upper division electives in history.

Part C.
One upper division elective in literature or philosophy, chosen with approval of faculty coordinator.

Hum 401 and/or Hum 402 (Independent Study) may be substituted for electives, with approval of faculty coordinator.

HUMAN RESOURCES (18 credits)

Administered by: School of Industrial Management. Weston Hall, Room 200. See page 51 to learn more about the human resources discipline.

Part A. *Take both courses.*

SS 201	Economics (3-0-3)
Mgmt 390	Principles of Management (3-0-3)

Part B. *Four of the following:*

HRM 301	Organizational Behavior (3-0-3)
HRM 303	Human Resource Management (3-0-3)
HRM 304	Industrial Safety Administration (3-0-3)
HRM 305	Supervision and Employee Relations (3-0-3)
HRM 307	Industrial Psychology (3-0-3)
HRM 308	Labor Economics and Industrial Relations (3-0-3)
HRM 402	Administration of Equal Employment Opportunity Programs (3-0-3)
HRM 405	Organizational Strategies for Productivity Improvement (3-0-3)
HRM 406	Wage and Salary Analysis (3-0-3)
HRM 407	Social Insurance Employee Benefits (3-0-3)
HRM 410	Group Development and Dynamics (3-0-3)
HRM 411	Training and Development (3-0-3)
HRM 412	Labor-Management Relations (3-0-3)
HRM 413	Industrial Relations Policy (3-0-3)
HRM 414	Labor Market Analysis (3-0-3)
Mgmt 499	Employee-Management Communications (3-0-3)

INFORMATION SYSTEMS (24 credits)

Administered by: Department of Computer and Information Science. Guttenberg Information Technologies Center, Room 4400. See page 50 to learn more about the information systems discipline.

Part A. *Take all courses listed.*

CIS 114	Introduction to Computer Science II (3-1-3)
CIS 390	Requirements Analysis and Systems Design (3-0-3)
CIS 431	Introduction to Database Systems (3-0-3)
CIS 465	Computer Techniques for Management Information Systems (3-0-3)

Part B. *Four of the following:*

CIS 251	Computer Organization (3-0-3)
CIS 350	Computers and Society (3-0-3)
CIS 365	Computer Applications to Commercial Problems (2-2-3)
CIS 370	Introduction to Artificial Intelligence (3-1-3)
CIS 447	Human-Computer Interfaces (3-0-3)
CIS 451	Introduction to Data Communications and Networks (3-1-3)
CIS 455	Computer Systems Management (3-0-3)
CIS 461	Systems Simulation (3-0-3)
CIS 490	Guided Design in Software Engineering (3-0-3)

LITERATURE (21 credits)

Administered by: Department of Humanities. Cullimore Hall, Room 515.

The minor in literature is about human experience expressed in imaginative language and embodied in aesthetically pleasing works of art. The study of literature enriches one's experience, heightens awareness of the fundamental problems of existence, and leads to the discovery of one's potential as a human being. It also teaches specific practical skills, such as the ability to understand, analyze, and clearly and concisely discuss complex texts.

The core of the literature minor consists of four electives that each student chooses from among the large number of upper level literature courses offered at NJIT. Examples include courses in the nature, history, and psychology of the novel; courses on particular literary forms such as the short story, satire, poetry, and non-fiction; courses in the literature of the Bible and the Greek and Roman classics; courses in dramatic literature and the relationship of literature and film; and courses in special genres such as science fiction and utopian literature. Qualified students may also apply toward the core requirement in literature appropriate Honors Seminars in the Humanities and advanced independent course work.

Part A. *Take both courses.*

Hum 112	Culture and History I (3-0-3)
Hum 231	Culture and History II (3-0-3)

Part B.
Four upper division electives in literature.

Part C.
One upper division elective in history or philosophy, chosen with approval of faculty coordinator.

Hum 401 and/or Hum 402 (Independent Study) may be substituted for electives, with approval of faculty coordinator.

MANAGEMENT (21 credits)

Administered by: School of Industrial Management. Weston Hall, Room 200. See page 51 to learn more about the management discipline.

Part A. *Select as noted.*

Acct 115	Principles of Accounting I (3-0-3) *and*
Acct 116	Principles of Accounting II (3-0-3)
	or
Acct 515	Accounting for Managerial Control (3-0-3)

Part B. *Take all courses.*

Fin 315	Principles of Financial Management (3-0-3)
MIS 345	Management of Information Systems (3-0-3)
Mgmt 390	Principles of Management (3-0-3)
Mrkt 330	Principles of Marketing (3-0-3)
OM 375	Management Science (3-0-3)
SS 201	Economics (3-0-3)

MANUFACTURING ENGINEERING (24 credits)

Administration: Manufacturing engineering is an interdisciplinary program. It is overseen by the director of manufacturing engineering programs. Guttenberg Information Technologies Center, Room 2400. See page 53 to learn more about the manufacturing engineering discipline.

MnE 320	Manufacturing System Dynamics and Control (3-0-3)
MnE 351	Materials for Manufacturing (2-2-3)
MnE 371	Manufacturing Processes for Metals (2-2-3)
MnE 372	Manufacturing Processes for Plastics (2-2-3)
MnE 401	Design for Manufacturability (2-2-3)
MnE 481	Manufacturing Systems Integration (2-2-3)
IE 453	Computer-Integrated Manufacturing (2-2-3)
IE 460	Measurement Techniques and Quality Control (3-0-3)

MARKETING (18 credits)

Administered by: School of Industrial Management. Weston Hall, Room 200. See page 51 to learn more about the marketing discipline.

Part A. *Take all courses.*

SS 201	Economics (3-0-3)
Mrkt 330	Principles of Marketing (3-0-3)
Mrkt 331	Consumer and Buyer Behavior (3-0-3)

Part B. *One of the following:*

Mrkt 433	Services Marketing (3-0-3)
Mrkt 434	Industrial Marketing (3-0-3)
Mrkt 435	International Marketing (3-0-3)

Part C. *Two of the following:*

Mrkt 332	Advertising Theory and Technique (3-0-3)
Mrkt 336	Marketing Communications: Promotion, Persuasion and Public Relations (3-0-3)
Mrkt 337	Marketing Distribution Channels (3-0-3)
Mrkt 338	Product Development and Management (3-0-3)

PHYSICS (24 credit minimum)

Administered by: Department of Physics. Tiernan Hall, Room 463. See page 31 to learn more about the applied physics discipline.

Part A. *Take all courses.*

Phys 111	Physics I (3-0-3)
Phys 111A	Physics I Laboratory (0-2-1)
Phys 121	Physics II (3-0-3)
Phys 121A	Physics II Laboratory (0-2-1)
Phys 231	Physics III (4-0-4)

Part B.

Twelve credits of upper division physics courses forming a coherent plan of study. Students may take relevant courses offered by departments other than physics such as ME 311 Thermodynamics; however, a minimum of 6 credits must be physics courses taken at NJIT or Rutgers-Newark.

SCIENCE, TECHNOLOGY AND SOCIETY (18 credits)

Administered by: Department of Social Science and Policy Studies. Cullimore Hall, Room 501. The STS minor is offered cooperatively by NJIT and Rutgers-Newark, and is overseen by a program director at NJIT. See page 56 to learn more about the STS program.

Part A.

Six credits of lower division social science courses.

Part B. *Twelve credits from the following:*

Any upper division STS courses or

Hist 485	Technology and Society in Western Europe (3-0-3)
Hist 486	Technology in American History (3-0-3)
Phil 434	Engineering Ethics (3-0-3)
R512:395	History of Science I (3-0-3)
R512:396	History of Science II (3-0-3)
R790:310	Science, Technology and Public Policy (3-0-3)

SCIENTIFIC COMPUTING (24 credits)

Administered by: Department of Computer and Information Science. Guttenberg Information Technologies Center, Room 4400.

The minor in scientific computing is available to the student who seeks to have an advanced understanding of those tools and methodologies in computer science which may be applied to the design and analysis of scientific and engineering systems.

Part A. *Take all courses listed.*

CIS 114	Introduction to Computer Science II (3-1-3)
CIS 352	Parallel Computers and Programming (3-1-3)
CIS 421	Numerical Algorithms (3-0-3)
CIS 438	Programming for Interactive Computer Graphics (3-0-3)
CIS 453	Microcomputers and Applications (3-1-3)

Part B. *Three of the following:*

CIS 332	Principles of Operating Systems (3-1-3)
CIS 370	Introduction to Artificial Intelligence (3-1-3)
CIS 431	Introduction to Database Systems (3-0-3)
CIS 432	Advanced Operating Systems and Computer Architecture (3-0-3)
CIS 451	Introduction to Data Communications and Networks (3-1-3)
CIS 461	Systems Simulation (3-0-3)

STATISTICS (23 credit minimum)

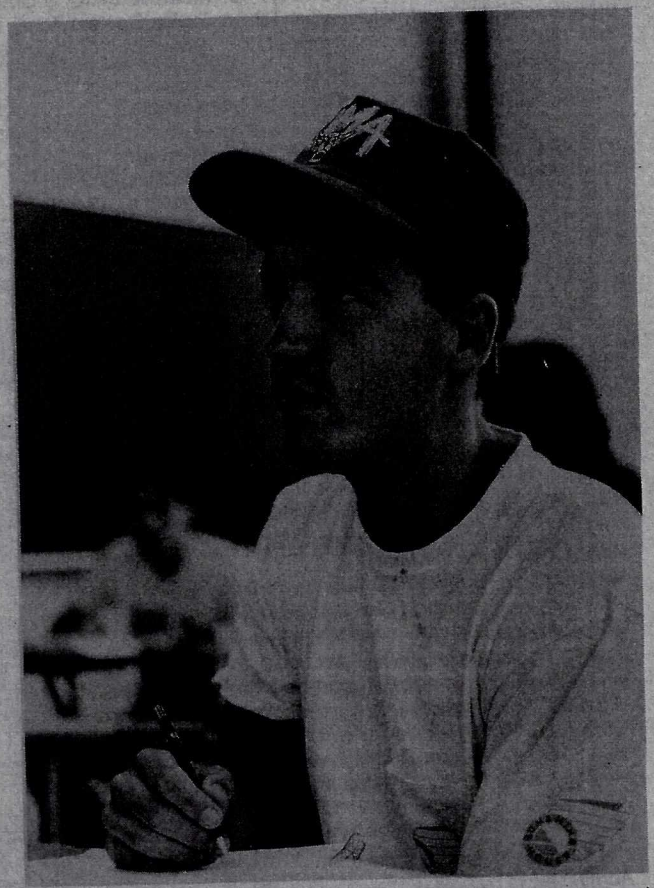
Administered by: Department of Mathematics. Cullimore Hall, Room 606. See page 57 to learn more about the statistics discipline.

