D H MANGNALL

NEWARK COLLEGE OF ENGINEERING

1881

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NEW JERSEY

CATALOG OF UNDERGRADUATE DAY AND EVENING PROGRAMS

1966-1967

January, 1966

DIRECTORY FOR CORRESPONDENCE

MAILING ADDRESS: 323 High Street, Newark, N. J. 07102.

TELEPHONE: Area Code 201, 624-2424.

MATTERS OF GENERAL COLLEGE INTEREST:
Address the President.

ADMISSIONS (UNDERGRADUATE OR GRADUATE):
For everything concerned with admissions, including requests for publications, and information on scholarships and student aid, advanced standing, tuition, and fees, address the Dean of Admissions. Telephone: Ext. 257.

REGISTRATION:
Address the Registrar. Telephone: Ext. 367.

ALUMNI ACTIVITIES:
Address Alumni Secretary. Telephone: Ext. 364.

CONTINUING ENGINEERING STUDIES OR CERTIFICATE PROGRAMS IN TECHNOLOGY:
For information concerning non-credit courses, address the Director of the Division. Telephone: Ext. 366 or 368.

FINANCIAL MATTERS:
Address the Business Manager. Telephone: Ext. 218.

GRADUATE PROGRAM:
Address the Graduate Division. Telephone: Ext. 277.

PLACEMENT OF SENIORS AND GRADUATES:
Address the Director of Placement. Telephone: Ext. 363.

COUNSELING:
Address the Counseling Center. Telephone: Ext. 263.

TRANSCRIPTS:
For transcripts and student grades, address the Records Supervisor. Telephone: Ext. 229.

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For information on veteran status, address the Veterans' Coordinator. Telephone: Ext. 379.

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Address the Administrator. Telephone: Ext. 243.

PLANT, EQUIPMENT, AND UTILITIES:
Address the Director of Physical Plant. Telephone: Ext. 270.

The business and administrative offices of the College are open between the hours of 9:00 A.M. and 5:00 P.M. Monday through Friday during the school year. The Registrar's Office and the Finance Office are also open evenings between the hours of 5:45 P.M. and 8:45 P.M. daily except Saturdays. During the summer program, the business and administrative offices remain open until 4:00 P.M., Monday through Friday, while the Registrar's Office and the Finance Office are open between the hours of 5:45 P.M. and 8:45 P.M., Monday through Thursday.

CATALOG OF UNDERGRADUATE DAY AND EVENING PROGRAMS

1966-1967

PUBLISHED BY
THE BOARD OF TRUSTEES
OF SCHOOLS FOR INDUSTRIAL EDUCATION
OF NEWARK, N. J.

GENERAL INFORMATION

Newark College of Engineering, instituted in 1919, is a development of the Newark Technical School founded in 1881 by the Board of Trade of Newark and civic-minded citizens. The College is a public institution supported by both the City of Newark and the State of New Jersey and is governed by a Board of Trustees appointed by the Governor of the State of New Jersey. The Governor and the Mayor of Newark are ex-officio members.

The College is organized under five divisions: the Day Undergraduate Division, the Evening Undergraduate Division, the Graduate Division, the Division of Technology and the Division of Continuing Engineering Studies. This catalog describes programs leading to the degree of Bachelor of Science offered by the Day and Evening Undergraduate Divisions.

The Graduate Division offers programs leading to the degree of Master of Science in the major engineering fields and to the degree of Doctor of Engineering Science in chemical engineering and electrical engineering. These programs are described in the catalog of the Graduate Division.

The Division of Technology offers a wide variety of courses and certificate programs for training engineering technicians. The Division of Continuing Engineering Studies provides non-credit short courses, conferences, and seminars for up-dating practicing engineers. The offerings of these two divisions are described in a separate catalog.

The College is accredited by the Middle States Association of Colleges and Secondary Schools and by the Engineers' Council for Professional Development.

The College's administrative offices are located at 323 High Street, immediately west of Newark's central business district, convenient to all transportation.

Current enrollment figures show 3771 students in the Undergraduate divisions, 1041 in the Graduate Division, and 1591 in the Divisions of Technology and Continuing Engineering Studies.

CONTENTS

COLLEGE CALENDAR: 1966-1967

The College reserves the right to make changes in this calendar.

1966

Registration — Fall Semester.....In accordance with instructions to be issued.

Fall Semester Begins.....September 21

Midpoint of Semester.....November 15

Thanksgiving Holidays.....November 23 to 26 inclusive.

Christmas Holidays .....December 21 to January 3 inclusive

1967

Fall Semester Ends.....January 28

Registration — Spring Semester.....In accordance with instructions to be issued.

Spring Semester Begins.....February 8

Washington's Birthday Holiday.....February 22

Good Friday .....March 24

Midpoint of Semester, except for February Freshmen.....April 4

Spring Vacation.....April 10 to 15 inclusive

Spring Semester Ends for February Freshmen.....May 29

Memorial Day Holiday.....May 30

Last Day of Attendance for Seniors.....June 1

Registration for Summer Semester —February Freshmen.....June 5

Spring Semester Ends for all students except February Freshmen and Seniors ..... June 6

Summer Semester Begins for February Freshmen ..... June 7

Commencement (tentative) ..... June 8

*Registration — Evening Undergraduate Summer Session ..... June 13

Evening Undergraduate Summer Session Begins ..... June 14

Independence Day Holiday ..... July 4

Summer Semester Ends
for February Evening Freshmen .... August 22
for February Day Freshmen ..... August 22

Evening Undergraduate Summer Session Ends ..... August 31

*The Evening Undergraduate Summer Session Announcement will be available at the Office of the Registrar on or about April 1.

1966

1966 SEPTEMBER 1966						
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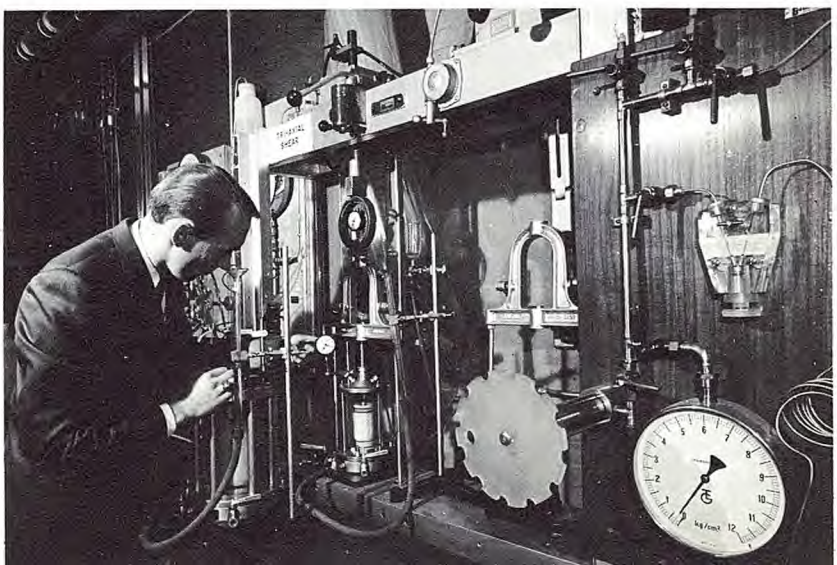

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PROFESSOR MISRA
PROFESSOR RIGASSIO
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COMMITTEE ON RESEARCH GRANTS

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PROFESSOR ORENS
PROFESSOR RUSSELL
PROFESSOR SIZELOVE
PROFESSOR THOM
PROFESSOR WORKMAN
PROFESSOR ZATZKIS

HISTORY OF NEWARK COLLEGE OF ENGINEERING

The history of Newark College of Engineering and of its predecessor, the Newark Technical School, closely parallels the technological growth of New Jersey and the nation over the past eighty years. Created originally to meet the demands of Newark's expanding industry in the 1880's, the Technical School and subsequently the College have been in a continuous process of development, as industry has developed, ever since.

During his term as governor of New Jersey, General George B. McClellan became convinced that the path to industrial supremacy lay in a broad system of technical education that would supply a skilled labor force. In 1879 the Civil War general therefore proposed to the legislature that funds be allocated by the State to aid in the establishment of technical schools.

In Newark, New Jersey's leading industrial city, the Board of Trade had been contemplating a technical school since 1875.

Thus, in 1881, the Board of Trade's ambitions were finally realized with the passage of the first successful legislation in the United States to provide state aid for technical education. The Newark Board was quick to act. Spearheaded by such prominent

citizens as inventor Edward Weston, school superintendent William Barringer and former congressman Thomas B. Peddie, the organization launched its campaign to bring the school into reality.

As a result, the Newark Technical School opened its doors on February 9, 1885, with Professor Charles A. Colton as its director. Its aim was to develop men who could eventually assume positions of leadership in Newark's many industries.

By offering its courses during the evening, the new technical school sought to help those who could not otherwise afford to attend. Its students, who usually worked ten hours a day, attended classes five nights a week, where they studied a hard-core curriculum of science and mathematics. At a time when many thought that technical education should consist mainly of manual training, Director Colton, backed by a sympathetic board of trustees, was determined to emphasize for his students training in scientific and technical disciplines.

Of the 106 students who began classes in 1885, only 16 were graduated in 1888. Their subsequent success, however, surpassed the expectations of the founders of the School and bore out the wisdom of Dr. Colton's approach to technical education. Many of the graduates continued their studies in leading colleges, entered various professions and rose to positions of leadership in their communities.

The success of the young School soon caused its modest rented facilities to be overtaxed. Dr. Colton appealed to the citizens of Newark to contribute funds to enable the School to erect its own building. Through the donations of a number of prominent Newarkers the money was quickly raised and in 1897 the Newark Technical School moved into its own somewhat more spacious quarters on High Street on the site of Newark College of Engineering's present campus.

With these expanded facilities, Dr. Colton was able to offer various special courses in addition to the regular curriculum. Jewelry design, architectural drawing and electricity, for example, were set up to meet the special demands of Newark's industries. As new programs were added, the basic technical curriculum was also constantly upgraded to conform to the progress of technology.

In the final years of his administration, Director Colton initiated plans for a day college program. But in 1918, exhausted by 34 years of dedicated service, he expressed his wish to retire. He left that year, highly honored by those who had worked with him through the crucial, formative period of the School's development.

The Board of Trustees carried Dr. Colton's plans forward and in 1919 the State Board of Education authorized the School to grant degrees in engineering. That fall a day college program was begun with a class of 40.

In 1920, Allan R. Cullimore, formerly dean of the College of Engineering at the University of Delaware, became Director of the Newark Technical School and Dean of the College. Dr. Cullimore strongly believed that engineering education should stress an understanding of human relations as well as technical knowledge. To fill this dual requirement, he established a co-operative program with industry, in which students spent alternate periods at the College and in industrial plants. He believed that through such first-hand knowledge of the human-relations aspect of industry, his students would be more mature by the time they graduated and thus better equipped to cope with engineering problems.

As advancing technology increased its demands upon the engineer's knowledge the co-operative plan was dropped in the late 1930's in order to permit students to devote full time to their studies. To compensate for the change, Dr. Cullimore introduced into the curriculum a strong program of professional development, designed not only to make students aware of the "human relations" element in industry but also of their own individual responsibilities as citizens. Dr. Cullimore especially believed that engineers were equipped, through their particular type of education, to make special contributions of service to community, state and nation.

Over the years, the program has become such a strong element of NCE's curriculum that in 1960, on the occasion of the College's 75th anniversary, the motto "Dedicated to Education in Engineering and Citizenship" was established as a permanent statement of the College's governing philosophy.

While the College was developing its day program, the Technical School, continuing to operate at night, had also been growing. In addition, Dr. Cullimore began to realize the need for an evening degree program, and in the late 20's an evening undergraduate program was instituted which today serves over 1,000 students.

While the Newark Technical School is still a legal entity, its function has gradually undergone a metamorphosis into the Division of Technology of the College. This division, today, continues to offer terminal technical programs for the special needs of industry. Advanced conferences for graduate scientists and engineers are given by the Division of Continuing Engineering Studies.

During and after World War II, due first to the federal government's need for the rapid training of thousands of defense workers, and later for the retraining and rehabilitation of

returning veterans, NCE became an important center for such help.

To further assist returning veterans, the College, under Dr. Cullimore's leadership, established a Testing and Guidance Center in 1943. Working in cooperation with the Veterans Administration, this service gave help to thousands of veterans through 1951, when it was reorganized as the Newark College of Engineering Counseling Center. The Center now provides counseling and guidance to industry, high schools, students of the College and the general public.

Originally open only to residents of Newark, the Technical School began admitting non-residents in 1897. By the late 20's the majority of the students both of the College and the Technical School were non-residents. Although financed by the City of Newark and by the State, the institution was still receiving most of its funds from Newark. Accordingly, Dr. Cullimore appealed for more State support. Gradually over the years the amount of support has shifted and today, while the City of Newark still supports the institution, most of the public support is received from the State.

Since World War II, the College has experienced a steady expansion of its facilities so that today it has six buildings in use; four under construction, to be ready for occupancy this year; two more, authorized in November, 1964, to be ready in 1967; and still more in the planning stages scheduled for completion in 1970.

Most of this major expansion has taken place under Dr. Robert W. Van Houten, a graduate of the College, who served as acting president for two years and who succeeded Dr. Cullimore as President in 1949. The tremendous growth of the nation's technology since the War has not only necessitated these new facilities, but has also stimulated the College's development in other directions. Thus, the College's graduate program, begun in 1940, has developed during the last few years into one of the largest in engineering in the nation, granting both the master's and doctoral degree.

In addition, the Graduate Division works closely with a major adjunct of the College, the privately financed and separately administered Foundation for the Advancement of Graduate Study in Engineering, established in 1959, which coordinates various projects among graduate students and faculty that seek to further the frontiers of science and engineering technology.

Today, Newark College of Engineering has a foremost reputation among its peers throughout the country as it continues to fulfill the wishes of General McClellan and of those dedicated members of the Board of Trade who in the 1880's had the vision and determination to establish a technical school in Newark.

FACILITIES

BUILDINGS

From its original modest building on West Park Street, Newark College of Engineering has now expanded to six edifices along High Street, Summit Street, Summit Place and Bleeker Street in the heart of Newark. The first of the buildings to be erected at the present site was a combination administration and classroom building, designated Weston Hall in honor of Dr. Edward Weston, one of the founders of the institution, which was torn down in 1958 to be replaced by a new Weston Hall, completed in 1960. The College soon outgrew the facilities of the original building and there was built on adjoining property a four story laboratory building now known as Colton Hall, which contains equipment used in the courses, and also provides classroom, lecture and drafting room space. The continued expansion of the College necessitated the construction of Campbell Hall in 1926 and a five story Campbell Hall annex in 1930.

Still greater work areas were found necessary immediately following the Second World War, and a five story extension to Colton Hall was built which houses departmental offices and laboratories. The expansion of administrative and student facilities also occasioned the purchase of the former Newark Orphan Asylum property at the corner of Bleeker Street. This century old building was rehabilitated and named Eberhardt Hall in honor of Frederick L. Eberhardt, former chairman of the Board of Trustees of the College.

Additional facilities were completed in the Spring of 1958 with the opening of Cullimore Hall, a six story building at the rear of Eberhardt Hall, containing a new cafeteria, student commons, and 37 classrooms, as well as other offices and college services. With the completion of the new Weston Hall, a seven story building, 15 laboratory areas, an enlarged Library, and a 400-seat lecture hall were added to the College plant.

In 1956, the College also acquired a building situated at 240-250 High Street through the philanthropy of Mr. Martin F. Tiernan, which after extensive remodeling became occupied by the departments of Chemical and Civil Engineering for laboratories, offices, and classrooms. This is the Martin F. Tiernan Laboratory Building.

As one of New Jersey's eight state-supported higher educational institutions, Newark College of Engineering has received the sum of $9,631,000 from two recent bond issues which is enabling the College further to expand its facilities between now and 1967 in order to take care of the greatly increased need for opportunities in engineering education created by the State's expanding college-age population.

This year the College will occupy a Center with dining facilities for 900 students, a bookstore and complete facilities for student organizations; a physical education building with three gymnasiums, a swimming pool and outside tennis courts and a playing field; a major academic building to house the Department of Electrical Engineering; and an Alumni Center for Continuing Engineering Studies, a gift to the College by the NCE Alumni Association.

Ground has been broken for a library-humanities building and a two-story maintenance building to be completed in 1967.

COUNSELING CENTER

The Counseling Center exists primarily to assist students in two ways: first, to help them understand and deal with problems which may be interfering with their satisfactory scholastic progress; and secondly, to help them plan thoughtful and responsible action regarding their educational and career choices. Noteworthy services of the latter kind are the pre-employment career counseling of seniors and of students who, for any reason, may have to leave the College. These confidential services are free to undergraduate students of the College.

Students may themselves request counseling whenever the Center is open. Students may be referred for counseling by the Dean of Students, the Assistant Dean of Students, and members of the faculty.

The Center is located in especially designed rooms on the third floor of Eberhardt Hall. In addition to experienced professional counselors, its staff includes a trained psychometrist who administers standard psychological and other tests, and scoring and stenographic assistants. Its facilities provide privacy for counseling and for individual or group testing, including the testing of vision.

The Center dates from 1943, when the first of over 14,000 veterans were counseled for the Veterans Administration. Since 1943, about 30,000 persons and many business and industrial firms have used the services of the Center.

The Center's community services, all by appointment (see inside front cover), include: (a) the educational and career counseling of 11th and 12th grade students, college students and out-of-school adults; (b) the evaluation for business and industry of applicants for employment and of employees for promotion, training, or transfer; (c) educational counseling for the parents of 8th, 9th, and 10th grade students who are too young for career counseling; and (d) individual testing and score reporting for applicants to graduate schools which require the Miller Analogies Test, the Minnesota Engineering Analogies Test, or the

Doppelt Mathematics Reasoning Test. Counseling and testing fees reflect the cost of providing each service.

The Center is open from 9 a.m. to 5 p.m. Monday through Friday, as well as one evening each week (for evening students) and by appointment on occasional Saturday dates.

LIBRARY

The College Library occupies the third floor of Weston Hall. The reading room has seating accommodations for two hundred students and provides an environment suitable for serious study. Display cases exhibiting the late Dr. Edward Weston's early electric equipment and inventions occupy a small portion of the room.

The book collection consists of over 46,000 bound volumes and a considerable number of unbound periodicals, government bulletins, and miscellaneous booklets. Over five hundred fifty periodical titles are received regularly on subscription. Books and magazines are selected with special emphasis on the fields of study offered by the College; in addition, books and magazines are constantly being acquired in literary and cultural subjects. Students are encouraged to expand their scope of knowledge through extensive reading in all areas.

To augment the resources of the College Library, students have access to other excellent libraries: The Newark Public Library grants limited book-borrowing privileges to students attending the College, the Public Service Corporation Library is available for limited use; the libraries of the Engineering Societies and the Chemists' Club, and the New York Public Library all permit students to use their facilities.

Country-wide interlibrary loan relationships, together with the availability of microfilm and copying services further extend the volume of printed information for research and study.

Memorial gifts from the personal libraries of men formerly associated with the College have been received. Foremost among these gifts are books and periodicals from the collections of former Trustee Dr. Edward Weston and State Senator Roy V. Wright.

The Library is open for service on all days when classes are in session, between the hours of 8:30 a.m. and 10:00 p.m. and on Saturdays during the fall and spring semesters from 9:00 a.m. to 4:00 p.m. Holiday and recess period hours are posted on the bulletin board located at the Library entrance.

OBJECTIVES

Newark College of Engineering is founded upon the philosophy that education in scientific, technological, and humanistic studies should be provided for those young men and women who have interest and ability, irrespective of their financial situation. The College is in effect a community project. As a result, there has been developed here an institution which enjoys a well earned reputation for academic excellence. It has conceived that its function lies in the development of sound, well trained engineers and citizens at the lowest cost consistent with high technological quality.

The factors involving this democratic education available to young men and women of capacity are the basic American concepts of:

1. Character
2. Initiative
3. Hard work
4. Understanding human relations
5. A knowledge of fundamentals of applied science

The vision and foresight of its founders have been amply evidenced in the service that the College has performed to supply the needs of ever-expanding industry for engineering personnel.

The College maintains close contact with industry and passes on to its students the important and fundamental objectives of the industries and their attitudes toward modern engineering techniques. This is accomplished by lectures from industry, by the Professional Development program and placement service which arranges to have qualified students placed in plants during their summer vacations for practical experience, and by the use of professors and instructors who in addition to their academic background have had extensive professional experience.

The College feels that the development of a sensitivity in the students on the importance of dress and good grooming is a part of the social, technical and professional disciplines which constitute engineering education. The College therefore requires that all male students shall wear the customary items of dress, including shirt, tie and coat in all places of assembly such as corridors, dining halls, and formal classes and that women students shall also be suitably attired. Certain concessions can be made during continuous warm weather and in laboratories, drafting rooms, and on field trips.

The College requires that every student shall conduct himself with decorum and shall constantly adhere to ethical and professional behavior. No student may use or give any unauthorized aid in any test, report, or assigned paper. All work offered as the student's own must be the work of the individual student. Instances of alleged unethical or unprofessional conduct will be brought to the attention of the appropriate College authorities for investigation and action.

PROGRAMS

DAY AND EVENING UNDERGRADUATE DIVISIONS

The College offers four-year undergraduate curriculums in Chemical, Civil, Electrical, Industrial and Mechanical Engineering.

Much of the subject matter in the undergraduate programs of study is common to all of them (although course titles may be different). These common courses represent the unity in all branches of engineering of basic sciences, mathematics, humanities, and engineering science.

The work of the first two years of the Day Division has been designated as the Junior Division. The work of the third and fourth years, being predominantly in the departments of Chemical, Civil, Electrical, Industrial and Mechanical Engineering, is known as the Senior Division.