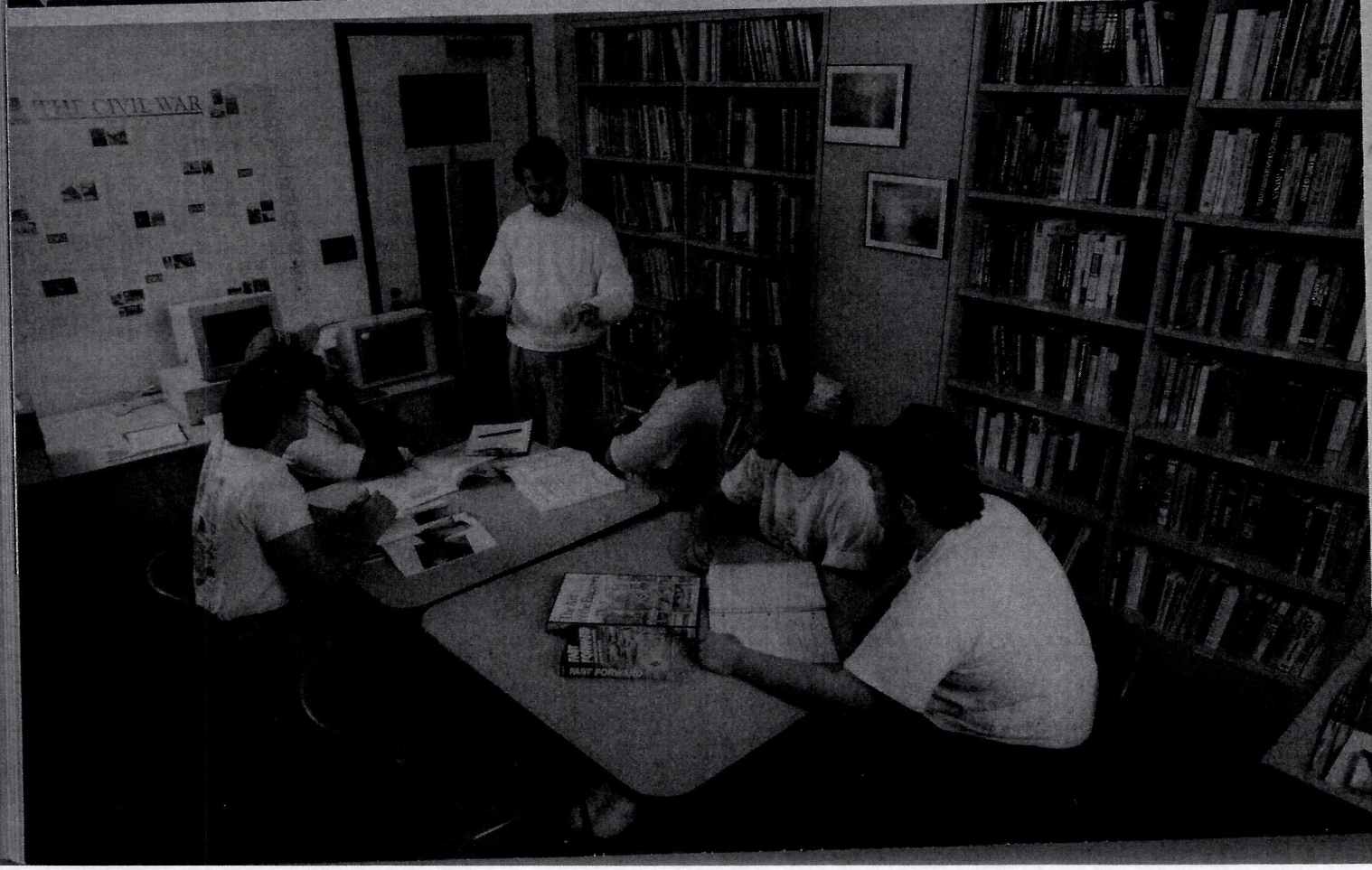
Part A. *Take all courses.*

Math 112	Calculus II (4-0-4)
Math 211 / Math 213	Calculus IIIA (3-0-3) *or* Calculus IIIB (4-0-4)
Math 222 / Math 226	Differential Equations (4-0-4) *or* Discrete Analysis (4-0-4)
Math 333	Probability and Statistics (3-0-3)
Math 337	Linear Algebra (3-0-3)
Math 344	Regression Analysis (3-0-3)

Part B. *One of the following:*

Math 341	Statistical Methods I (3-0-3)
Math 342	Statistical Methods II (3-0-3)
Math 444	Applied Sampling Methods (3-0-3)
Math 445	Introduction to Experimental Design (3-0-3)
Math 446	Topics in Applied Statistics (3-0-3)




THE CIVIL WAR

Courses of Instruction

NUMERICAL CODE

Lower Division Courses
Courses numbered between 100 and 199 are normally taken by freshmen.
Courses numbered 200-299 are normally taken by sophomores.

Upper Division Courses
Courses numbered 300-399 are normally taken by juniors.
Courses numbered 400-499 are normally taken by seniors.
Courses numbered 500-599 are graduate courses open to undergraduates with advisor's approval, except in the School of Architecture, where such courses are taken by fifth-year undergraduate students.
Courses numbered 600 and above are not available to undergraduates, except with special permission.

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

PREREQUISITE/COREQUISITE REQUIREMENTS
It is the responsibility of the student to meet all prerequisite and corequisite requirements. The department concerned may refuse to give credit for a course if its prerequisites have not been satisfactorily passed.

ADDITIVE CREDIT
Additive credit cannot be used to satisfy graduation requirements in any curriculum. Courses taken for additive credit add to the student's overall education and are listed on the transcript, with additive credit adding to the total number of credits required for a degree.

ALPHABETICAL CODE AND PAGE NUMBER

Rutgers-Newark Courses

Accounting

Offered by the School of Industrial Management. See Management course list for faculty.

Acct 115
Principles of Accounting I 3-0-3
Basic accounting concepts, documents, work sheets, ledgers, and procedures for keeping accounts. Emphasis given to inventory and job order accounting methods. (formerly IM 110)

Acct 116
Principles of Accounting II 3-0-3
Prerequisite: Acct 115. A continuation of Acct 115. Valuation, depreciation, costing methods, overhead accumulations and distribution. Emphasis given to standard costs, cost estimating and budgets. (formerly IM 111)

Acct 317
Managerial Accounting 3-0-3
Prerequisites: Acct 115, Acct 116. The techniques of evaluating labor, material and overhead costs. Rate of return, variance analysis, and break-even analysis. (formerly IM 230)

Acct 515
Accounting for Managerial Control
Using a case study approach, the course explores the accounting-based issues impacting on management decision making. It encompasses the following subjects at a minimum: nature of managerial accounting, cost behavior, cost-volume-profit analysis, full costing and its use, job order and process costing systems, standard costs, variances, differential cost analysis, responsibility accounting, transfer pricing, and capital budgeting.

Aerospace Studies

Offered by the Department of Aerospace Studies

Chairperson: Lt. Col. Stephen L. Jensen
Professor: Lt. Col. Jensen
Assistant Professors: Major Stone, Major Walters, Capt. Gearhart

AS 111
The Air Force Today I 1-1.5-1
This introductory course explores the mission and organizational structure of the United States Air Force. It examines the missions and specialized tasks the Air Force is responsible for, and how it is organized to accomplish them. The focus is on the mission, resources, and operation of major Air Force organizations. An introduction to effective communication is included. One hour of class and one and a half hours of Leadership Laboratory per week (not required for those with Special Student status).

AS 112
The Air Force Today II 1-1.5-1
Prerequisite: AS 111 or approval of the professor of Aerospace Studies. This course continues with the mission, resources, and operation of additional Air Force organizations, and provides an overview of the spectrum of job specialties performed by the Air Force officer. It introduces the concepts of geopolitics, U.S. defense policy, military balance, and terrorism and examines the roles and responsibilities of the other branches of the Armed Forces as well as those of the Air Force Reserve and Air National Guard. One hour of class and one and a half hours of Leadership Laboratory per week (not required for those with Special Student status).

AS 221
U.S. Air Power: Ascension to Prominence 1-1.5-1
Prerequisite: AS 112 or approval of the professor of Aerospace Studies. This course examines the development of air power from its earliest beginnings through World War II. It traces the evolution of air power concepts and doctrine, and provides an assessment of the student's communication skills. One hour of class and one and a half hours of Leadership Laboratory per week (not required for those with Special Student status).

AS 222
U.S. Air Power: Key to Deterrence 1-1.5-1
Prerequisite: AS 221 or approval of the professor of Aerospace Studies. This course emphasizes historical events from the creation of a separate U.S. Air Force after World War II through the present, and how they influenced the development and deployment of U.S. air power leading to its growth as a primary element of national security. One hour of class and one and a half hours of Leadership Laboratory per week (not required for those with Special Student status).

AS 333
Leadership and Management I 3-1.5-3
Prerequisite: AS 222 or approval of the professor of Aerospace Studies. Emphasizes the concepts and skills required by the successful management and leader. Curriculum includes individual motivational and behavioral processes, leadership, communication, and group dynamics, providing the foundation for developing the junior officer's professional skills. Course material stresses decision-making, and the use of analytic aids in planning, organizing, and controlling in a changing environment. The student's communication skills are developed through writing and speaking exercises. Three hours of class and one and one half hours of Leadership Laboratory per week. Note: AS 333 may be taken to satisfy the Management General University Requirement.

AS 334
Leadership and Management II 3-1.5-3
Prerequisite: AS 333 or approval of the professor of Aerospace Studies. A continuation of AS 333. Organizational and personal ethics, management of change, organizational power, politics, and managerial strategy are discussed within the context of the military. Actual Air Force case studies are used throughout the course. Three hours of class and one and one half hours of Leadership Laboratory per week.

AS 443
National Security Forces in Contemporary American Society I 3-1.5-3
Prerequisite: AS 334 or approval of the professor of Aerospace Studies. Focusing on the U.S. Armed Forces as an integral element of American society, this course examines a wide variety of topics concerning American civil and military relations and the environment in which U.S. defense policy is formulated. Specific topics include the role of the professional officer in a democratic society, socialization processes within the American military forces, and the requisites for maintaining adequate national security forces. A special emphasis is placed on further refining the student's communications skills in the context of the course material. Three hours of class and one and one half hours of Leadership Laboratory per week.

AS 444
National Security Forces in Contemporary American Society II 3-1.5-3
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 and military relations and the environment in which defense policy is formulated. Specific themes addressed are the political, economic, and social constraints on the national defense structure; impact of technological and international developments on strategic preparations and the policy-making process; and a futuristic look at the world diplomatic-military scene. Special interest topics are the laws of war and American military law, highlighted by a study of military justice and its effect on citizenship. Three hours of class and one and one half hours of Leadership Laboratory per week.

Architecture

Offered by the School of Architecture

Dean: Urs P. Gauchat
Associate Dean: James E. Dyer
Sponsored Chair: Ehrenkrantz
Professors: Ehrenkrantz, Gauchat, Greenfield, Hatch, Hawk, Mostoller, Papademetriou
Associate Professors: Celik, Elwell, Franck, Goldman, Jackson, Moore, Schuman, Wall, Weisman, West, Zdepski
Assistant Professors: Hewitt, Gami, Ozel
Research Professor: Bales

Arch 103
Introduction to People and Their Environment 3-0-3
An introduction to design that presents an overview of the relationship between people and their environment, both natural and manmade. Emphasis on seeing and comprehending what is around us, identifying and discussing the forces of change at work in the environment, and clarifying the role of the environmental designer. Supplementing the faculty lectures are guest lecturers and field trips to significant environments and professional design offices.

Arch 155
Architectural Graphics 2-3-3
Techniques of graphic presentation introduced as a basic language of architecture. Students work with a broad range of graphic presentation methods. Skills developed in drawing and architectural delineation. Fundamentals of perspective drawing, rendering techniques and format layout examined through an array of projects.

Arch 163
Introduction to Design I 1-9-4
Introduction to an array of basic principles and elements of design. Emphasis on design methods, sensitivity to context, manipulation of form and space, and representation skills. General design fundamentals presented in the lecture hour.

Arch 164
Introduction to Design II 1-9-4
Prerequisite: Arch 163. A continuation of Arch 163.

Arch 172
Architectural Programming 3-0-3
Prerequisite: Arch 163. Establishes the relationship between human activities and architectural intention through learning methods for systematically outlining goals and performance criteria, and means for achieving them. Programming approached as management of information in terms of gathering, analyzing and presenting data useful for informing design. Students develop a schematic design program for a final project.

Arch 241
Architectural Construction I 3-0-3
Prerequisite: Arch 155. Introduction to the construction process and its role in architecture. Materials and methods of wood, heavy timber and masonry construction presented. Emphasis on process, compatibility of materials and drawings as a communication tool in construction.