The evening program of Newark College of Engineering is also divided into two sections. The first four years of work come under the heading of the Junior Division (Evening). This division has the same entrance standards and requirements as the day program, and the work taken during the evening hours parallels the subjects studied in the first two years of the undergraduate day division. The program of the Senior Division is approximately four years in length if taken on a full evening schedule, and completion of these courses under the same standards as in the day third and fourth year programs will lead to the bachelor of science degree.

Courses for which less than fifteen students are enrolled may not be given. Students may not register for part of a course.

For information concerning programs consult or write the Dean of Admissions.

HONORS PROGRAM

An Honors Program at Newark College of Engineering has been established in the Day Undergraduate Division in all four years and all five curriculums. Students in the freshman and sophomore years may participate in Honors courses in Mathematics and in English and Humanistic Studies with the recommendation of members of the faculty; aptitude tests and high school records are used as corroborative selective criteria. Such Honors courses, appropriately designated, are described under the offerings of their respective departments. Students in the junior and senior years may participate in a program involving concentrated course work, summer honors reading and course work, special lectures, and individual course or laboratory work,

with the recommendation of members of the faculty; college records are used as corroborative selective criteria. In certain cases, students in the Program may, with the approval of the department concerned, substitute graduate courses for courses in the regular undergraduate curriculum. The Honors Program is guided by a faculty committee and special advisers within each department involved.

GRADUATE DIVISION

Newark College of Engineering offers courses at the graduate level leading to the degree of Master of Science in the fields of Chemical, Civil, Electrical, Management, and Mechanical Engineering, and the degree of Master of Science without designation. A program of courses and the opportunity for research, leading to the degree of Doctor of Engineering Science, are also offered in the fields of Chemical and Electrical Engineering.

Graduates of accredited institutions who wish to enroll in programs of advanced study may obtain further information by requesting the Division's *Catalog of Graduate Programs.* (See inside front cover.)

Specially qualified seniors at Newark College of Engineering may take courses in the Graduate Division before graduation under certain specified conditions. Information as to these conditions may be obtained from the Director of the Graduate Division.

The College encourages well-qualified students to consider full-time graduate study. Fellowship support sponsored by the College, by the Federal government and by industry is available. The College and the Foundation for the Advancement of Graduate Study in Engineering also sponsor a combined program of research, teaching and study leading to the master's degree. Inquiries concerning these programs should be directed to the Graduate Division.

FOUNDATION FOR THE ADVANCEMENT OF GRADUATE STUDY IN ENGINEERING

The Foundation for the Advancement of Graduate Study in Engineering, a privately incorporated and financed organization, serves as a coordinating agency for research activities at the College. One of the Foundation's major objectives is to offer the opportunity for professional development to graduate students and members of the teaching staff by providing for or obtaining support for research activities. The staff of the Foundation assists with the preparation of research proposals, solicitation of financial support, and administrative details involved in research programs.

COMPUTING CENTER

The Computing Center is an inter-departmental laboratory for the use of students and staff of all divisions of the College. The equipment consists of an analog computer and a modern high-speed digital computer with peripheral card-handling devices. The computers are capable of obtaining numerical solutions to a wide range of engineering and scientific problems as well as the processing of data for general business operations.

Instructions in computer programming and operation are given at various times during the school year as an integral part of the college curriculum and also through a number of special courses. Those who have taken these courses may, through their instructors, reserve time on the computer for their problems. The staff of the Center is available for consultation in problems of programming and operation.

DIVISION OF TECHNOLOGY

Individual courses and two and three year certificate programs are offered for men and women in industry who wish to further their technical, scientific, or mathematical training, but who are not concerned with credits toward a degree. One hundred fifty courses in architectural, building construction, civil, industrial, chemical, and plastics technologies, as well as metallurgy, refrigeration and air conditioning, and machine and tool design are offered under the supervision of various departments of the College. These courses are conducted in the evening and on Saturday for twelve-week terms which begin in the fall, winter, and spring. The certificate programs are designed to prepare persons for placement as engineering technicians.

DIVISION OF CONTINUING ENGINEERING STUDIES

The educational programs arranged by this division are intended to fulfill the requirements of practicing engineers, scientists, and those in management for information on scientific analysis and modern mathematical techniques in solving more complex engineering problems. This is accomplished by offering short courses and seminars which illustrate present theory and applications. Other new information, such as that resulting from current research and development in various fields, is announced periodically and given through lectures, conferences, and symposia and may be presented during the day or in the evening. The Division works closely with many professional organizations and societies and especially with groups of industries to fulfill needs for specialized training programs which are not for credit toward any degree. Such requirements may be discussed with members of the Division staff.

CRITERIA FOR GRADUATION

DEGREES

Newark College of Engineering reports to and receives the right to grant degrees from the New Jersey State Board of Education.

Candidates for graduation who satisfactorily complete a regular undergraduate course of study and the examinations required receive the degree of Bachelor of Science (B.S.) in the course pursued.

While passing marks are required as a minimum in all subjects undertaken, barely passing marks alone do not insure graduation.

To be eligible for graduation, a student must attain a grade point average of 2.00 in all the courses listed in this catalog as being required in the third and fourth years of the engineering department in which he desires to earn a Bachelor of Science degree.

The catalog of the Graduate Division states the requirements for the degrees of Master of Science (M.S.) and Doctor of Engineering Science (Engr. Sc. D.).

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

Each prospective candidate for any degree must file an Application for Candidacy prior to the opening of the spring semester of the year in which the candidate expects to graduate.

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

GRADES

Grades used in the College and their general significance are as listed below:

GRADE	SIGNIFICANCE
4	Superior
3	Above average
2	Satisfactory
1	Minimum for credit
O	No credit

INC "Grade deferred"—given in *rare* instance for students who would normally complete work, but because of special circumstances *could* not. If this grade is not removed within the next regular semester, a grade of O will result.

R Resigned

W Withdrawn.

ADMISSIONS

APPLICATION

Candidates for the Freshman Class must submit an application for admission and a certified secondary school record on forms provided by the Office of Admissions. Forms normally employed for that purpose by the secondary school submitting the record may also be used for the scholastic record. A $10.00 application fee must accompany the application.

SCHOLASTIC RECORD

The certified record must include the date of graduation; or if the record is submitted prior to graduation, a certificate of graduation must be submitted before final acceptance can be granted.

Failure on the part of the applicant or the secondary school to provide complete information may delay consideration of the application.

In lieu of a certificate of graduation from an approved secondary school, a candidate may offer a high school equivalency certificate as issued by the New Jersey State Board of Education.

REQUIREMENTS

Engineering requires more than mere technical ability. Graduates of engineering colleges are expected to be well versed not only in mathematics and science but also in English and social studies. The curriculums in accredited engineering colleges are designed with this goal in mind, and experience has proved that applicants for admission need an all-inclusive secondary school background.

Candidates for admission must submit a minimum of 16 secondary school units:

Ten are required:

English	4 units
College preparatory mathematics, including algebra, geometry, and trigonometry	4 units
Physics	1 unit
Chemistry	1 unit

The remaining 6 may be submitted from among the following as indicated:

Foreign Language	2 to 5 units
Social Studies	1 to 5 units
Science and Mathematics in addition to required units	1 to 3 units
Any other subject having a value of one full unit	1 unit

In selecting applicants for admission from among those who meet the entrance requirements listed above, preference will be given to those who submit two or more units in one foreign language.

Candidates should plan to take the Scholastic Aptitude Test of the College Entrance Examination Board, the entrance examination required of all applicants, in December or January of their senior year. In addition, day freshmen candidates are encouraged to take achievement tests in Mathematics (Level 1) and either Physics or Chemistry. Applications and information on fees and dates of examinations can be obtained from the College Entrance Examination Board, Box 592, Princeton, New Jersey.

Since increasing enrollments are causing existing facilities to be used to the utmost, legal residents of the State of New Jersey will be given preference in acceptance. A limited number of non-residents of New Jersey may be accepted for admission.

ADMISSION BY TRANSFER

Students who have pursued studies at accredited colleges or universities offering comparable programs and who have demonstrated by their previous records that they are capable of doing academic work of the high caliber which would enable them to earn a degree at Newark College of Engineering may be admitted with advanced standing. Credit may be given for completed courses that are equivalent to those in the curriculum for which the applicant is accepted, and in which he has earned final grades higher than the lowest passing grade.

Candidates who have previously attended another institution giving courses above the secondary school level must comply with all the regulations set forth for candidates for the first year class, including the scores earned on the Scholastic Aptitude Test of the College Entrance Examination Board and, in addition, submit official transcripts and statements of honorable dismissal from all institutions which they have previously attended.

SPECIAL STUDENTS

NON-MATRICULATED STUDENTS

Although the College usually recommends a program of studies leading to a degree, applicants who fulfill all the admission requirements may, with the approval of the Admissions Office, choose courses without following a degree program. Official transcripts of record for non-matriculated students will list subjects completed, grades earned, and the credits which will be granted if the student matriculates.

AUDITOR

Permission to enroll as an auditor may be granted by the Admissions Office to mature students who can demonstrate that they are qualified to take and profit from the courses for which they desire to register. Auditors receive no grade or academic credit but may receive a statement of their attendance in the course.

ENROLLMENT

Those who wish to be considered for enrollment as Special Students may receive instructions as to the procedure to be followed by writing to the Office of Admissions.

Special Students approved for enrollment will be permitted to register for courses in which there is still room available after all degree candidates have completed their registration.

PRE-COLLEGE GUIDANCE

Since students of Newark College of Engineering are in the main graduates of secondary schools located in the northeastern part of New Jersey, personal communication with those likely to be candidates for admission is readily maintained. Members of the Admissions Staff make scheduled visits to all the schools in the area and in addition make every effort to accept invitations to participate in guidance programs or to talk informally with groups of students. A class characteristics study of the most recently admitted class and a follow-up report of their graduates already enrolled are sent annually to the high schools concerned.

High school and junior high school students are encouraged to visit the Admissions Office for an interview or to be escorted on tours of the buildings. Members of Alpha Phi Omega, national college service fraternity, act as guides for these tours. Arrangements can be made for guided tours or interviews by telephoning the Admissions Office, 624-2424, Ext. 257.

The Counseling Center also participates in pre-college guidance. For details, refer to the section "Facilities."

INTERVIEWS

An interview may be required of any candidate to assist in determining his probable fitness to do engineering college work. The date and time of the interview will be arranged by the Dean of Admissions.

EXPENSES

TUITION AND FEES

Day Division

As a public institution receiving support from the State of New Jersey and the City of Newark, and having no general endowment funds, it is incumbent upon Newark College of Engineering to establish its tuition and fees at a level which will maintain the proper relationship between the responsibilities of the State, the City, and the direct beneficiary, the student.

To preserve the equities of all interested parties, it is necessary for the College to adjust its tuition charges from time to time as educational costs become affected by changing economic conditions.

	Charges per Semester	
	New Jersey Residents	*Non-Residents*
Tuition*	$193.00	$386.00
Regular Fees		
Registration	10.00	10.00
Student Activities & Facilities Fee	17.00	17.00
Total Tuition and Regular Fees per Semester	$220.00	$413.00

*Tuition includes charges for services other than instruction, such as library, publications, counseling, placement, etc., but does not cover the breakage or loss of College property.

Tuition charges are somewhat higher for special programs of study differing from those shown in this catalog.

APPLICATION, MATRICULATION AND SPECIAL FEES

Day Division

ADMISSION APPLICATION FEE

Each candidate for admission to the College must pay an APPLICATION FEE of $10.00 at the time the application for admission is submitted. The fee is not returnable, regardless of whether or not the applicant is admitted to the College. This fee covers service which is necessary to evaluate applications for admission.

READMISSION APPLICATION FEE

Any applicant for readmission to Newark College of Engineering must pay a READMISSION APPLICATION FEE of $10.00 at the time the Application for Readmission form is submitted. (See section "Readmission," page 44.) This fee is not returnable, regardless of whether or not the student is readmitted to the College. This fee covers service which is necessary to evaluate applications for readmission.

MATRICULATION FEE

All students entering the College for the first time as candidates for a degree are charged a MATRICULATION FEE of $5.00.

LATE REGISTRATION FEE

Registration is required for each semester. A LATE REGISTRATION FEE of $10.00 is required of those who register late.

PHYSICAL EXAMINATION FEE

A fee of $10.00 is charged if, at the discretion of the College, it seems advisable for the student to be given a physical examination.

LABORATORY FEE

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

SCHEDULE CHANGE FEE

A SCHEDULE CHANGE FEE of $3.00 is charged when a student requests a schedule change for reasons other than those beyond his control.

CHANGE OF GRADE FEE

A fee of $1.00 is charged for the removal of a grade of "INC."

SPECIAL EXAMINATION FEE

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

GRADUATION FEE

A GRADUATION FEE of $25.00 is required of all candidates for the Bachelor's degree; and a graduation fee of $25.00 for advanced degrees. The graduation fee includes cost of rental of academic dress.

Health and accident insurance is made available to full time day students at a reasonable cost. See page 52.

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

For the first semester of the freshman year, books cost approximately $70.00 with an additional $50.00 covering the cost of a slide rule, drawing instruments and general supplies for that semester. Books and supplies for the second semester of the freshman year will cost approximately $50.00.

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

EVENING DIVISION

Information concerning expenses for the Evening Division will be found on pages 72-74.

PROCEDURES

REGISTRATION

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

Students entering the College for the first time are required to submit before registration a *completed physical examination form* which will be furnished by the Registrar. The form must be prepared by a physician within a thirty-day period preceding registration for the first semester. Each examination will be reviewed by the College physician.

Currently enrolled students will be informed of registration procedures (during July for the Fall Semester and during January for the Spring Semester) by the Registrar.

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

Failure to complete registration by the close of the registration period will make the student subject to payment of a late fee. (See page 43.)

CHANGE OF PROGRAM

A student who adds a course, or courses, to his program will be charged the full tuition and fee for the course, or courses, added, regardless of the date on which the addition takes place. If, *within the first two weeks of the semester,* a student changes his schedule, he must fill out a set of schedule change forms and see to it that they are properly authorized. His charges will then be recalculated and, if he is entitled to a refund or financial credit, such refund or credit will be made.

After the first two weeks of the semester any change of program will be considered a withdrawal from a course (or from the College) and the student should follow the procedures stipulated in the section "Withdrawals and Refunds."

READMISSION

Students of any of the groups listed below who wish to resume their studies at the College must apply for readmission:

1. Students who withdraw from the College during any semester and wish to return for the next or any succeeding semester,
2. Former students who have not been in attendance for one or more semesters, and

3. Students who have been dismissed for academic reasons.

Students who have been dismissed for academic reasons are not eligible for readmission until one semester has elapsed since the time of their dismissal. The results of a recent series of aptitude tests (which can be arranged at no cost to the applicant) must be on file at the Counseling Center. This is mandatory for both Day and Evening students.

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

For the Fall Semester	August 15
For the Spring Semester	January 15
For the Summer Session	May 15

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

TRANSCRIPT OF GRADES

A semester grade record is issued to the student by the Registrar at the end of each semester. Students who wish to have a Transcript of Record issued on their behalf must submit a request in writing to the Records Supervisor. Transcript requests must be accompanied by a payment fee of $1.00 for each copy. Grades are discussed fully in the section "Criteria for Graduation."

WITHDRAWALS AND REFUNDS

WITHDRAWAL PROCEDURE

Registration for a course places a definite responsibility upon the student to carry the course through to conclusion and to receive the grade he has earned. However, it is recognized that in exceptional cases it may be impossible for the student to continue in attendance. If a student wishes to withdraw from a course, or courses, or from college, he should notify the Dean of Students in writing, using a form to be obtained from his office or from the Registrar.

A student may resign from any subject during the first eight weeks of the term, or equivalent, and receive an "R" in any subject from which he resigns. After the first eight weeks, or equivalent, when an instructor has reason to believe that a student is no longer in attendance and if the student's class standing at the time of last attendance is 2 or better, the instructor will report a grade of "W"; if below a 2, the instructor will report a grade of "O," except that if the withdrawal comes within the last four weeks, or equivalent, of the semester, the

student will be given the grade earned as of the end of the semester.

Should a student be forced to withdraw due to causes beyond his control, the matter should be promptly referred to the Dean of Students for consideration.

The receipt of the notice by the Dean of Students will be considered as the date of the withdrawal.

Students withdrawing from a course, or courses, or from college, should adhere strictly to the general regulations as stated above.

WITHDRAWALS FROM COLLEGE—SELECTIVE SERVICE

Any student who is forced to withdraw from college because of induction by selective service is entitled to a pro rata refund as of the date of his induction. If his induction occurs after the middle of a semester, certain options are available to the student, and he is advised to confer with the Dean of Students concerning particulars. In order to obtain a refund in a case of induction, a student should submit a copy of his notice of induction with the notice of withdrawal.

WITHDRAWALS FROM COLLEGE—GENERAL

Students who withdraw from College of their own accord will receive a refund based upon the following schedule, provided that a signed withdrawal application has been received by the Dean of Students. The date of withdrawal will be the date upon which the application has been received by the Office of the Dean of Students. Refunds will not be granted for withdrawal applications received after the fifth week, except in cases of military induction as is explained elsewhere in this catalog. Applications for withdrawal may be obtained from the Registrar or from the Office of the Dean of Students.

REFUNDS

Matriculation fees, registration fees, and all other fees except laboratory and general fees, are under no condition returnable.

The percentage of tuition and general fee refunded will be based on the following table:

Date of Receipt of Application	*Percentage Refund*
During the first week of the term	80%
During the second week of the term	80%
During the third week of the term	60%
During the fourth week of the term	40%
During the fifth week of the term	20%
During the remainder of the term	0%

The above schedule applies only to the regular fall and spring semesters but will also be used as a guide to compute comparable percentage refunds for short terms, such as during a summer session.

SCHOLARSHIPS, AWARDS AND STUDENT AID

SCHOLARSHIPS AND AWARDS

Through the years the College has received applications from students who have shown a definite need for financial assistance in meeting their college expenses. For such needy young men who also possess the ability to carry on engineering study satisfactorily, certain scholarships are available.

Most of the following scholarships are available to full time students registered in the Day Division. It is expected that since evening students will be engaged during the day in income-producing occupations, there will be few cases where scholarship assistance is actually required.

Alcoa Foundation Scholarships

Four scholarships of $250 a year have been established by the Aluminum Company of America for junior and senior students who stand high scholastically in their class and show a potential of becoming successful engineers in their particular field.

American Society of Tool Engineers Scholarship

Northern New Jersey Chapter 14 of the American Society For Tool & Manufacturing Engineering will award two scholarships of $150 each to two students of sound scholastic ability who have a need for financial assistance and who are majoring in mechanical engineering.

Board of Trustees Scholarships

A limited number of scholarships in the amount of $100 each are made available each fall and spring semester by the College Board of Trustees.

Blonder-Tongue Foundation Award

A scholarship of $250 has been established for award to a senior in electrical engineering in recognition of high scholastic attainment and the demonstration of outstanding potential in the fields of radio and television (electronics).

Boy Scout Scholarships

The Board of Trustees has granted two scholarships, the recipients of which are to be chosen from scouts in Newark, Belleville and Irvington by the Robert Treat Council of Boy Scouts of America.

James Francis Cochrane Scholarship Fund

A four year scholarship is awarded in memory of James Francis Cochrane, alumnus. The award, based upon an endowed fund established by his mother, Mrs. Josephine

M. Cochrane, is made to a graduate of East Orange High School or Clifford J. Scott High School. If a qualified candidate cannot be found from these two institutions, the Dean of Students may select a candidate from another New Jersey high school.

ESSEX ELECTRICAL LEAGUE SCHOLARSHIP

The Essex Electrical League annually awards a $500 scholarship to a third year electrical engineering undergraduate for his senior year. To be qualified, a student must be a resident of Essex County, N.J. and demonstrate both high scholarship and financial need.

EVA COHN SCHOLARSHIPS

By the will of Eva Cohn a few scholarships are available for worthy and capable students in financial need.

COLTON MEMORIAL SCHOLARSHIP

A Colton Memorial Scholarship, established in memory of Dr. Charles A. Colton, first director of the Newark Technical School, is awarded each year by the Scholarship Fund Trustees of the Newark College of Engineering Alumni Association, in the amount of $400, to a member of the Freshman class. Applicants will be considered on the basis of high school record, College Board scores, and need.

ALLAN R. CULLIMORE MEMORIAL SCHOLARSHIP

A scholarship in memory of the late Dr. Allan R. Cullimore, former president of the College, is awarded annually by the Scholarship Fund Trustees of the Newark College of Engineering Alumni Association. This scholarship, in the amount of $400, will be awarded in the Spring semester to the Junior class member having the highest grade-point average in the Class during the first five semesters at NCE.

JOHN CHRISTOPHER DENMAN SCHOLARSHIP FUND

This fund has been established to provide a scholarship for an evening school student who wishes to take professional work at NCE.

ESSEX COUNTY ENGINEERING SOCIETY SCHOLARSHIPS

The Society will provide one or more scholarships in the amount of $200.00 annually, divided equally between two successive semesters. The student must have maintained a satisfactory academic record through one or more years at this institution and must need financial assistance.

Other things being equal, the son or daughter of a professional engineer will be given preference. The student must be willing to take such tests as may be requested

by the college committee appointed to select the recipient. The recipient will automatically become the nominee for the same award for the next year unless he no longer requires financial assistance, in which case the award will be made to another qualified student. The final selection of each candidate will be made by a committee of the faculty of the college.

Foley Machinery Engineering Scholarship

The Foley Machinery Engineering Scholarship of $500 is awarded annually to a male undergraduate in Civil, Electrical, or Mechanical Engineering for the junior year. The award winner must be a resident of one of the 13 northern counties of New Jersey and will be selected on the basis of promise in his field of engineering, leadership, character, personal and academic achievement, and financial need.