Arch 242
Architectural Construction II 3-0-3
Prerequisite: Arch 241. A continuation of Arch 241 that relates construction to architectural design. The study of materials and methods of construction concentrates on steel, precast and poured-in-place concrete. Emphasis on criteria for selection of materials and systems, materials research, standards and test methods, and forces of deterioration.

Arch 251
History of Architecture I 3-0-3
Prerequisite: Hum 112. A survey of the social, political, technological, functional, and aesthetic concerns of Western architecture from its earliest beginnings.

Arch 252
History of Architecture II 3-0-3
Prerequisite: Arch 251. A continuation of Arch 251, bringing the survey of the continuing evolution of Western architectural works and ideas up to the present day.

Arch 263
Architecture Studio I 1-12-5
Prerequisite: Arch 164. Utilizing knowledge and skills gained in Introduction to Design I and II, students learn about architectural design. Examination of the technological, social and environmental issues as they relate to architectural design. Lecture hour used to explore in-depth aspects of architecture.

Arch 264
Architecture Studio II 1-12-5
Prerequisite: Arch 263. A continuation of Arch 263. Lecture hour used to explore in-depth aspects of architectural design.

Arch 282
Structures I 3-0-3
Prerequisite: Phys 102. Introduces structural statics through timber and steel design. Influences of materials and structural system choice analyzed relative to their impact on building design. Responsibilities of the architect during the structural design phase are introduced.

Arch 283
Special Topics 3 credits
Group investigation of problem of special interest in architecture.

Arch 310
Co-op Work Experience I 3 credits
Prerequisites: completion of the sophomore year, approval of the school and permission of the Division of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. A designated faculty member monitors and evaluates the student's work and project. Requirements include mandatory participation in seminars and completion of a report and/or project.

Arch 312
Environmental Education I 2-3-3
Prerequisite: Arch 264. Involves architecture students in working with grade school or high school students in the solution of a joint environmental design project. Participants first work toward developing their own understanding and sensitivity of the manmade environment. Emphasis on learner-directed and discovery-guided inquiry, and educational methods to increase awareness of the physical settings created for human activities. Projects developed in nearby schools which focus on the interaction of individuals and small groups with the environment.

Arch 316
Computer Applications to Architecture 2-3-3
Prerequisite: CIS 104. Introduces both philosophical and technical approaches to the use of the computer in architectural design and analysis. Explores the use of existing computer programs for spatial allocation, energy analysis, life cycle costing, problem analysis, and computer simulation. Projects include development of computer programs applicable to architecture.

Arch 317
Advanced Architectural Graphics 2-3-3
Prerequisite: Arch 264. Gives students advanced techniques for architectural expression, including Chinese ink wash and air brush techniques. Emphasis on how drawing may be used to reveal the inner qualities of design. A basic knowledge of drawing methods, media, materials, and projection techniques is assumed.

Arch 318
New York City Lab 1-6-3
Prerequisite: Arch 172. Explores the architectural and environmental development of New York City during the past 200 years in an organized series of field trips. Each week's trip encompasses a section and/or representative aspect of the city's evolution.

Arch 321
Radical Architecture 3-0-3
Prerequisites: Arch 252, Arch 172, Arch 363. A broad-based exploration of art and architecture as a form of individual, social, or cultural expression, stressing the relationship between ideas and craft.

Arch 328
Urban Values 2-3-3
Prerequisites: Arch 172, Arch 363. A survey of urban planning practice and historical, contemporary, and theoretical urban design approaches. Considers the physical environment as a response to human values, and explores how nature, the city, and the user influence the form and content. Case studies include cities, towns, and specialized recreation and retirement communities. Laboratory work includes field trips, demonstration exercises, and analysis of case studies.

Arch 331
Landscape Architecture 3-0-3
An overview of the opportunities and constraints of landscape designs. Emphasis on developing a practical understanding of the potentials of earth, water and plants in architecture. Students given an overview of social and ecological determinants of relations between land and buildings.

*Arch 342
Architectural Construction III 3-0-3
Prerequisite: Arch 387. A variety of life safety and comfort situations studied in terms of specific building types. Topics include: building evacuation, compartmentalization, fire fighting and suppression, evaluation and testing of new building materials and systems, and systems control and management. Special attention placed on such building types as multi-use, high-density, schools, hospitals and other institutional categories.

Arch 363
Architecture Studio III 1-12-5
Prerequisite: Arch 264. A continuation of Arch 264. Lecture hour explores in depth the nature of technology, environment, and social order as they relate to studio work.

Arch 364
Architecture Studio IV 1-12-5
Prerequisites: Arch 363, Arch 172. A continuation of Arch 363. Lecture hour explores in depth the nature of technology, environment, and social order as they relate to studio work.

*Arch 381
Architectural History III 3-0-3
Prerequisite: Arch 252. This course covers architecture as a manifestation of the technological era 1800-1950. Issues of aesthetics and society in architecture are analyzed as part of the development of modern industry and modern culture. Emphasis is on American and regional architecture. Important European influences are reviewed.

*Arch 382
Architectural History IV 3-0-3
Prerequisite: Arch 381. This course covers architectural theory and practice from 1960 to the present. Among the issues discussed are reactions and responses to Modernism, reevaluations of history, recondiseration of urban contexts, balancing universalism and regionalism, utopias and anti-utopias. While the focus is on European and American architecture, developments in other parts of the world also are introduced.

*pending approval

Arch 383
Structures II 3-0-3
Prerequisite: Arch 282. Methods and details of timber and steel design summarized. Emphasizes details, methods and practices of concrete design, mixing, pouring and testing. Structural design taught in the context of architectural design and cost constraints.

Arch 384
Structures III 3-0-3
Prerequisite: Arch 383. Continuing with the content of Structures I and II, students develop a systematic overview of important differences between wood, steel and concrete structural systems. Students learn methods and procedures for selecting between alternative structural systems. Advanced topics such as complex structural behavior, prestressed concrete and new structural technologies are introduced.

Arch 386
Building Performance 3-0-3
Prerequisites: Phys 102 and Phys 103. Students develop an understanding of the physical concepts of heat, air movement, and thermal mass for use in architectural design. Approaches to dynamic analysis and energy conservation examined.

Arch 387
Environmental Control Systems 3-0-3
Prerequisite: Arch 386. A framework for making informed selections of building systems and equipment. Students provided the necessary background to analyze the advantages and disadvantages of alternative system designs for mechanical, electrical, plumbing and transportation systems in buildings. An introduction to working with consulting engineers and conducting life-cycle costing of building systems is provided.

Arch 403
The American Home and Household I 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. Students 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 race, sex and class.

Arch 404
The American Home and Household II 3-0-3
Prerequisite: upper division standing. Analyzes the architecture of 20th century American homes and households—hotels, apartment houses, war housing, suburban homes, public projects, collectives, communes, self-help housing, and housing concepts for the future. Psychological, sociological, and cultural perspectives considered insofar as they affect the architecture of the home.

Arch 408
Advanced Landscape Architecture 2-3-2
Prerequisite: Arch 331. Introduces students to the design, construction and management of contemporary landscape projects through case studies, field trips, and personal contact with prominent practicing landscape architects. A historical perspective of landscape architecture is used as a context for discussion.

Arch 410
Co-op Work Experience II 3 credits
Prerequisites: Co-op Experience I or approval of the school and permission of the Division of Cooperative Education and Internships. Provides for a co-op internship major-related work experience. A designated faculty member monitors and evaluates the student's work and project. Requirements include mandatory participation in seminars and completion of a report and/or project.

Arch 419
Architectural Photography 2-3-3
Prerequisite: Arch 364. Gives the student a wide range of photographic solutions for presentations and portfolios. Lectures consist of orientation on general topics, including light and space, using relevant text selections, and slide presentations for reinforcement. Includes basic demonstrations of darkroom techniques and unorthodox methods to encourage experimentation.

Arch 422
Mythical House 3-0-3
Prerequisites: Arch 252, Arch 172, Arch 363. Shows that the house develops not only in response to reasoning, laws of physics, and biological needs, but also in response to magic, ritual, culture, personality, fantasy and dreams.

Arch 463
Architecture Studio V 1-12-5
Prerequisite: Arch 364. A continuation of Arch 364. Lecture hour explores in depth the nature of technology, environment, and social order as they relate to studio work.

Arch 464
Architecture Studio VI 1-12-5
Prerequisite: Arch 463. A continuation of Arch 463. Lecture hour explores in depth the nature of technology, environment, and social order as they relate to studio work.

Arch 483
Special Topics 3 credits
Group investigation of problem of special interest in architecture.

Arch 491
Independent Study 1 credit

Arch 492
Independent Study 2 credits

Arch 493
Independent Study 3 credits

Arch 530
Methodologies of Architectural History, Theory and Criticism 3-0-3
Prerequisites: Arch 251, Arch 252. A seminar examining the salient methodologies of architectural history, theory and criticism. Structured around a series of critical texts, with each set of core readings intended to provide a basis for analyzing and assessing the approach in question.

Arch 531A
History of Renaissance Architecture 3-0-3
Prerequisites: Arch 251, Arch 252. An examination of the development of Renaissance architecture and urban design in Italy and elsewhere in Europe. The re-emergence of the classical tradition is considered within the context of social, political and economic developments as well as formal intentions.

Arch 531B
History of Baroque Architecture 3-0-3
Prerequisites: Arch 251, Arch 252. An investigation of architectural development from the 17th and 18th centuries in Europe and Latin America, including consideration of stylistic variations, social and political factors, and trends in garden and urban design.

Arch 531C
History of Modern Architecture 3-0-3
Prerequisites: Arch 251, Arch 252. A study of major tendencies of architectural theory and practice from the mid-19th to the mid-20th centuries. Formal and stylistic transformation considered in relation to theoretical intentions as well as social, cultural, and technical developments.

Arch 531D
History of American Architecture 3-0-3
Prerequisites: Arch 251, Arch 252. An investigation of the guiding ideals and dominant stylistic trends in American architecture and planning from colonial times to the mid-20th century. Critical shifts in conception and scope of architectural production considered in relation to the prevailing cultural, socio-economic, and technical contexts out of which they evolved.

Arch 531E
History of Non-Western Architecture 3-0-3
Prerequisites: Arch 251, Arch 252. An examination of major architectural traditions of China, Japan, Southeastern Asia, India and the Middle East. Each area considered with reference to a conceptual, iconographic and stylistic paradigm that evolved from a particular historical context.

Arch 531F
Thresholds of Architectural Theory 3-0-3
Prerequisites: Arch 251, Arch 252. A seminar that investigates key thresholds of Western architectural theory, from Vitruvius to Robert Venturi, with emphasis on examining the corresponding critical theoretical texts and related didactic buildings and projects.

Arch 531H
Aspects of Urban Form 3-0-3
Prerequisites: Arch 251, Arch 252. An examination of the major forms and patterns of urban development from classical antiquity to the 20th century, considered in relation to the changing conceptions of the city as well as cultural, socio-economic, and political development.

Arch 532
Problems and Methods in Architectural Preservation 3-0-3
Prerequisites: Arch 251, Arch 252. Theory and practice of preservation planning, with emphasis on current concepts, problems and techniques of area preservation in the United States. Exploration of the successive guiding ideals and approaches to historic preservation in America, together with their European parallels and antecedents. Discussion of theories of continuity and change in the urban environment and of planning concepts and techniques that further preservation planning objectives in relation to programs for community development and neighborhood conservation.

Arch 533
Case Studies in Architectural Creativity 3-0-3
Prerequisite: Arch 364. Considers creativity in architecture from psychological, philosophical and autobiographical perspectives. The buildings, writings and lives of contemporary architects discussed in the context of general theories of creativity. Each student chooses an individual architect noted for creative accomplishments and prepares a case study of his or her life.