General Motors Corporation Scholarships

One General Motors Corporation Scholarship to Newark College of Engineering is awarded each year to an entering freshman. The amount of the award is flexible, depending upon the need of the individual for financial assistance, and ranges from an honorary award of $200 up to $2000 per year. The scholarship is renewable for four years providing the recipient maintains a high academic record.

Herbert P. Gleason Scholarships

By the will of Herbert P. Gleason several scholarships are available from time to time for young men of character and ability.

The Irvington Optimist Club Scholarship

The Optimist Club of Irvington offers annually a $350 scholarship at Newark College of Engineering to a senior boy in one of the high schools in Irvington, New Jersey.

A committee of school personnel determines the winner and an alternate on the basis of need, scholarship, College Board scores, marks, especially in English, mathematics, and science, personality ratings, and extra curricular activities. The winner must already have been accepted at Newark College of Engineering and determination made that he will definitely attend Newark College of Engineering.

Jersey Central Power And Light Company Scholarships

Jersey Central Power and Light Company and the New Jersey Power and Light Company annually award two scholarships to students who will be members of the

senior class. The awards are made on the basis of academic achievement and need.

JUNIOR ACHIEVEMENT SCHOLARSHIP

The college Board of Trustees annually awards a scholarship of $200.00 to be used to pay part of the first year's tuition expenses for a Junior Achiever. Candidates are selected by the National Scholarship Committee of Junior Achievement.

ODON S. KNIGHT MEMORIAL AWARD

Each year a scholarship is awarded by the North Jersey Section, American Institute of Chemical Engineers to a senior chemical engineering student. The award will be announced upon completion of the student's junior year. The recipient must be of outstanding scholarship, good character, and in need of financial assistance.

MATERIALS HANDLING PRIZE

The Silent Hoist and Crane Company Materials Handling Award is presented annually for the best papers on the subject of materials handling. The award is made from proceeds from a trust established by the Wunsch Foundation, Inc., of Brooklyn.

ROBERT M. PERKINS SCHOLARSHIP

An annual scholarship, established by the A.P. Smith Manufacturing Company in honor of Robert M. Perkins, is awarded to a candidate for admission to NCE or to an undergraduate of NCE who is either an employee, a former employee, or the child of an employee or former employee of the A.P. Smith Manufacturing Company or of Linker Machines, Inc. If no qualified candidate is available, the award may be given to a student of NCE not so qualified.

NEW JERSEY FEDERATION OF BUSINESS AND PROFESSIONAL WOMEN'S CLUBS SCHOLARSHIP

The New Jersey Federation of Business and Professional Women's Clubs annually awards a scholarship to an outstanding coed undergraduate.

NEW JERSEY SOCIETY OF PROFESSIONAL ENGINEERS SCHOLARSHIP AWARDS

Each year the New Jersey Society of Professional Engineers awards one or more scholarships to regular daytime students who are in the last year of candidacy for the Bachelor's Degree in a curriculum accredited by the Engineers Council for Professional Development. Students of Newark College of Engineering and three other engineering colleges in New Jersey are eligible for consideration. Each scholarship is in the amount of

$500.00 with final selection determined by the scholarship committee of the college.

Nopco Chemical Company Scholarships

Nopco Chemical Company annually makes two scholarships available to Chemical Engineering juniors for their senior year. The recipients are usually selected by the Chemical Engineering Department on the basis of academic achievement and need.

Henry J. Ruesch Scholarship Fund

A scholarship fund established in memory of Henry J. Ruesch, Class of 1891, to provide financial assistance to a day undergraduate who has demonstrated good academic progress. The scholarship will be retained by the recipient until graduation, provided he continues to qualify academically and has continued to maintain acceptable standards of professional conduct.

John A. Schieck Memorial Fund

By the will of Caroline D. Schieck, a scholarship fund has been established in the name of her brother, John A. Schieck. From time to time several scholarships will be available from this fund.

William L. Schoonover Scholarships

By the will of William L. Schoonover several scholarships are available from time to time for worthy and capable students in financial need.

Arthur Silverman Scholarship

Arthur Silverman, Class of 1939, makes available to NCE a yearly scholarship covering tuition and fees which is awarded to a student upon the recommendation of the scholarship committee.

Union Carbide Engineering Scholarship

One scholarship is awarded each year to an entering freshman who intends to specialize in either Chemical or Mechanical Engineering. The scholarship is renewable each year, provided the student maintains a high grade point average.

United States Rubber Company Foundation Scholarships

Funds for a limited number of annual scholarships have been granted to Newark College of Engineering to assist junior and senior year students of proven ability who lack personal financial resources.

Western Electric Fund Scholarships

These scholarships are awarded annually by the Western Electric Co., Inc. to third and fourth year students who exhibit high academic performance. Awards are made by the scholarship committee and cover tuition, books, and fees.

STUDENT AID

The College participates in the National Defense Student Loan Program of the Federal Government whereby outstanding full-time students at the College may secure loans to meet the cost of attending the College and make repayment after graduation or leaving the College.

The College also administers several loan funds from which loans may be made to a limited number of students. These funds include the Continental Electric Company Student Loan Fund, the Sanford L. Kahn Loan Fund, Morris County Association of Professional Engineers and Land Surveyors Loan Fund, Newark College of Engineering Scholarship Fund, the Abraham Rothschild Loan Fund, the David Steinman Foundation Loan Fund, Senior Loan Fund, the Mechanical Engineers' Loan Fund, and the Molina Loan Fund.

Some part time positions in the college during hours when classes are not in session, or in the evening or during holiday periods, are also available to students who can qualify for such positions. Students interested in obtaining such part-time positions should consult the Dean of Students and the College Placement Office.

Applications for any form of student aid should be made to the Dean of Students.

HEALTH AND ACCIDENT INSURANCE

Health and accident insurance protection is available at low rates to all day students on a group basis. Coverage extends 24 hours per day throughout the 12 month period or until a student ceases to be enrolled as a day undergraduate.

Subscription to the insurance coverage is voluntary, although each student is required at registration to submit a statement declaring whether or not he desires to enroll in the Student Medical Reimbursement Insurance Plan.

DISABLED VETERANS

Public Law 87-815 provides educational assistance for veterans who sustained a 30% minimum service-connected disability in peacetime military duty. All such veterans have until October 15, 1971 to file for benefits with the Veterans Administration.

WAR ORPHANS ACT

Public Law 634 provides education and training at higher institutions to all children of servicemen who died as a result of a disability or disease incurred in line of duty during World War I, II, or the Korean War. Also eligible are children of living veterans who were permanently or totally disabled as a result of service-connected conditions. Any applicant or student between the ages of 18 and 23 who believes he is eligible under this bill should contact the Veterans Administration Regional Office, Newark, New Jersey.

PLACEMENT

RELATIONS WITH INDUSTRY

The aims and purposes of the college program are directed toward properly preparing the student for his place in industry. Under the guidance and supervision of the professional departments he has been trained in the fundamentals of engineering principles. He has further received instruction in the human relations problems of industry in the courses of the Department of Industrial Relations. It is the function of the Department to culminate that training by helping place the individual student in the type of work for which he has demonstrated interest and ability.

PROFESSIONAL DEVELOPMENT PROGRAM

The Professional Development Program is intended to supply the opportunity for qualified students to take on the challenge of more advanced work assignments offered through a cooperative plan with industry for the summer months.

Each year a number of industrial firms and governmental agencies are solicited for the purpose of identifying a list of selected pre-engineering positions demanding students of above average academic achievement.

The program is open to sophomore and junior students in the Day Division who achieve a minimum G.P.A. of 3.00. The students so qualified will receive priority placement in the job opportunities made available through this program. A student who meets the requirements of high academic excellence and who achieves satisfactory job progress reports from industry will receive a certificate of distinction at the conclusion of the year's program. Furthermore, those students who successfully maintain this class rank for the sophomore and junior academic years and attain satisfactory work performance records in industry for two summers will receive a special citation on their diplomas at graduation in recognition of this outstanding achievement.

PLACEMENT

Modern industry, with its activity in research, design, development, production, and management, recognizes academic achievement as only one of its criteria for selection. The criteria for advancement, in addition to the academic, are initiative, industry, and leadership. It is for this reason that the Department coordinates its efforts in placement with the Counseling Center and the professional departments with the single aim of making the recruiting period as efficient as possible for both the students and company representatives. The College maintains

membership in the Middle Atlantic Placement Association and the Metropolitan New York College Placement Officers Association through its Director of Placement.

Each candidate for graduation is provided with a printed schedule of company recruiting dates, and arrangements may be made through the Placement Office for interviews with representatives of companies who regularly recruit at the college. An up-to-date Relations With Industry file of company information is available to make the students' preparation a thorough one.

Recognizing the importance of the placement interview, both to the student and company representative, the College has made available modern and comfortable interviewing facilities. Upon his arrival at the College, the company recruiter receives a schedule of student interviews and an Interview Data Sheet for each student on his schedule. In addition, the Placement Office maintains on file the personally written resume of each student, his transcript of grades, and Employer Evaluation Forms from the Professional Development Program.

The department maintains a file of all job openings received for candidates for graduation as well as for alumni.

The Placement Office is open during business hours throughout the year, and one evening each week during the academic year, primarily for the convenience of evening students.

The Placement Office provides information on part-time off-campus employment for students throughout the year. Part-time positions in the various areas of the College are listed with the office of the Dean of Students. Assistance in obtaining summer employment is available to all undergraduate and graduate students. Since the best interest of the student requires unqualified attention to his course of study, the Placement Office supervises such placements and feels that outside activity should be limited to the ability of the individual student.

STUDENT LIFE

Student life, through its guidance, counseling, and extracurricular programs, plays an important role in preparing NCE students for their eventual careers in industry, education and government. Membership in the College's various clubs and athletic organizations, in professional and honor societies, and in student government councils provides excellent training for eventual participation in similar activities beyond college. The guidance resources of NCE provide additional aids for students in academic, vocational and personal decision-making.

GUIDANCE AND COUNSELING

The guidance and counseling services of the College are coordinated by the Dean of Student's office and are available to all students through the office of the Dean of Students and the Counseling Center. During their Orientation Program, freshmen learn about the engineering education they will be offered. At this time the Counseling Center administers a comprehensive battery of tests, and the freshmen are introduced to the total counseling and guidance program. As freshmen, they utilize the services of the office of the Dean of Students for problems of a vocational, academic, social or personal nature. When they become upperclassmen, a faculty adviser is assigned to each student. When a problem requires intensive counseling, the students are referred to the Counseling Center. The Counseling Center also provides valuable pre-employment counseling for all seniors.

STUDENT GOVERNMENT

A Student Council, acting with the Director of Student Activities as the adviser, constitutes the basic form of student government. This group is composed of officers who are elected by the student body and of representatives from various special-interest areas. The Council also coordinates the overall Student Activity Program. The freshman, sophomore, junior, and senior classes are organized further to meet the needs of these student groups.

SOCIAL ACTIVITIES

Social gatherings range from dinner meetings and lectures conducted by student professional societies to class or fraternity-sponsored dances and outings. In all cases, the group sponsoring a social event is responsible for the conduct of those attending, including that of members and guests. Further, each student is expected always to conduct himself on the basis of high professional standards.

Eleven social fraternities offer the student desiring this type of affiliation a choice of the fraternity in which he may wish to

participate. Representatives of these fraternities to the Interfraternity Council coordinate various unified programs of the group.

SPECIAL INTEREST ORGANIZATIONS

The development of individual interests is fostered by the opportunity for participation in a number of organizations. Those students wishing to develop spiritually may participate in Christian Fellowship, Newman Club, Campus Christian Foundation, Shalom, or YMCA activities. In addition, there are club activities in physical recreation, such as outing, rod and gun, yachting and golf. The Audio, Bridge, Chess, Dance, Motor, Photo and Radio Clubs, and a number of others, offer additional opportunities for students with special interests.

COEDUCATIONAL ACTIVITIES

The coeds of the College participate actively in student government, clubs and social organizations, and in professional and honor societies. Sigma Chi Epsilon, a College sorority open to all coeds, promotes social and intellectual activities of special significance to women students.

STUDENT PUBLICATIONS

A newspaper, *The Vector,* is operated and published entirely by student staff members. There is a yearbook, *Nucleus,* published by each Senior class. *Log NCE,* the handbook for freshmen, as well as professional, departmental, and other publications, are also edited by students.

HONOR SOCIETIES

Freshmen who rank in the upper 20 percent of their class are considered for membership in Phi Eta Sigma, national scholarship society for freshmen. The College is also among the leading engineering colleges of the United States having a chapter of Tau Beta Pi, the honorary engineering society. Membership in this distinguished organization is open, by election, to junior and senior students of high scholarship and exemplary character, of unselfish activity and breadth of interest in technical and nontechnical fields.

There are also several other national honor societies. Omicron Delta Kappa, leadership society, recognizes students on the basis of character and specific eligibility in scholarship and extracurricular activity. Faculty and alumni members are chosen for similar qualities. Four national honor societies are associated with particular professional departments, all of them open only to juniors and seniors: Omega Chi Epsilon, Chemical Engineering; Pi Tau Sigma, Mechanical Engineering; Eta Kappa Nu,

Electrical Engineering; Chi Epsilon, Civil Engineering; and Alpha Pi Mu, Industrial Engineering.

The Arnold Air Society is the honor society of the Air Force Reserve Officers Training Corps. Its purpose is to further the mission, tradition, and concept of the Air Force as a means of defense, to promote American citizenship, and to create a closer and more efficient relationship among the students. Membership is limited to advanced students who qualify academically, show an interest in the Air Force ROTC program, and are considered favorably in voting sessions of the active members of the squadron.

PROFESSIONAL SOCIETIES

National professional engineering societies sponsor student branches at the College. The societies represented are the American Chemical Society, American Institute of Chemical Engineers, American Society of Civil Engineers, American Institute of Industrial Engineers, American Society of Mechanical Engineers, Institute of Electrical and Electronics Engineers, and Society for the Advancement of Management.

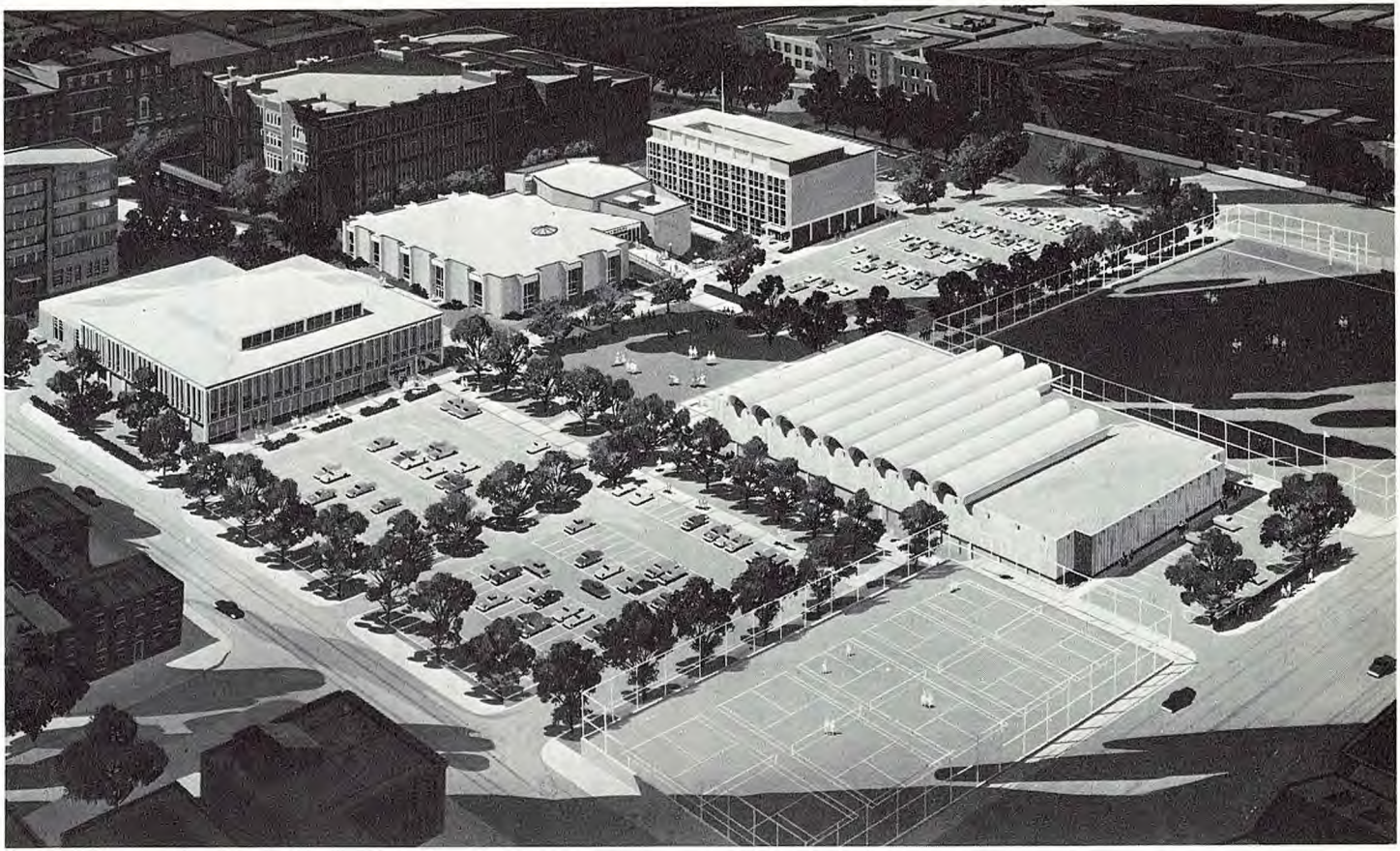
The faculty encourages student participation in the activities of the student branches of these societies as an important phase of their engineering education.

ATHLETICS

The Director of Health, Physical Education, and Athletics, assisted by the joint Student-Faculty Athletic Committee and the Student Athletic Association directs an extensive and varied program in athletic activities which reflects the interests and capabilities of the engineering student and provides him with opportunities for participation.

Intercollegiate competition is usually provided in soccer, basketball, baseball, bowling, tennis, golf, fencing, riflery, and judo. On the intramural level, competition is college-wide in the form of tournaments in basketball, bowling, softball, table tennis, volleyball, and badminton.

Students are encouraged to participate in a wide range of activities on a purely amateur basis. Interested members of the faculty participate in the capacity of coach or adviser.



ARTIST'S RENDERING OF THE NEW ... NGE

CURRICULUMS

DAY DIVISION

The Freshman Year is common to all curriculums. Note that the Sophomore Year requires a choice of department of major study. Much of the Sophomore curriculum is common to all departments; but to provide the proper sequence of courses, certain differences appear in each departmental program.

Students taking the Air Force ROTC program will find the necessary course requirements listed for each year under the heading "Aerospace Studies Option." These courses are to be taken *in addition to* regular courses in the Freshman and Sophomore Years and *in lieu of* courses indicated by an asterisk in the Junior and Senior Years.

All curriculums are undergoing extensive revision. Therefore, courses listed apply to the 1966-67 academic year only. Students should consult with their major departments to determine requirements for the years following the 1966-67 academic year.

The numbers following the course title under the headings "1st Semester" and "2nd Semester" represent, in order: class hours per week, laboratory hours per week, and credits for the semester. All courses are one-semester courses.

FIRST YEAR

COMMON TO ALL CURRICULUMS

COURSE NUMBER		TITLE	1ST SEMESTER		2ND SEMESTER	
(Chem 15)	(Chem 16)	General Chemistry	4-3	4½	4-3	4½
(EG 1)	(EG 2)	Engineering Graphics	1-3	2½	1-3	2½
(Eng 11)	(Eng 12)	Composition and Literature	3-0	3	3-0	3
(Math 11)		Introductory Mathematics	4-0	4	-	
	(Math 12)	Calculus I	-		4-0	4
(Phys 1)	(Phys 2)	Physics I & II	3-2	3½	3-2	3½
(IR 31)		Psychology of Personal Adjustment	2-0	1	-	
	(IR 34)	Elements of Industrial Growth	-		3-0	2
		Physical Education	0-1	0	0-1	0
AEROSPACE STUDIES OPTION						
(AS 1)	(AS 1)	World Military Systems I	1-1	1	1-1	1

CHEMICAL ENGINEERING
B.S. (Ch. E.)

FIRST YEAR

The courses offered in the First Year will be found on page 59.

SECOND YEAR

Course Number		Title	1st Semester		2nd Semester	
(Chem 25)		Principles of Engineering Materials	3-0	2½	-	
(Chem 28)		Quantitative Analysis	1-4	2	-	
	(ChE 27)	Chemical Engineering Problems	-		3-0	2½
(Hist 21)	(Hist 22)	Development of the Modern World I & II	3-0	2½	3-0	2½
	(IR 34)	Elements of Industrial Growth	-		3-0	2
(Math 21)		Calculus II	4-0	4	-	
	(Math 22)	Differential Equations	-		4-0	4
	(Math 90)	Computer Programming & Numerical Methods	-		2-2	2½
(Mech 7)	(Mech 8)	Mechanics of Rigid & Deformable Bodies I & II	5-0§	4	5-0§	4
(Phys 3)		Physics III	3-2	3½	-	
	(Phys 4)	Modern Physics	-		3-0	2½
AEROSPACE STUDIES OPTION						
(AS 2)	(AS 2)	World Military Systems II	1-1	1	1-1	1

THIRD YEAR

(Chem 25)		Principles of Engineering Materials	3-0	2½	-	
(ChE 21)	(ChE 22)	Physical Chemistry I & II	3-0	2½	3-0	2½
(ChE 23)	(ChE 24)	Organic Chemistry I & II	3-3	3½	3-3	3½
(ChE 45)	(ChE 46)	Chemical Engineering Thermodynamics I & II	3-0	2½	3-0	2½
(ChE 63)		Stage Operations	3-0	2½	-	
	(ChE 64)	Transport Operations I	-		3-0	2½
	(IR 25)*	Human Relations	-		2-0	1½
(IR 27)*		Labor Relations	2-0	1½	-	
		Elective (Humanities)†	-		3-0	2½
(Math 31) *or* (Math 33)		Introduction to Partial Differential Equations Probability and Statistics	3-0 3-0	2½ 2½	-	
	(Mech 6)	Mechanics of Deformable Bodies	-		3-2‡	4
*AEROSPACE STUDIES OPTION						
(AS 3)	(AS 3)	Growth and Development of Aerospace Power	3-1	2½	3-1	2½

§ Selected laboratory experiments to be performed periodically.
† The humanities elective program is outlined on page 70.
‡ 5-0 on alternate weeks.