Arch 541
Experiments in Structural Form 2-2-3
Prerequisite: Arch 384 or equivalent. Study of structural form through model design, construction and testing of minimum structures. Inquiry into the relationship between elements of soap film study, orthogonal and diagonal grids, design of tension grids through deflection loading, photoelastic models and calculation. Studies the relationship between structural form, geometric systems, patterning and proportion, symmetry, asymmetry, relative scale, nesting, linearity and spiral orders, rectilinear patterns, randomness resulting in architectural structure and form.

Arch 542
Regulatory Codes and Standards for Architectural Construction 3-0-3
Prerequisite: Arch 544. Explores the variety of standards and regulations which affect the evolution of a building from preliminary design through occupancy. Topics include building codes, life safety and comfort, structural performance, environmental protection, construction products and systems standards, materials testing, zoning, land use, and aesthetic restrictions, etc. Regulations analyzed for their impact upon various building types such as residential development, or specialized uses such as hospital and research laboratories.

Arch 543
Lighting 2-2-3
Prerequisites: Arch 386 and Arch 387 or equivalents. Explores, through modeling and calculation, the means by which architectural form and detail influence the luminous environment. Perceptual responses such as visual comfort and delight are examined. Topics include daylighting footprints, model design and testing, and computer-assisted light level analysis. Areas of investigation include: relationship between daylight and electric light in architecture; the variations of light with time; analysis of seasonal and weather differences; role of task in lighting strategies; and means of control for light quantity and quality.

Arch 544
Building Structure, Construction and Climatology 3-0-3
Prerequisites: Arch 386 and Arch 387 or equivalents. Discussion of the development of building materials, construction systems, structural systems and approaches to climate responsive design in architecture. Examines the evolution of environmental control systems, building structure and architectural form. Presents several approaches to different climate conditions, including traditional, vernacular and modern.

Arch 545
Case Studies in Architectural Technology 3-0-3
Prerequisite: senior standing. Technological systems involved in the construction and use of buildings. Students conduct in-depth investigation of technology-related problems in architecture and construction. Case study method used. Construction documents and reports analyzed. Field visits required.

Arch 546
Designing and Optimizing the Building Enclosure 3-0-3
Prerequisites: Arch 386, CIS 104. Considers the "building envelope," the boundary dividing the inside of a structure from the outside environment. Students study and design optimal enclosures considering energy exchange, the relationship between energy and light, and life cycle costs.

Arch 547
Special Topics in Computer Applications 2-2-3
Prerequisite: senior standing. Evaluation, utilization, and development of computer programs for analysis, simulation and information management. Programs range from energy analysis, building structures analysis, and mechanical systems design to spatial allocation, graphics and computer-aided design. Different theories of information transformation and delivery used in terms of architectural applications. Course hardware ranges from computer-aided design and drafting systems, through micro- and mini-, to mainframe computers.

Arch 548
Interdisciplinary Energy Conscious Design 2-2-3
Prerequisite: senior standing. Architecture and engineering design strategies affecting energy savings in buildings. Heating, cooling, ventilating and lighting alternatives evaluated in the context of energy conservation and their influence on building design and mechanical systems. Project teams of architecture and engineering students examine specific design situations, such as fenestration, daylighting, natural ventilation and relationships between various systems. Emphasis on interrelationships between analysis and design.

Arch 549
Life Safety Issues in Contemporary Buildings 3-0-3
Prerequisites: Arch 386, Arch 387. A variety of life safety and comfort situations studied in terms of specific building types. Topics include: building evacuation, compartmentalization, fire fighting and suppression, evaluation and testing of new building materials and systems, systems control and management. Special emphasis on such building types as multi-use, high-density, schools, hospitals, and other institutional categories.

Arch 550
Building Economics 3-0-3
Prerequisite: senior standing. Economic issues and methods of analysis influencing the building process and product are presented. The focus is on relations between architectural decisions and economic consequences. Students will use computer models to manage building cost data and conduct life cycle costing.

Arch 557
Problems in Modern Housing 3-0-3
Prerequisite: Arch 252. Historical approach used to place housing in its social, economic, and political context. Attempts to provide decent, affordable and well-designed housing for broad segments of society are examined. Dwelling examined through analysis of prototypical design solutions in urban environments.

Arch 558
Professional Architectural Practice 3-0-3
Prerequisite: Arch 364. A forum for examination of the structure and practices of the profession of architecture. The formal and informal relationships between architects, and between architects and clients, government officials and consultants are studied. Basic principles of office management for the small and large architectural firm are introduced.

Arch 563
Architecture Studio VII 1-12-5
Prerequisite: Arch 464. A continuation of Arch 464. Lecture hour explores in depth the nature of technology, environment, and social order as they relate to studio work.

Arch 564
Architecture Studio VIII 1-12-5
Prerequisite: Arch 563. A continuation of Arch 563.

Arch 566
Senior Thesis 0-15-5
Prerequisite: Arch 563. An independent study option which may be chosen by the student with the approval of the school, and in place of Arch 564.

Arch 572
Architecture and Social Change 3-0-3
Prerequisite: senior standing. Architectural form is analyzed in relation to political, economic and technology change, and change in social values. Buildings and other designed environments such as parks, streets and neighborhoods studied relative to the social processes and institutions that generate and transform them. The role of the design professions in initiating or supporting change also considered.

Arch 573
Technologies for Community and Urban Design 3-0-3
Prerequisite: senior standing. Advanced and traditional technologies analyzed with regard to their role in community and city design, construction and reconstruction. Emphasis on technological systems influencing location, configuration and use. Examples are: infrastructures, communication systems and construction technologies. Skills developed in using methods to evaluate alternative technologies relative to their social, economic and physical promise, problems and feasibility.

Arch 574
Case Studies in Community and Urban Design 3-0-3
Prerequisite: senior standing. In-depth investigation of specific real-world problems of urban or community design carried out using case method approach. Current practices in the U.S. and other countries studied using interviews with designers, developers, community groups and government agencies. Site visits, reports and other documents provide important sources of information. Final report with supporting documentation required.

Arch 575
The Practice of Community Design 1-6-3
Prerequisite: senior standing. Knowledge, skills, and techniques developed by professionals for effective intervention in community architecture and planning proposals. Important issues of study are: participatory design techniques, identification of funding sources, grant writing requirements, intervention theory, role of on-site charrettes, and techniques for effecting communication with neighborhood groups, governmental agencies and other institutions.

Arch 576
The Architecture of Utopia 3-0-3
Prerequisite: senior standing. Seminar for the review of utopian projects that have attempted to embody and strengthen social ideas through transformations in the structuring of space. Architectural implications of different literary and philosophical utopias analyzed with an emphasis on those experimental proposals which were realized, in whole or in part, in built form.

Arch 583
Special Topics 3 credits
Group investigation of problem of special interest in architecture.

Arch 591
Independent Study 1 credit

Arch 592
Independent Study 2 credits

Arch 593
Independent Study 3 credits

Arts

Offered by the Department of Humanities. See Humanities course list for faculty.

Arts 334
Elements of the Theater 3-0-3
Prerequisites: Eng 111, Hum 112. Corequisite: Hum 231. Using the resources of the NJIT Theater, students receive instruction in the elements of stage presentation: acting, design, theater history, and lighting and other technologies.

Arts 433
History and Criticism of Films 3-0-3
Prerequisites: Eng 111, Hum 112, Hum 231. 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.

Arts 435
Advanced Theater Workshop 3 credits
Prerequisites: Eng 111, Hum 112, Hum 231, Arts 334. An advanced level course in practical theater, including hands-on work in various elements of stage presentations. Open to students by invitation of the theater director. Enrollment limited to ten students. This course does not satisfy General University Requirements in Humanities or Hum/SS/STS.

Biology

Required Courses offered at Rutgers-Newark

Bio 120:101
General Biology 4 credits
Lectures and discussions complement minicourse clusters on major biological principles and their relevance to humans. Topics include scientific investigation, cellular basis of life, plant and animal structure and function, genetics, reproduction, evolution, and ecology.

Bio 120:102
General Biology 4 credits
Lectures and discussions complement minicourse clusters on major biological principles and their relevance to humans. Topics include scientific investigation, cellular basis of life, plant and animal structure and function, genetics, reproduction, evolution, and ecology.

Chemical Engineering

Offered by the Department of Chemical Engineering, Chemistry and Environmental Science

Chairperson: Gordon Lewandowski
Associate Chairpersons: Barbara B. Kebbekus (freshman chemistry), Reginald P.T. Tomkins, (chemical engineering/chemistry), Richard Trattner (environmental science)
Professors: Greenstein, Hanesian, Huang, Lewandowski, Magee, Perna, Roche, Shaw
Associate Professors: Armenante, Baltzis, Knox
Assistant Professors: Barat, Bart, Loney, Petrides

ChE 223
Chemical Process Calculations I 2-0-2
Prerequisites: Chem 116, CIS 101, Math 112. An introduction to the analysis of chemical processes, with special emphasis on mass balances.

ChE 224
Chemical Process Industries I 1-0-1
An introduction to the broader context of chemical engineering as a profession including such topics as ethics, safety, law, government regulations, and communication.

ChE 225
Chemical Process Calculations II 2-0-2
Prerequisite: ChE 223. A continuation of ChE 223 with special emphasis on energy balances.

ChE 226
Chemical Process Industries II 1-0-1
A continuation of ChE 224.

ChE 310
Co-op Work Experience I 3 additive credits
Prerequisites: completion of the sophomore year, approval of the department, and permission of the Division of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op Division. Mandatory participation in seminars and completion of a report.

ChE 311
Co-op Work Experience II 3 additive credits
Prerequisites: ChE 310 or its equivalent, approval of the department, and permission of the Division of Cooperative Education and Internships. Provides major-related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and/or project.

ChE 343
Chemical Engineering Thermodynamics I 3-0-3
Prerequisites: ChE 225, Chem 231. A course emphasizing engineering applications of the basic laws of thermodynamics, including equations of state, fluid properties, batch and flow systems.

ChE 344
Chemical Engineering Thermodynamics II 2-0-2
Prerequisite: ChE 343. The concepts and methods developed in ChE 343 are applied to the treatment of heat engines, refrigeration, phase equilibria, and chemical reactors.

ChE 349
Kinetics and Reactor Design 3-0-3
Prerequisites: Chem 335, ChE 225, Math 222. 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 is also included.

ChE 363
Transport Operations I 3-0-3
Prerequisite: ChE 225, Math 222. The principles of the molecular and turbulent transport of momentum are considered, particularly as they apply to pressure drop calculations in piping systems, packed columns, and other flow devices. Also considered is flow around submerged objects.

ChE 364
Transport Operations II 3-0-3
Prerequisites: ChE 225, Math 222. The principles of molecular and turbulent transport of energy are considered, particularly as they apply to design of heat exchangers. Also considered is radiant heat transfer.

ChE 366
Diffusional Systems 2-0-2
Prerequisites: ChE 363, ChE 364. The principles of molecular and turbulent transport of mass are considered, particularly as they apply to design of packed columns, and other mass transfer devices.

ChE 391H
Honors Research Topics I 1 to 3 additive credits
Prerequisites: participation in the Honors Program, permission of the instructor directing the research and approval of the associate chairperson for undergraduate studies. A course intended to provide a formal research opportunity for honors students at the sophomore and junior levels. Research is directed by a member of the department faculty.

ChE 392H
Honors Research Topics II 1 to 3 additive credits
Prerequisite: 391H. A continuation of ChE 391H.

ChE 444
Introduction to Polymer Engineering 3-0-3
Prerequisites: ChE 349, ChE 363, ChE 364. 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.

ChE 466
Pollution Control in Chemical Processes 3-0-3
Prerequisites: ChE 349, ChE 366. A course applying chemical engineering principles to the appropriate treatment of gaseous and liquid effluents from manufacturing and utility plants. The course will take into consideration toxicity, safety, and economic constraints. A case study approach is used to evaluate processes and pinpoint pollution sources. Quantitative designs and calculations will be required.

ChE 468
Air Pollution Control Principles 3-0-3
Prerequisites: ChE 366, ChE 349. A course focusing on the sources and control of air pollution.

ChE 471
Equilibrium Stage Processes 3-0-3
Prerequisites: ChE 344, ChE 366. A course covering the design of distillation columns, extraction columns, leaching, and other stagewise separation processes.

ChE 472
Process and Plant Design 4-0-4
Prerequisites: ChE 344, ChE 349, ChE 366, ChE 471. A capstone course in the chemical engineering program. This class is divided into three-person groups. Each group must complete an open-ended process design problem, including equipment specification and economics.

ChE 473
Mathematical Methods in Chemical Engineering 3-0-3
Prerequisites: Math 222 and senior standing in chemical engineering. A course demonstrating the importance of higher level mathematics in chemical engineering applications. Designed principally for those students considering graduate studies.

ChE 476
Introduction to Biochemical Engineering 3-0-3
Prerequisites: Chem 344, ChE 349, ChE 366. The application of chemical engineering to biochemical processes. Topics include enzyme reactions, metabolism, nutrient transport, dynamics of microbial populations, and reactor design.

ChE 478
Process Dynamics and Control I 3-0-3
Prerequisites: ChE 349, ChE 363, ChE 364, ChE 471. Mathematical description of unsteady state processes, with application to control systems.

ChE 479
Process Dynamics and Control II 1-2-2
Prerequisite: ChE 478. A continuation of ChE 478. Includes laboratory component.

ChE 484
Special Topics in Mass Transfer 3-0-3
Prerequisites: ChE 471, ChE 366. 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 the instructor.

ChE 486
Alternative and Synthetic Fuels 3-0-3
Prerequisites: senior standing in chemical engineering. A survey of the chemical processes involved in converting available fossil fuels to more useable forms to supplement or replace existing energy sources. Consideration is given to the technical, economic, and environmental problems that must be solved to produce synthetic fuels.

ChE 487
Chemical Engineering Laboratory I 2-4-4
Prerequisites: ChE 363, ChE 364, Math 225. A course in engineering experimentation and data analysis. Experiments are conducted in the areas of fluid mechanics and energy transport. Bench and pilot-scale equipment is used. Results are presented in both oral and written reports.

ChE 488
Chemical Engineering Laboratory II 0-6-3
Prerequisites: ChE 349, ChE 366, ChE 471. A course in engineering experimentation and data analysis. Experiments are conducted in the areas of distillation, extraction, and chemical/biochemical reactions. Bench and pilot-scale equipment is used. Results are presented in both oral and written reports.

ChE 490
Special Topics in Chemical Engineering 3-0-3
Prerequisites: ChE 223, ChE 225, advisor's permission. A course consisting of three five-week segments on topics which reflect current interests in chemical engineering, such as supercritical fluid extraction, combustion research, environmental problems, biotechnology, technologies in hazardous and toxic substance management, etc. As interests develop, other topics will be considered.

ChE 491
Research and Independent Study 3-0-3
Prerequisites: senior standing in chemical engineering, agreement of a department faculty advisor, and approval of the associate chairperson for undergraduate studies. An honors course open to a limited number of qualified students. This course provides the student with an opportunity to work on a research project under the individual guidance of a member of the department. Students taking ChE 491 must take ChE 492. The grade for this course is Satisfactory or Unsatisfactory. Credit for graduation will be given upon completion of ChE 492, at which time a grade for six credits will be submitted covering both courses. A written report is required for course completion.

ChE 492
Research and Independent Study 3-0-3
A required continuation of ChE 491.

ChE 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. Cannot be used for degree credit.

ChE 583
Petroleum Refining 3-0-3
Prerequisite: undergraduate courses in chemical engineering, kinetics, and mass transfer. A study of the major petrochemical feedstocks. A consideration of the economic and technical problems in refinery operation with changing sources of raw materials and changing product demand.

Chemistry

Offered by the Department of Chemical Engineering, Chemistry and Environmental Science

Chairperson: Gordon Lewandowski
Associate Chairpersons: Barbara B. Kebbekus (freshman chemistry), Reginald P.T. Tomkins, (chemical engineering/ chemistry), Richard Trattner (environmental science)
Professors: Bozzelli, Greenberg, Gund, Kebbekus, Kimmel, Kristol, Parker, Shilman, Trattner, Tomkins, Venanzi
Associate Professors: Dauerman, Getzin, Grow, Lambert, Lei, Perlmutter
Assistant Professors: Cagnati, Mitra
Director of Freshman Chemistry: Robert J. Conley

Chem 105
Applied Chemical Principles 3-2-4
Prerequisite: high school algebra or equivalent. The fundamentals and relation of chemistry to living in today's society. Suitable laboratory experiments illustrate the course material. Not open to engineering or science students, or students who have completed a college level chemistry course.

Chem 108
College Chemistry I 3-1-3
Prerequisites: A one-year college prep high school chemistry course, high school math including algebra and trigonometry. Delivered as a telecourse, the course provides the first of a two-semester sequence of college chemistry for high school students and other distance learners seeking college credit and/or preparation for the AP Examination. Matriculated undergraduates may not receive credit for this course.

Chem 109
College Chemistry II 3-1-3
Prerequisite: Chem 108. A continuation of Chem 108.

*Chem 111
Fundamentals of Chemistry and Materials I 3½-0-4
Prerequisites: high school math including algebra and trigonometry; chemistry placement examination required. The first semester of a three-semester chemistry and materials science program that is suitable for students wishing to pace their studies. 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. Chem 111A (Lab) must be taken concurrently. The Chem 111, 112, 113 program has exactly the same curriculum as the two-semester Chem 115, 116 program.

Chem 111A
Chemistry 111 Laboratory 0-1½-0
Prerequisite: same as Chem 111. This course is the laboratory component of Chem 111 and must be taken concurrently to receive credit for Chem 111.

Chem 112
Fundamentals of Chemistry and Materials II 3½-0-4
Prerequisite: Chem 111. The second semester of a three-semester chemistry and materials science program. This course is a continuation of Chem 111. Chem 112A (Lab) must be taken concurrently.

Chem 112A
Chem 112 Laboratory 0-1½-0
Prerequisite: Chem 111. This course is the laboratory component of Chem 112 and must be taken concurrently.

Chem 113
Fundamentals of Chemistry and Materials III 3½-0-4
Prerequisite: Chem 112. The last semester of a three-semester chemistry and materials science program. This course is a continuation of Chem 112. Chem 113A (Lab) must be taken concurrently.

Chem 113A
Chem 113 Laboratory 0-1½-0
Prerequisite: Chem 112. This course is the laboratory component of Chem 113 and must be taken concurrently.

Chem 115
Fundamentals of Chemistry and Materials I 3½-0-4½
Prerequisites: high school math including algebra and trigonometry; chemistry placement examination required. The first semester of a two-semester chemistry and materials science program. 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. Chem 115A (Lab) must be taken concurrently.

*For engineering students, Chem 111 is taken for 3 additive credits and one degree credit.

Chem 115A
Chem 115 Laboratory 0-2-0
Prerequisite: same as Chem 115. This course is the laboratory component of Chem 115 and 115H and must be taken concurrently.

Chem 115H
Chemistry and Materials I Honors 3½-0-4½
Admission is by invitation only. 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. Lab must be taken concurrently. See Chem 115A.

Chem 116
Fundamentals of Chemistry and Materials II 3½-0-4½
Prerequisite: Chem 115 or equivalent. The last semester of a two-semester chemistry and materials science program. This course is a continuation of Chem 115. Lab must be taken concurrently. See Chem 116A.

Chem 116A
Chem 116 Laboratory 0-2-0
Prerequisite: Chem 115. This course is the laboratory component of Chem 116 and must be taken concurrently. When registering, students should bear in mind that Honors and non-Honors sections of this course are offered.

Chem 116H
Chemistry and Materials II Honors 3½-2-4½
Prerequisite: Chem 115H. A continuation of Chem 115H, which parallels the course content of Chem 116. An individual research project will be completed. Honors lab must be taken concurrently. See Chem 116A.

Chem 231
Physical Chemistry I 3-0-3
Prerequisites: Chem 116 or equivalent, Math 211 or Math 213, Phys 111. The topics covered include the properties of ideal and non-ideal gases and liquids, solutions, thermochemistry, thermodynamics, the phase rule, and phase equilibria.

Chem 301
Chemical Technology 2-2-3
Prerequisites: high school algebra and trigonometry or equivalent. Designed for students in the engineering technology curricula. Covers principles of chemistry, with a focus on chemical energetics and chemistry of materials. Suitable laboratory experiments illustrate the course material. Not open to students who have completed a college level chemistry course.

Chem 305
Chemical Technology 3-2-4
Prerequisites: High school algebra and trigonometry or equivalent. Designed for students in the engineering technology curricula who require a four credit course in chemistry. Material similar to that in Chem 301 is covered, with additional work on selected topics.

Chem 321
Analytical Chemical Methods 0-4-2
Prerequisite: Chem 116. Introduction to quantitative chemical analyses by gravimetry, volumetric measurements, spectroscopy, chromatography, and potentiometry.

Chem 335
Physical Chemistry II 3-4-5
Prerequisite: Chem 231. The lecture presents a continuation of Chem 231. The topics 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 students apply and extend the basic knowledge of physical chemistry acquired in the lecture.

Chem 336
Physical Chemistry III 3-0-3
Prerequisite: Chem 335. An introduction to quantum mechanics, statistical mechanics and spectroscopy.

Chem 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. Also covered is the commercial utilization of these materials in the synthesis of useful products used in areas such as foods, cosmetics, textiles, plastics and pharmaceuticals.

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

Chem 350
Industrial Chemistry 3-0-3
Prerequisite: Chem 344. Applications of chemistry to the development of products from basic research and development through scale-up and marketing. Inorganic and organic processes, environmental considerations, industrial catalysis, and cost calculations will be covered.

Chem 412
Inorganic Reactions and Processes 2-2-3
Prerequisite: Chem 231. A lecture-recitation-laboratory course in practical inorganic chemistry. The chemistry of most of the elements and their compounds is covered. Preparation in the laboratory will be followed by purification and characterization.

Chem 440
Fundamentals of Polymers 3-0-3
Prerequisites: Chem 335, Chem 344, or equivalent. An introduction to the important fundamental aspects of polymers including preparation, structure, physical states and transitions, molecular weight distributions, viscous flow and mechanical properties.

Chem 443
Introductory Polymer Laboratory 1-4-3
Prerequisite: 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.

Chem 448
Preparations and Analysis of Organic Compounds 0-4-2
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.

Chem 471
Chemical Aspects of Industrial Health 2-2-3
Prerequisite: Chem 116 or equivalent. Topics related to occupational health and safety will be discussed. Regulations involved in industrial hygiene and methods of determining and controlling worker exposure to hazardous materials in the workplace are treated. Sampling and analysis of industrially important materials are conducted in the laboratory.

Chem 473
Biochemistry 3-0-3
Prerequisite: Chem 344 or equivalent. Covers the fundamentals of biochemistry including buffers, blood, proteins, enzymes, carbohydrates, fats and nucleic acids. Emphasis on the relationship of biochemistry to biotechnology and medicine.

Chem 483
Bio-Organic Chemistry 3-0-3
Prerequisite: Chem 116. This course is for students interested in environmental or biological engineering. Not open to applied chemistry or chemical engineering majors. The fundamentals of organic chemistry and biochemistry are studied and applied to living systems. Those who take Chem 343 cannot receive credit for this course.