FOURTH YEAR

Course Number		Title	1st Semester		2nd Semester	
(ChE 46)		Chemical Engineering Thermodynamics	3-0	2½	-	
(ChE 49)		Reaction Kinetics	3-0	2½	-	
(ChE 65)		Transport Operations II	4-0	3	-	
(ChE 67)	(ChE 68)	Chemical Engineering Laboratory I & II	0-3	2	0-3	2
(ChE 71)	(ChE 72)	Process and Plant Design I & II	1-2†	2½	1-2†	2½
	(ChE 74)	Process Dynamics and Control	-		3-0	2½
(ChE 75)	(ChE 76)	Physical Chemistry Laboratory I & II	0-3	2	0-3	2
	(EE 92)	Electrical Engineering	-		3-3	3½
		Elective (Technical)	3-0	2½	3-0	2½
(IR 26)*		Personnel Administration	2-0	1½	-	
	(IR 28)*	Contemporary Issues	-		3-0	2

*AEROSPACE STUDIES OPTION

(IR 38)		Industrial Relations	2-0	1½	-	
	(IR 29)	Contemporary Issues	-		2-0	1½
(AS 4)	(AS 4)	The Professional Officer	3-1	2½	3-1	2½

TECHNICAL ELECTIVES

Courses other than those listed (including courses offered by the Graduate Division) may be substituted, provided that the student can meet the prerequisites and if Department of Chemical Engineering approval has been granted.

	(Chem 120)	Advanced Inorganic Chemistry‡	-		3-0	3
(Chem 130)		Advanced Analytical Chemistry‡	3-0	3	-	
	(Chem 151)	Biochemistry‡	-		3-0	3
(ChE 73)		Chemical Engineering Problems II	3-0	2½	-	
(ChE 77)		Chemical Engineering Metallurgy	3-0	2½	-	
	(ChE 78)	Chemical Reactor Design	-		3-0	2½
(ChE 102)		Advanced Organic Chemistry‡	3-0	3	-	
	(Math 33)	Probability and Statistics	-		3-0	2½
	(Math 35)	Vector Analysis	-		3-0	2½
	(ME 14)	Metallurgy	-		3-0	2½
(ME 54)		Gas Dynamics	3-0	2½	-	
	(Phys 7)	Nuclear Engineering	-		3-0	2½

† In this course, the laboratory hours refer to hours of design.
‡ For a description of this course, refer to the 1966-67 *Catalog of Graduate Programs.*

CIVIL ENGINEERING
B.S. (C.E.)

FIRST YEAR

The courses offered in the First Year will be found on page 59.

SECOND YEAR

Course Number		Title	1st Semester		2nd Semester	
(Chem 25)		Principles of Engineering Materials	3-0	2½	-	
	(CE 3)	Surveying	-		3-3	4
(Hist 21)	(Hist 22)	Development of the Modern World I & II	3-0	2½	3-0	2½
	(IR 34)	Elements of Industrial Growth	-		3-0	2
(Math 21)		Calculus II	4-0	4	-	
	(Math 22)	Differential Equations	-		4-0	4
(Math 90)		Computer Programming & Numerical Methods	2-2	2½	-	
(Mech 7)	(Mech 8)	Mechanics of Rigid and Deformable Bodies I & II	5-0	4	5-0	4
(Phys 3)		Physics III	3-2	3½	-	
	(Phys 4)	Modern Physics	-		3-0	2½
AEROSPACE STUDIES OPTION						
(AS 2)	(AS 2)	World Military Systems II	1-1	1	1-1	1

THIRD YEAR

(CE 21)	(CE 22)	Strength of Materials I & II	3-3	3½	3-0	2½
(CE 41)		Fluid Mechanics I	4-0	4	-	
	(CE 61)	Electronic Computations	-		3-1	3
(EE 93)		Electrical Engineering	3-3†	4½	-	
(Eng 21)		English and American Literature to 1850	3-0	2½	-	
	(Eng 22)	English and American Literature after 1850	-		3-0	2½
	(IE 97)	Enterprise Management	-		4-0	3
	(IR 25)*	Human Relations	-		2-0	1½
(IR 27)*		Labor Relations	2-0	1½	-	
		Elective (Technical)	3-0	2½	3-0	2½
	(ME 41)	Thermodynamics I	-		3-0	2½
*AEROSPACE STUDIES OPTION						
(AS 3)	(AS 3)	Growth and Development of Aerospace Power	3-1	2½	3-1	2½
TECHNICAL ELECTIVES						
(CE 5)		Advanced Surveying I	3-0	2½	-	
	(CE 6)	Aerial Photographic Interpretation	-		3-0	2½
(CE 17)		Engineering Geology	3-0	2½	-	
	(CE 45)	Fluid Mechanics II	-		3-0	2½
(CE 47)	(CE 48)	Hydr. & San. Engrg. I & II	3-0	2½	3-0	2½
(CE 51)		Urban Planning	3-0	2½	-	
	(CE 52)	Transportation Engrg.	-		3-0	2½
(IE 98)		Basic Accounting & Finance for Construction Mgmt.	3-0	2½	-	
	(IE 99)	Management & Control of Construction	-		3-0	2½

† Laboratory and problem sessions on alternate weeks.

FOURTH YEAR

Course Number		Title	1st Semester		2nd Semester	
(CE 13)	(CE 14)	Soil Mechanics I & II	3-0	2½	0-3	1½
(CE 27)	(CE 28)	Structures I & II	3-0	2½	6-0	5½
	(Eng 41)	Engineering Report Writing	-		3-0	1½
(IR 26)*		Personnel Administration	2-0	1½	-	
	(IR 28)*	Contemporary Issues	-		3-0	2
		Elective (Humanities)†	3-0	2½	3-0	2½
		Electives (Technical)	6-0	5	6-0	5
(ME 73)		Thermodynamics for C.E. II	3-0	2	-	
(ME 77)		Power & Fluids Laboratory	0-3	2	-	
•AEROSPACE STUDIES OPTION						
(IR 38)		Industrial Relations	2-0	1½	-	
	(IR 29)	Contemporary Issues	-		2-0	1½
(AS 4)	(AS 4)	The Professional Officer	3-1	2½	3-1	2½

TECHNICAL ELECTIVES

Students must take two courses per semester. Other graduate or undergraduate courses of 2½ or 3 credits each may be elected with the approval of the student's adviser.

(Chem 200)		Sanitary Microbiology‡	3-0	2½	-	
	(Chem 201)	Sanitary Chemistry‡	-		3-0	2½
(CE 5)		Advanced Surveying I	3-0	2½	-	
	(CE 6)	Aerial Photographic Interpretation	-		3-0	2½
(CE 17)		Engineering Geology	3-0	2½	-	
(CE 31)	(CE 32)	Constr. Management I & II	3-0	2½	3-0	2½
	(CE 45)	Fluid Mechanics II	-		3-0	2½
(CE 47)	(CE 48)	Hydr. & San. Engrg. I & II	3-0	2½	3-0	2½
(CE 51)		Urban Planning	3-0	2½	-	
	(CE 52)	Transportation Engrg.	-		3-0	2½
(CE 63)	(CE 64)	Numerical Methods I & II	3-0	2½	3-0	2½
(CE 71)	(CE 72)	Civil Engrg. Projects I & II	0-3	2½	0-3	2½
(IE 98)		Basic Accounting & Finance for Construction Mgmt.	3-0	2½	-	
	(IE 99)	Management & Control of Construction	-		3-0	2½

† The humanities elective program is outlined on page 70.
‡ For a description of this course, refer to the 1966-67 *Catalog of Graduate Programs.*

ELECTRICAL ENGINEERING
B.S. (E.E.)

FIRST YEAR

The courses offered in the First Year will be found on page 59.

SECOND YEAR

Course Number		Title	1st Semester		2nd Semester	
	(Chem 25)	Principles of Engineering Materials	-		3-0	2½
	(EE 10)	Electric Circuits and Measurements	-		3-2	3
(Hist 21)	(Hist 22)	Development of the Modern World I & II	3-0	2½	3-0	2½
	(IE 23)	Economics	-		3-0	2½
(IR 34)		Elements of Industrial Growth	3-0	2	-	
(Math 21)		Calculus II	4-0	4	-	
	(Math 22)	Differential Equations	-		4-0	4
(Math 90)		Computer Programming & Numerical Methods	2-2	2½	-	
(Mech 7)	(Mech 8)	Mechanics of Rigid & Deformable Bodies I & II	5-0§	4	5-0§	4
(Phys 3)		Physics III	3-2	3½	-	
	(Phys 4)	Modern Physics	-		3-0	2½
AEROSPACE STUDIES OPTION						
(AS 2)	(AS 2)	World Military Systems II	1-1	1	1-1	1

THIRD YEAR

(EE 20)		Passive Circuits	4-0	3	-	
	(EE 25)	Electromagnetic Fields	-		4-0	3
(EE 40)		Electronic Devices	3-0	2	-	
	(EE 42)	Active Circuits I	-		4-3	4½
(EE 60)		Electromagnetics	3-3	3½	-	
	(EE 62)	Electrokinetics I	-		3-0	2½
	(IR 25)*	Human Relations	-		2-0	1½
(IR 27)*		Labor Relations	2-0	1½	-	
	(Math 32)	Functions of a Complex Variable	-		3-0	2½
(Math 35)		Vector Analysis	3-0	2½	-	
(Math 90)**		Computer Programming & Numerical Methods	2-2	2½	-	
	(Mech 6)**	Mechanics of Deformable Bodies	-		3-2†	4
(ME 41)		Thermodynamics I	3-0	2½	-	
*AEROSPACE STUDIES OPTION						
(AS 3)	(AS 3)	Growth and Development of Aerospace Power	3-1	2½	3-1	2½

† 5-0 on alternate weeks.
§ Selected laboratory experiments to be performed periodically.
** Some sections will interchange Math 90 and Mech 6.