Chem 484
Modern Analytical Chemistry 1-4-3
Prerequisite: Chem 335. Basic principles and techniques of quantitative analysis, with emphasis on application of modern analytical instrumentation. Atomic and molecular spectroscopy, chromatography, and electrochemical methods are studied and applied in the laboratory. Calibration, sampling methodology and sample preparation are also treated.

Chem 486
Introductory Physical Chemistry 3-0-3
Prerequisites: Chem 116 or equivalent, Math 112, Phys 121. This course is for students interested in the environmental sciences. Not open to applied chemistry or chemical engineering majors. Those who take Chem 231 cannot receive credit for this course. 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.

Chem 490
Special Topics in Chemistry 3-0-3
Prerequisite: depends upon the nature of the course given. Course is offered in specific areas as interest develops.

Chem 491
Research and Independent Study I 3-0-3
Prerequisite: senior standing in applied chemistry. This course provides the student with an opportunity to work on a research project under the individual guidance of a member of the department.

Chem 492
Research and Independent Study II 3-0-3
Prerequisite: Chem 491. A continuation of Chem 491.

Chem 502
Advanced Organic Chemistry I 3-0-3
Prerequisites: Chem 335, Chem 344, or equivalent. Organic molecules are treated from a structural rather than mechanistic viewpoint. Topics include atomic and molecular structure, stereochemistry, reactive intermediates (cations, anions, radicals and carbenes), orbital symmetry and spectroscopy.

Chem 552
Laser Chemistry and Technology 3-0-3
Prerequisites: Chem 116 or equivalent, Phys 231 or equivalent, Math 211 or Math 213. An introduction to the underlying chemistry and physical principles of lasers, their operation, uses, and the related optoelectronic technology. Topics include analysis of each class of laser; pumping mechanisms for creating the atomic and molecular excited states; detection of light; absorption and emission of radiation; and current industrial and state of the art uses.

Civil Engineering

Offered by the Department of Civil and Environmental Engineering

Chairperson: William Spillers
Associate Chairperson: C.T. Thomas Hsu (graduate studies)
Distinguished Professors: Liskowitz, Pignataro
Professors: Ansari, Chan, Cheng, Cheremisinoff, Dauenheimer, Deutschman, Dresnack, Golub, Hsu, Khera, Konon, Pincus, Raghu, Salek, Spillers, Wu
Associate Professors: Bagheri, Ciesla, Hsieh, Meegoda, Olenik, Schuring, Wecharatana
Assistant Professors: Greenfeld, Saadeghvaziri, Sadegh
Academic Coordinator: Roberta Hartlaub

CE 200
Surveying I 2-0-2
Prerequisite: Math 111. Angle and distance measurement; leveling; tacheometry, topographic mapping; traverse and area computations. Emphasis on the use of the computer for solving typical field and office problems. Lab should be taken concurrently.

CE 200A
Surveying I Laboratory 0-3-1
Corequisite: CE 200. Field exercises in conjunction with the classroom exercises in CE 200 utilizing classical and electronic instruments and COGO/CAD software.

CE 201
Surveying II 2-0-2
Prerequisite: CE 200. Horizontal and vertical curves; cross-sections; triangulation; state plane coordinates; global positioning system; hydrographic surveying.

CE 210
Construction Materials and Procedures 3-0-3
A study is made of current practices in construction, including earth moving, soil and rock excavation, 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 4-0-4
Prerequisites: Mech 235, Math 211, 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. Lab should be taken concurrently.

CE 231A
Strength of Materials Laboratory 0-3-1
Corequisite: CE 231. Students perform basic experiments in strength of materials.

CE 232
Strength of Materials 1-2-2
This course is intended only for students who have taken Mech 232, Mechanics of Materials, or the equivalent, and who subsequently have decided to transfer into the civil engineering program. The student is required to complete additional laboratory and class work needed to bring him/her to the level required in CE 231, Strength of Materials. Registration is by departmental permission only and the student must consult with his/her advisor before registering to plan a program of work in this course.

CE 305
Aerial Photographic Interpretation 3-0-3
Prerequisite: CE 200 and 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.

CE 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.

CE 311
Co-op Work Experience I 3 additive credits
Prerequisites: completion of the sophomore year, approval of the department, and permission of the Division of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op Division. Mandatory participation in seminars and completion of a report.

CE 320
Fluid Mechanics 4-0-4
Prerequisites: Math 211, Mech 235, Mech 236. 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 incompressible fluids. These include flow in pipe systems and natural channels.

CE 321
Water Resources Engineering 3-0-3
Prerequisite: junior standing. The objective of this course is to train the student in methods of developing water supplies and the means to treat said supplies for consumptive use. In addition, the nature of wastewaters and related treatment is examined. Hydrologic techniques such as surface and ground water yield, hydrograph and routing analyses, probabilistic methods related to hydrologic studies are treated in the course.

CE 322
Hydraulic Engineering 3-0-3
Prerequisites: CE 320, CE 321. The objective is to provide the tools required to design water distribution systems, storm drains, and sanitary sewers. Various hydrologic and hydraulic techniques related to the above will be examined.

CE 332
Structures I 3-2-4
Prerequisite: CE 231 or equivalent. The student must have a working knowledge of free body diagrams, equilibrium conditions for force systems and moments. The primary objective is an understanding of the various methods of analyzing determinate and indeterminate beams, frames, and trusses encountered in practice.

CE 333
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.

CE 341
Soil Mechanics 3-0-3
Prerequisite: CE 231 or equivalent. Prerequisite or corequisite: CE 342. A study of soil types and properties is made with the objective of developing a basic understanding of soil behavior. The methods of subsurface investigation and compaction are presented. Fundamentals pertaining to permeability, seepage, consolidation, stress distribution, and shear strength are introduced. Bearing capacity and settlement analysis are also presented. Lab should be taken concurrently.

CE 341A
Soil Mechanics Laboratory 0-3-1
Prerequisite or Corequisite: CE 341. Students perform basic experiments in soil mechanics.

CE 342
Geology 3-0-3
Prerequisite: satisfactory sophomore engineering standing or special permission. The science of geology is studied with emphasis on physical geological 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.

CE 343
Geology with Laboratory 3-3-4
Prerequisites: junior standing in engineering technology or special permission. This course covers the material given in CE 342 with the addition of a laboratory component. It provides a more in-depth understanding of geology through rock and mineral identification, laboratory experiments, field trips, and selected case studies.

CE 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.

CE 360
Civil Engineering Methods 2-0-2
Prerequisite: junior standing. Provides students with in-depth experience in computer applications in civil engineering and with written and oral communication.

CE 401
Photogrammetry 3-3-4
Prerequisite: CE 305 or permission of instructor. 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.)

CE 406
Remote Sensing 3-0-3
Prerequisite: Phys 230. Principles of remote sensing are covered including general concepts, data acquisition procedures, data analysis and role of remote sensing in terrain investigations for civil engineering practices.

CE 408
Analytical Aerotriangulation 3-0-3
Prerequisites: CE 401. Theory and applications of analytical aerotriangulations will be stressed, investigation of existing computer software; various computer solutions will be executed by each student.

CE 410
Construction Scheduling and Estimating I 3-0-3
Prerequisite: CE 210. Quantity take off, cost estimate and CPM computer analysis of typical building or highway projects. A study is made of construction project organization, contract requirements and management control techniques with an introduction to computer applications.

CE 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. Organization of construction companies and field accounting practices are introduced.

CE 412
Construction Codes and Specifications 3-0-3
Prerequisites: CE 210 or CET 313 and senior standing in the BSCE or BSET program. This course deals with the code and specification aspects 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 Code, Energy Code Provisions, construction safety, and the impact of the E.P.A. on construction.

CE 413
Co-op Work Experience II 3 additive credits
Prerequisites: CE 311 or its equivalent, approval of the department, and permission of the Division of Cooperative Education and Internships. Provides major-related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and/or project.

CE 416
Construction Processes 2-3-3
Prerequisite: CE 210 or CET 313. This course will give students practical experience in transforming design and technical theory into buildings. Lectures will present broad exposure to construction processes which comprise the construction project; studios will involve application of theory and skills to actual projects. Lectures and discussions will be supplemented by field trips to manufacturers, fabricators, architects, offices, and construction sites.

CE 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 multistory buildings, bridges, and industrial buildings.

CE 443
Foundation Design 3-0-3
Prerequisites: CE 341. Site investigation, selection of foundation types and basis for design, allowable loads, and permissible settlements of shallow and deep foundations. Structural design of footings and pile caps. Computations of earth pressure and design of retaining walls.

CE 450
Urban Planning 3-0-3
Prerequisites: 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.

CE 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.

CE 460
Civil Engineering Seminar 1-0-1
Prerequisite: CE 494. Students have an opportunity to present their design project in a seminar environment.

CE 461
Civil Engineering Special Topics 1-0-1
Prerequisite: senior standing. Students have an opportunity to bring together the entire civil engineering curriculum in a special study environment in preparation for professional practice.

CE 490
Civil Engineering Projects 3-0-3
Prerequisite: senior standing in civil engineering and approval of the department. The student works on an individually selected project, guided by department faculty advisor. The project 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 select his or her own topic. The project must be completed and professionally presented by assigned due dates for appropriate review and recording of accomplishment.

CE 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 the project.

CE 495
Civil Engineering Design II 3-0-3
Prerequisite: senior standing in civil engineering. 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, and sanitary and environmental engineering.

CE 541
Structure Model Analysis 3-0-3
Prerequisite: undergraduate course in structural analysis. Basic theory of the analysis of structures by means of models, model design, and the interpretation of model tests.

CE 545
Rock Mechanics I 3-0-3
Prerequisite: approved undergraduate course in soil mechanics within last five years or permission of instructor. Rock mechanics including geological aspects, mechanical properties, testing, and in-situ measurements of rock properties, and a brief introduction to design of structures on rock.

CE 552
Geometric Design of Transportation Facilities 3-0-3
Prerequisite: CE 350 or equivalent. Design principles and criteria related to highways and railroads resulting from requirements of safety, vehicle performance, driver behavior, topography, traffic, design speed, and levels of service. Elements of the horizontal and vertical alignments and facility cross-section, and their coordination in the design. Computer-aided design procedures including COGO, CADAM, Digital Terrain Modeling.

Computer Engineering

Offered by the Department of Electrical and Computer Engineering

Chairperson: Jacob Klapper
Associate Chairperson: Edwin Cohen
Director of Computer Engineering: Anthony Robbi
Professor: Rosenstark
Associate Professors: Manikopoulos, Robbi
Assistant Professors: Carpinelli, Hou, Zhou, Ziavras

CoE 302
Engineers in Society 1-0-1
Prerequisites: Hum 231, CoE 351 or EE 352 (for EE majors). An introduction to the concepts of professionalism and ethics in the workplace and outside. Traditions in the field and the role of the professional society are covered. Written and oral presentation techniques are practiced by the student.

CoE 327
Signal Transmission 3-0-3
Prerequisite: EE 232. Prerequisite or corequisite: EE 372. A course that familiarizes the computer engineer with signal transmission both within and between digital systems. Topics include the telegraphers equations, lattice diagrams, steady state behavior of transmission lines, transients in digital systems, the transmission characteristics of strip lines and twisted pairs, and computer bus signals.

CoE 351
Computer Systems Organization 3-0-3
Prerequisites: EE 251 and either CIS 113, CIS 213 or CIS 105 with CIS 101. An introduction to computer system structure and assembly language programming. Topics include processor and memory organization, instruction sets, input/output structures and assembly language programming. Students receiving credit for CoE 351 cannot receive credit for EE 352 or CIS 453.

CoE 391
Computer Engineering Lab I 1-3-2
Prerequisites: EE 271, EE 291. Prerequisite or corequisite: CoE 351. This lab is intended primarily to support the parallel course CoE 351 and to reinforce design concepts of EE 251. The experiments emphasize the real-time I/O facilities of a computer system. Students will develop hands-on familiarity with busses, serial and parallel I/O ports, interrupt structure, and device drivers. The mechanics of assembly language programming including linking, loading, and debugging are covered. Several experiments on electronic device characterization are performed. Students receiving credit for CoE 391 cannot receive credit for EE 393 or CIS 453.

CoE 392
Computer Engineering Lab II 1-3-2
Prerequisite: CoE 391. Prerequisite or corequisite: EE 372. A course reinforcing the course concepts of EE 372 and CoE 351, using experiments on logic circuit design, A/D conversion and D/A conversion. The assembly language programming practice of CoE 391 is continued.

CoE 421
Digital Data Communications 3-0-3
Prerequisites: CoE 327, Math 333. A course covering communications basics and some topics in digital communications most germane to data communication. Topics include spectral analysis, energy and power spectral density, noise, sampling and quantization, and digital signal communication systems.

CoE 451
Computer Architecture 3-0-3
Prerequisites: CoE 351, CIS 332. A course emphasizing the hardware design of computer systems. Topics include register transfer logic, central processing unit design, microprogramming, ALU design, microcoded arithmetic algorithms and I/O organization.

CoE 493
Computer Engineering Lab III 2-4-4
Prerequisites: CoE 392, EE 372. Prerequisite or corequisite: CoE 451. This lab and associated lectures prepare the student to put into practice the concepts learned in the computer architecture course, CoE 451. Hardware design and debugging are emphasized. Topics include combinational and sequential logic design using CAD techniques for design and verification, design based upon PLA/PLD devices, computer interface design using hardware and software, and a design project such as a central processing unit.

CoE 494
Computer Engineering Lab IV 0-3-1
Prerequisites: CoE 421, CoE 392. This lab complements the course in digital data communication. Students will experiment with modulation techniques, transmission technology, detection, spectral analysis, and error measurement.

CoE 495
Computer Engineering Project 3-0-3
Prerequisite: CoE 493. The student's knowledge is applied to the synthesis of a previously approved design project of the student's choice. Projects must involve the design and execution of both hardware and software, and include library research, cost estimation and time budgeting. Seminar discussions bring the student's attention to the projects of other class members. The student must give an oral presentation and demonstration of the project. A final written report must be submitted.

CoE 496
Independent Study 3-0-3
Prerequisite: CoE 493. Students work on various individually selected projects guided by the department faculty. The project(s) of each student must be completed and professionally presented by assigned due dates for appropriate review and recording of accomplishment. An oral presentation will be made at a meeting of all students and faculty advisors involved in the course. A formal written report will be presented to the faculty advisor at the end of the course. If the course is used in lieu of CoE 495, the project must meet CoE 495 guidelines.

Computer and Information Science

Offered by the Department of Computer and Information Science

Chairperson: Peter A. Ng
Associate Chairpersons: Michael A. Baltrush, James A.M. McHugh, Julian M. Scher
Sponsored Chair: Erol Gelenbe
Distinguished Professor: Gelenbe
Distinguished Research Professor: Neuhold
Professors: Hiltz, McHugh, Ng, Perl, Turoff, Veroy
Associate Professors: Baltrush, Featheringham, Nassimi, Ryon, Sarian, Scher, Shiau
Assistant Professors: Benanav, Chao, Eshaghian, Geller, Hung, Izaguirre, Karvelas, King, MacKellar, Parker, Rossak, Shih, Sohn, Stoyenko, Suresh, D. Wang, J. Wang, Watters, Welch
Special Lecturers: Cheng, Chiang, Deek, Jololian, Kushwaha, Maskara
Director of Undergraduate Curriculum: Fadi P. Deek

*CIS 101
Computer Programming and Problem Solving 2-1-2
An introductory course in computer science, and 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. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications. Designed for students not specializing in computer science. For students taking a minor in CIS or changing to a CIS major, a combination of CIS 105 (Pascal) and CIS 101 may be substituted for CIS 113.

*CIS 101H
Honors Computer Programming and Problem Solving 2-1-2
Prerequisite: departmental approval and/or permission of the director of the Honors Program. This course covers the same material as CIS 101 but in greater depth. Designed for students not specializing in computer science.

*CIS 102
Computer Science with Problem Solving 3-1-3
An introductory course in computer science, with applications to engineering and technology problems. Emphasis on programming methodology using the FORTRAN language as the vehicle to illustrate concepts. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications.

*CIS 103
Computer Science with Business Problems 3-1-3
An introductory course in computer science, with applications to business and managerial decision making. Emphasis on programming methodology using the COBOL language as the vehicle to illustrate concepts. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and abstraction, with applications.

*CIS 104
Computer Programming and Graphics Problems 2-1-2
Corequisite: Math 116 or Math 138. An introductory course in computer science with applications in computer graphics for architecture. Emphasis on programming methodology using the Pascal language as the vehicle to illustrate the concepts. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications.

*CIS 104H
Honors Computer Programming and Graphics Problems 2-1-2
Prerequisite: departmental approval and/or permission of the director of the Honors Program. Corequisite: Math 116 or Math 138. This course covers the same material as CIS 104, but in greater depth.

*All students at NJIT are required to complete at least one 2-credit or 3-credit CIS course. The Department of Computer and Information Science offers a set of 100 level courses to satisfy this requirement, and the student should select one based upon his or her intended major. It is imperative that students speak with their advisors prior to enrolling to determine the appropriate CIS course.

CIS 105
Computer Programming 1-1-1
Prerequisite: 100-level GUR course in CIS. Details of programming in one particular computer language. Problems will be coded and run on a computer. Languages include ADA, APL, C, FORTRAN, LISP, MODULA-2, Pascal, PROLOG, or others. May be repeated for credit when a different language is used. Does not count as an elective for B.S. and B.A. degrees in computer science. For students taking a minor in CIS or changing to a CIS major, a combination of CIS 105 (Pascal) and CIS 101 may be substituted for CIS 113.

*CIS 113
Introduction to Computer Science I 3-1-3
Corequisite: Math 111. Fundamentals of computer science are introduced, with emphasis on programming methodology and problem solving. Topics include basic concepts of computer systems, software engineering, algorithm design, programming languages and data abstraction, with applications. The Pascal language, which is fully discussed, serves as the vehicle to illustrate many of the concepts. CIS majors should enroll in CIS 113. Students who receive degree credit for CIS 113 may not receive degree credit for CIS 213.

*CIS 113H
Honors Introduction to Computer Science I 3-1-3
Corequisite: Math 111. Prerequisite: departmental approval and/or permission of the director of the Honors Program. A course similar to CIS 113, but material is covered in greater depth. Honors students contemplating a major in computer science, or who plan to take advanced electives in computer science, should take CIS 113H instead of CIS 101H. Students who receive degree credit for CIS 113H cannot receive degree credit for CIS 213.

CIS 114
Introduction to Computer Science II 3-1-3
Prerequisites: Math 111; CIS 113 or completion of a required 100 level GUR course in CIS, plus CIS 105 (Pascal). A study of advanced programming topics with logical structures of data, their physical representation, design and analysis of computer algorithms operating on the structures, and techniques for program development and debugging. Course covers program specifications, correctness and efficiency, data abstraction, basic aspects of simple data structures, internal searching and sorting, recursion and string processing. Algorithmic analysis is also discussed. Students receiving degree credit for CIS 114 cannot receive degree credit for CIS 335 or CIS 505.

CIS 114H
Honors Introduction to Computer Science II 3-1-3
Prerequisites: CIS 113H, or CIS 101H plus knowledge of Pascal, or department approval; Math 111; department approval and/or permission of the director of the Honors Program. A course similar to CIS 114, but material is covered in greater depth. Students receiving degree credit for CIS 114H cannot receive degree credit for CIS 335 or CIS 505.

CIS 213
Introduction to Computer Science 3-0-3
Prerequisite: 100-level GUR course in CIS. The course covers a study of the representation of data, its structures, and algorithms. Programming topics in Pascal and assembly language are included. Designed for students not majoring in computer science. Students receiving degree credit for CIS 213 cannot receive degree credit for CIS 113.

CIS 231
Machine and Assembly Language Programming 3-1-3
Prerequisites: CIS 113 or CIS 213 or completion of a required 100-level GUR course in CIS, plus CIS 105 (Pascal). Fundamentals of machine organization and machine language programming. Representation of computer instructions and data in machine, assembly and macro-assembly languages together with intensive practice in formulating programming, running, and debugging programs for both numerical and logical problems. Assemblers and loaders are discussed. Students receiving degree credit for CIS 231 cannot receive degree credit for CIS 510. (Formerly listed as CIS 331.)

CIS 251
Computer Organization 3-0-3
Prerequisite: CIS 113. Corequisite: CIS 231. An introduction to computer system structure and organization. Topics include representation of information, circuit analysis and design, register-transfer level, processor architecture and input/output. (Formerly listed as CIS 351.)

CIS 280
Programming Language Concepts 3-0-3
Prerequisite: CIS 114 or equivalent. Conceptual study of programming language syntax, semantics and implementation. Course covers language definition structure, data types and structures, control structures and data flow, run-time consideration, and interpretative languages.

CIS 310
Co-op Work Experience I 3 additive credits
Prerequisites: completion of the sophomore year, approval of the department, and permission of the Division of Cooperative Education and Internships. Students gain major-related work experience and reinforcement of their academic program. Work assignments facilitated and approved by the Co-op Division. Mandatory participation in seminars and completion of a report.

CIS 330
Mini-Computer Systems 3-0-3
Prerequisite: Completion of a required 100-level GUR course in CIS. 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.

CIS 332
Principles of Operating Systems 3-1-3
Prerequisite: CIS 231 or equivalent. Organization of operating systems covering structure, process management and scheduling; interaction of concurrent processes; interrupts; I/O, device handling; memory and virtual memory management and file management.

CIS 333
Introduction to UNIX Operating Systems 3-0-3
Prerequisite: CIS 332 or equivalent and knowledge of C language. The course covers the UNIX system kernel including initialization, scheduling, context switching, process management, memory management, device management, and the file system. The course also includes the organization of shells, editors, utilities, and programming tools of the UNIX operating system.

CIS 335
Data Structures and Algorithm Design 3-0-3
Prerequisite: CIS 113 or completion of a required 100 level GUR course in CIS, plus CIS 105 (Pascal). Students who receive degree credit for CIS 335 cannot receive degree credit for CIS 114 or CIS 505. A study of advanced programming topics dealing with logical structures of data, their hardware representation, and the design and analysis of computer algorithms operating on the structures. This course, the first of a two-course sequence, concentrates on data structures: primitive types, stacks, queues, arrays, sets, linked lists, trees and graphs. Also covered are some basic operations using these data structures including sorting, searching and memory management. Problems and individual computer exercises are assigned.

CIS 341
Introduction to Logic and Automata 3-0-3
Prerequisites: completion of a 100-level GUR course in CIS; Math 226. 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.

CIS 350
Computers and Society 3-0-3
Prerequisites: completion of a 100-level GUR course in CIS; one basic SS course. Examines the historical evolution of computer and information systems and explores their implications in the home, business, government and science. Impacts on the individual, the organization and society are considered. Topics include automation and job impact; applications in electronic funds transfer, government education, medicine and others; professional ethics, and legal issues. Co-listed as STS 350.

CIS 352
Parallel Computers and Programming 3-1-3
Prerequisites: CIS 251 or CoE 351, CIS 332. A course introducing parallel computers and parallel programming. General structures and design techniques of parallel computers are described. Programming paradigms and algorithm design considerations for parallel processors will be discussed.

CIS 365
Computer Applications to Commercial Problems 2-2-3
Prerequisite: CIS 113 or CIS 213 or completion of a 100-level GUR course in CIS, plus CIS 105 (Pascal). 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.

CIS 370
Introduction to Artificial Intelligence 3-1-3
Prerequisites: CIS 114 or CIS 335; Math 226. An exploration of concepts, approaches and techniques of artificial intelligence. Emphasizes both underlying theory and applications. Topics include knowledge representation, parsing language, search, logic, adduction, uncertainty, and learning. LISP and Prolog programming languages used extensively. Students are required to do programming assignments, complete a programming term project and review case studies.

CIS 390
Requirements Analysis and Systems Design 3-0-3
Prerequisite: CIS 114. A study of the information systems development life-cycle, from the initial stages of information requirements analysis and determination to the ultimate activities involving systems design. Theory, methodologies and strategies for information requirements analysis, including the assessment of transactions and decisions, fact-finding methodologies, structured analysis development tools, strategies of prototype development, and an overview of computer-aided software engineering (CASE) tools. Theory, methodologies and strategies for systems design, including design of user-interfaces, particularly menu-driven and keyword dialogue strategies, and issues in the proper design of computer output. (Co-listed as MIS 390.)

CIS 407
Computer Augmented Design 3-0-3
(Not open to CIS majors.)
Prerequisites: completion of a 100-level GUR course in CIS; calculus. Topics covered are those needed by engineers 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.

CIS 408
Computer Configurations 3-0-3
(Not open to CIS majors.)
Prerequisite: completion of a 100-level GUR course in CIS. 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 applications of these architectures in special-purpose computers, computer graphics equipment, and information retrieval systems.

CIS 410
Co-op Work Experience II 3 additive credits
Prerequisites: CIS 310 or its equivalent, approval of the department, and permission of the Division of Cooperative Education and Internships. Provides major-related work experience as co-op/internship. Mandatory participation in seminars and completion of requirements that include a report and/or project.

CIS 421
Numerical Algorithms 3-0-3
Prerequisite: completion of a 100-level GUR course in CIS. 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.

CIS 431
Introduction to Database Systems 3-0-3
Prerequisite: CIS 114 or equivalent. Introduction to data and file organization and management; database concepts and architecture; functions of a database management system (DBMS); database analysis and design. Student projects involve the use of a DBMS package.

CIS 432
Advanced Operating Systems and Computer Architecture 3-0-3
Prerequisites: CIS 251, CIS 332. The study of advanced computer architecture and operating systems emphasizing intrasystem communication. Topics include pipelining and parallelism, user interface considerations, introduction to telecommunications, distributed computing and networks, network operating system security, performance measurement, monitoring and evaluation, queueing theory, queueing networks, and concurrency theory.

CIS 435
Advanced Data Structures and Algorithm Design 3-0-3
Prerequisite: CIS 114 or CIS 335. Advanced topics in data structures and algorithms, including mathematical induction, analysis and complexity of algorithms, and algorithms involving sequences, sets, and graphs such as searching, sorting, order statistics, sequence comparisons, graph traversals, etc. Optional topics include geometric, algebraic, and numeric algorithms.

CIS 438
Programming for Interactive Computer Graphics 3-0-3
Prerequisites: completion of a 100-level course in CIS, plus knowledge of Pascal. This course introduces fundamental concepts of interactive graphics oriented toward computer-aided design systems. Such systems emerge in engineering, architecture, and manufacturing. Topics include computer data structures for representation of two- and three-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.

CIS 447
Human-Computer Interfaces 3-0-3
Prerequisite: CIS 390. This course covers the design and evaluation of the human-computer interface in interactive computer systems. Among the topics covered are approaches to interface design such as menus, commands, direct manipulation; screen layout strategies; metaphor models; models of human information process; evaluation approaches such as protocol for analysis, interactive monitoring, use of surveys; and requirements for documentation and help. Students are expected to design interface mockups and evaluate them.

CIS 451
Introduction to Data Communications and Networks 3-1-3
Prerequisite: CIS 251. Fundamental concepts in data communications. Topics include: circuit and packet switching, layered network architecture, ISO Network protocols, performance analysis of data communication systems, flow control and alternate routing strategies and algorithms, various types of networks and their interconnections, network security and privacy. Additional topics include systems analysis and design, traffic engineering, planning and forecasting methodologies as applied to data communication networks.

CIS 453
Microcomputers and Applications 3-1-3
Prerequisite: CIS 231. 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. Individual instructor-assigned exercises as well as one student-designed project will be assigned for solution in the laboratory portion of the course.

CIS 455
Computer Systems Management 3-0-3
Prerequisite: CIS 113 or CIS 213 or completion of a 100-level GUR course in CIS. 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.

CIS 461
Systems Simulation 3-0-3
Prerequisites: completion of a 100-level GUR course in CIS; Math 333. This course introduces computer simulation as a problem solving technique. Includes discrete simulation models, elementary theory, stochastic processes, use of simulation languages, random number generators, simulation methodology, design of simulation experiments, validation of models, queueing systems, and applications. The GPSS language is covered in detail.

CIS 465
Computer Techniques for Management Information Systems 3-0-3
Prerequisite: 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.

CIS 480
Theory of Languages 3-0-3
Prerequisite: CIS 280 and CIS 341. The formal treatment of programming language translation and compiler design concepts. Emphasis on theoretical aspects of parsing context-free languages, translation specifications and machine-independent code optimization. A programming project to demonstrate the concepts covered in the course is required in addition to class work and examinations.

CIS 485
Special Topics in Computer Science I 3-0-3
Prerequisites: junior standing and/or department approval. The study of new and/or advanced topics in an area of computer science not regularly covered in any other CIS course. The precise topics to be covered in the course, along with prerequisites, will be announced in the semester prior to the offering of the course. A student may register for no more than two semesters of Special Topics.

CIS 486
Special Topics in Computer Science II 3-0-3
Prerequisites: Same as for CIS 485. A continuation of CIS 485.

CIS 488
Independent Study in Computer Science 3-0-3
Prerequisites: open only to students in the Honors Program who are computer science majors and who have the prior approval of the department and the CIS faculty member who will guide the independent study. Independent studies, investigations, research, and reports on advanced topics in computer science. Students must prepare, in collaboration with their faculty mentor and in the semester prior to enrolling in this course, a detailed plan of topics and expected accomplishments for their independent study. This must have the approval of both the department and the faculty mentor. A student may register for no more than one semester of Independent Study.

CIS 490
Guided Design in Software Engineering 3-0-3
Prerequisite: senior standing or departmental approval. This course focuses on the methodology for developing software systems. Methods and techniques for functional requirements analysis and specifications, design, coding, testing and proving, integration and maintenance are discussed. Students will prepare a proposal for a project which includes its functional specifications and preliminary design.

CIS 491
Computer Science Project 3-0-3
Prerequisites: CIS 490, senior standing and project proposal approval. 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 computer science studies. To register for this course, a student must have a written project proposal approved by the department. The proposal must be submitted and approved in the prior semester, usually the third week of November or April.

CIS 491H
Honors Computer Science Project 3-0-3
Prerequisites: CIS 490, senior standing in the Honors Program and project proposal approval. A course similar to CIS 491, with a project of greater depth and scope.

CIS 500
Introduction to Systems Analysis 3-0-3
Prerequisites: statistics and differential equations. Covers a wide variety of systems-oriented approaches to solving complex problems. Illustrative examples are chosen from a wide variety of applications. Mathematical tools are introduced only to the extent necessary to understand the technique and its application to the problem. Topic areas include probabilistic and decision theory models, simulation, morphological analysis, cluster analysis, structural modeling, Delphi and dynamic system models. The role for the computer in applying these techniques to complex problems will be discussed. The student will be exposed to some of the fundamental controversies concerning the appropriateness or validity of systems approaches to human problem solving.

CIS 505
Programming, Data Structures, and Algorithms 3-1-3
Prerequisite: knowledge of at least one procedure-oriented language such as FORTRAN. Computer science students cannot use this course for graduate degree credit. Intensive introduction to computer science principles: a procedure-oriented language such as Pascal; program design techniques; introductory data structures (linked lists, stacks, sets, trees, graphs); and algorithms (sorting, searching, etc.) and their analysis. Programming assignments are included. Students who receive degree credit for CIS 505 cannot receive degree credit for CIS 114 or CIS 335.

CIS 510
Assembly Language Programming and Principles 3-0-3
Prerequisite: knowledge of at least one procedure-oriented language such as FORTRAN. Computer science students cannot use this course for graduate degree credit. An intensive course in assembly language programming including basic machine organization, the structure of instruction sets, program linkage, macros and macro libraries. Extensive programming assignments are included. Students who receive degree credit for CIS 510 cannot receive degree credit for CIS 231.

CIS 515
Advanced Computer Programming for Engineers 2-2-3
Prerequisite: knowledge of at least one procedure-oriented language such as FORTRAN. Not available to CIS majors. This course is designed for engineering students who require an extensive knowledge of programming for their project or thesis work. Topics include review of basic programming techniques, 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.

CIS 540
Fundamentals of Logic and Automata 3-0-3
Prerequisite: Math 226 or equivalent. Method and theory of logic and automata and their influence on the design of computer systems, languages, and algorithms. Covers the application of Boolean algebra to design of finite state machines; formal systems, symbolic logic, computability, halting problem, Church's thesis, and the main ideas of the theory of computation.

CIS 590
BS/MS Co-op Honors Work Experience I
3 additive credits
Prerequisite: standing and acceptance into the combined BS/MS program in computer science. Students must have the approval of the co-op advisor for the CIS department. The entire BS/MS Co-op Honors Work Experience sequence of courses must be completed with a single employer or the student cannot continue in the BS/MS internship. Provides on-the-job reinforcement and application of concepts presented in the undergraduate computer science curriculum. Work assignments are identified by the co-op division and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of each semester's work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science.

CIS 591
BS/MS Co-op Honors Work Experience II
3 additive credits
Prerequisite: standing and acceptance into the combined BS/MS program in computer science. Students must have the approval of the co-op advisor for the CIS department. The entire BS/MS Co-op Honors Work Experience sequence of courses must be completed with a single employer or the student cannot continue in the BS/MS internship. Provides on-the-job reinforcement and application of concepts presented in the computer science curriculum. Work assignments are identified by the co-op division and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of each semester's work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science.

CIS 592
Graduate Work Experience III
3 additive credits
Prerequisite: graduate standing, and acceptance by the CIS department and the division of co-op education. Students must have the approval of the co-op advisor for the CIS department. Provides on-the-job reinforcement and application of concepts presented in the undergraduate computer science curriculum. Work assignments are identified by the co-op division and developed and approved by the CIS department in conjunction with the student and employer. Students must submit, for CIS department approval, a proposal detailing the nature of the intended work. A report at the conclusion of each semester's work experience is required. Credits for this course may not be applied toward degree requirements for either the bachelor's or master's in computer science.

Cooperative Education

Coop 201
Career Development Seminar No Credit
This semester-long course is open to all sophomore through senior year students who have an interest in self-evaluation and career exploration. Students also learn effective job search strategies such as information gathering, resume and cover letter writing and interviewing skills, through discussion, group exercises, and actual practice. Guest lecturers from the private and public sectors add a "real-world" perspective to the classroom experience. The highlight of the seminar is the Externship Program, which allows each student to spend from a day to a week with a professional in their major field at the workplace to observe the work environment first hand. Offered by Division of Career Development Services.

Descriptions for undergraduate co-op work experience courses (Co-op Work Experience I and Co-op Work Experience II) are found in the course listings of the departments offering them. See list below. Graduate cooperative education courses may be found in the appropriate listing in the Graduate Catalog.

Arch 310	EE 411	ME 410
Arch 410	EET 395	MET 395
CE 311	EET 495	MET 495
CE 413	IE 310	MnE 310
CET 497	IE 411	MnE 410
ChE 310	Math 310	MNET 395
ChE 311	Math 410	MNET 495
CIS 310	Mgmt 310	Phys 311
CIS 410	Mgmt 410	Phys 411
EE 310	ME 310	STS 311
		STS 411