FOURTH YEAR

Course Number		Title	1st Semester		2nd Semester	
(EE 22)		Transmission Circuits	4-0	3	-	
(EE 25T)		Electromagnetic Fields	3-0	2½	-	
(EE 44)		Active Circuits II	3-3	4½	-	
	(EE 80)	Advanced Measurements	-		2-3	3½
		Elect. Engrg. Elective	3-0	2½	3-1§	3
	(EE 86)	Elect. Engrg. Project	-		0-3	2½
(IR 26)*		Personnel Administration	2-0	1½	-	
	(IR 28)*	Contemporary Issues	-		3-0	2
		Elective (Technical)	3-0	2½	3-0	2½
		Elective (Humanities)‡	-		3-0	2½
*AEROSPACE STUDIES OPTION						
(IR 38)		Industrial Relations	2-0	1½	-	
	(IR 29)	Contemporary Issues	-		2-0	1½
(AS 4)	(AS 4)	The Professional Officer	3-1	2½	3-1	2½
TECHNICAL ELECTIVES						
Students must elect one course in the 1st Semester and a second course in the 2nd Semester. Other courses may be chosen as electives with departmental approval.						
	(Chem 111)	Radioisotopes Laboratory†	-		0-3	3
	(Chem 120)	Advanced Inorganic Chemistry†	-		3-0	3
(EE 177)		Random Processes for EE's†	3-0	2½	-	
	(IE 91)	Enterprise Management	-		4-0	3
(Math 31)		Introduction to Partial Differential Equations	3-0	2½	-	
(Math 32)	(Math 32)	Introduction to Functions of a Complex Variable	3-0	2½	3-0	2½
(Math 33)		Probability and Statistics	3-0	2½	-	
(Math 111)		Introduction to Numerical Analysis†	3-0	3	-	
(Math 151)		Advanced Calculus I†	3-0	3	-	
	(ME 78)	Thermodynamics for E.E. II	-		3-0	2
	(Phys 6)	Engineering Physics	-		3-0	2½
	(Phys 7)	Nuclear Engineering	-		3-0	2½
(Phys 8)	(Phys 8)	Semiconductor Physics	3-0	2½	3-0	2½
ELECTRICAL ENGINEERING ELECTIVES						
	(EE 64)	Electrokinetics II	-		3-3	3½
(EE 69)		Power System Analysis	3-0	2½	-	
(EE 70)		Transistor Circuits	3-0	2½	-	
	(EE 71)	Control Systems	-		3-0	2½
	(EE 72)	Feedback Amplifiers	-		3-0	2½
(EE 73)		Electronic Devices	3-0	2½	-	
	(EE 74)	Analog Computation in Analysis and Design	-		3-1	3
	(EE 75)	Digital Computer Circuits	-		3-1	3
	(EE 76)	Microwaves	-		3-1	3
(EE 77)		Introduction to Reliability Problems in E.E.	3-0	2½	-	
(EE 78)		Information Transmission	3-0	2½	-	
(EE 79)		Pulse Techniques	3-0	2½	-	

† For a description of this course, refer to the 1966-67 *Catalog of Graduate Programs.* With special permission, certain 200-level courses may be elected.

‡ The humanities elective program is outlined on page 70.

§ Laboratory hours depend on course selected (0 to 3 hours).

INDUSTRIAL ENGINEERING
B.S. (I.E.)

FIRST YEAR

The courses offered in the First Year will be found on page 59.

SECOND YEAR

Course Number		Title	1st Semester		2nd Semester	
	(Chem 25)	Principles of Engineering Materials	-		3-0	2½
(Hist 21)	(Hist 22)	Development of the Modern World I & II	3-0	2½	3-0	2½
(IE 23)		Economics	3-0	2½	-	
(IE 24)		Production Process Design	2-2	2½	-	
(IE 25)		Logic and Scientific Method	2-0	2	-	
	(IR 34)	Elements of Industrial Growth	-		3-0	2
(Math 21)		Calculus II	4-0	4	-	
	(Math 22)	Differential Equations	-		4-0	4
	(Math 90)	Computer Programming & Numerical Methods	-		2-2	2½
(Mech 7)	(Mech 8)	Mechanics of Rigid and Deformable Bodies I & II	5-0§	4	5-0§	4
(Phys 3)		Physics III	3-2	3½	-	
	(Phys 4)	Modern Physics	-		3-0	2½
AEROSPACE STUDIES OPTION						
(AS 2)	(AS 2)	World Military Systems II	1-1	1	1-1	1

THIRD YEAR

(Eng 21)		English and American Literature to 1850	3-0	2½	-	
	(Eng 22)	English and American Literature after 1850	-		3-0	2½
(IE 37)	(IE 38)	Work Analysis I & II	3-2	3½	3-1	3
	(IE 47)	Accounting for Engineers	-		3-1	3
(IE 96)		Engineering Economy	2-0	2	-	
	(IR 25)*	Human Relations	-		2-0	1½
(IR 27)*		Labor Relations	2-0	1½	-	
(Math 33)		Probability and Statistics	3-0	2½	-	
	(Math 34)	Mathematics for Management Science	-		3-0	2½
(Mech 6)		Mechanics of Deformable Bodies	3-2†	4	-	
	(ME 39)	Machine Design Fundamentals	-		3-0	2½
(ME 41)		Thermodynamics I	3-0	2½	-	
	(ME 75)	Thermodynamics for I.E. II	-		3-0	2
*AEROSPACE STUDIES OPTION						
(AS 3)	(AS 3)	Growth and Development of Aerospace Power	3-1	2½	3-1	2½

† 5-0 on alternate weeks.

§ Selected laboratory experiments to be performed periodically.

FOURTH YEAR

Course Number		Title	1st Semester		2nd Semester	
(EE 96)	(EE 97)	Electrical Engineering	3-2	3½	3-2	3½
(IE 39)	(IE 40)	Studies in Management Science I & II	3-2	3½	4-0	3
(IE 43)	(IE 44)	Systems Design & Control I & II	2-2	3	2-3	3½
(IE 46)		Law	3-0	2	-	
(IR 26)*		Personnel Administration	2-0	1½	-	
	(IR 28)*	Contemporary Issues	-		3-0	2
		Elective (Humanities)†	3-0	2½	3-0	2½
		Elective (Technical)	3-0	2½	3-0	2½
*AEROSPACE STUDIES OPTION						
(IR 38)		Industrial Relations	2-0	1½	-	
	(IR 29)	Contemporary Issues	-		2-0	1½
(AS 4)	(AS 4)	The Professional Officer	3-1	2½	3-1	2½
TECHNICAL ELECTIVES						
Students may elect one course in each semester of the Fourth Year. In areas where the student has the necessary prerequisites, he may choose electives of equivalent credit offered by other Engineering departments.						
(IE 58)		Tool Engineering	3-0	2½	-	
	(IE 59)	Computerized Production Control	-		3-0	2½
(IE 60)		Inventory Models	3-0	2½	-	
(IE 61)		Statistical Quality Control	3-0	2½	-	
(IE 62)		Budgetary Planning and Control	3-0	2½	-	
	(IE 63)	Organization Planning and Control	-		3-0	2½
	(IE 64)	Product & Process Reliability	-		3-0	2½
	(IE 65)	Patent Law	-		3-0	2½
(IE 81H)	(IE 82H)	Investigations in Industrial Engineering	3-0	2½	3-0	2½

† The humanities elective program is outlined on page 70.

MECHANICAL ENGINEERING
B.S. (M.E.)

FIRST YEAR

The courses offered in the First Year will be found on page 59.

SECOND YEAR

Course Number		Title	1st Semester		2nd Semester	
(Hist 21)	(Hist 22)	Development of the Modern World I & II	3-0	2½	3-0	2½
(IE 23)		Economics	3-0	2½	-	
	(IR 34)	Elements of Industrial Growth	-		3-0	2
(Math 21)		Calculus II	4-0	4	-	
	(Math 22)	Differential Equations	-		4-0	4
	(Math 90)	Computer Programming & Numerical Methods	-		2-2	2½
(Mech 7)	(Mech 8)	Mechanics of Rigid and Deformable Bodies I & II	5-0§	4	5-0§	4
(ME 10)		Manufacturing Processes	0-3	1½	-	
	(ME 41)	Thermodynamics I	-		3-0	2½
(Phys 3)		Physics III	3-2	3½	-	
	(Phys 4)	Modern Physics	-		3-0	2½
AEROSPACE STUDIES OPTION						
(AS 2)	(AS 2)	World Military Systems II	1-1	1	1-1	1

THIRD YEAR

	(ME 10)	Manufacturing Processes	-		0-3	1½
	(ME 18)	Metallurgy	-		2-3	4
(ME 31)		Theory of Machines	2-2	3½	-	
(ME 33)		Vibration Analysis	3-0	2½	-	
(ME 41)	(ME 42)	Thermodynamics I & II	3-0	2½	3-0	2½
	(ME 43)	Mechanical Laboratory I	-		0-3	2
(ME 44)		Fluid Mechanics	3-0	2½	-	
	(ME 45)	Heat Transfer	-		3-0	2½
(Mech 6)		Mechanics of Deformable Bodies	3-2†	4	-	
	(EE 98)	Electrical Engineering I	-		3-0	2½
	(IR 25)*	Human Relations	-		2-0	1½
(IR 27)*		Labor Relations	2-0	1½	-	
		Elective (Technical)	3-0	2½	-	
*AEROSPACE STUDIES OPTION						
(AS 3)	(AS 3)	Growth and Development of Aerospace Power	3-1	2½	3-1	2½
ELECTIVES						
(Math 31)		Introduction to Partial Differential Equations	3-0	2½	-	
(Math 32)		Introduction to Functions of a Complex Variable	3-0	2½	-	
(Math 33)		Probability and Statistics	3-0	2½	-	
(Math 35)		Vector Analysis	3-0	2½	-	
(ME 55)		Automatic Controls	3-0	2½	-	
(Phys 7)		Nuclear Engineering	3-0	2½	-	

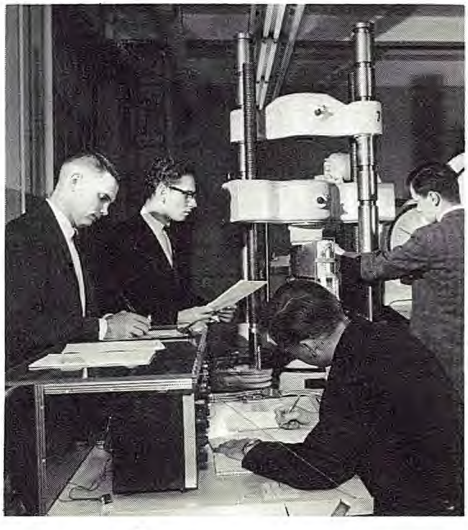
† 5-0 on alternate weeks.
§ Selected laboratory experiments will be performed periodically.

FOURTH YEAR

Course Number		Title	1st Semester		2nd Semester	
(EE 96)	(EE 97)	Electrical Engineering I & II	3-2	3½	3-2	3½
(IR 26)*		Personnel Administration	2-0	1½	-	
	(IR 28)*	Contemporary Issues	-		3-0	2
(ME 33)		Vibration Analysis	3-0	2½	-	
(ME 34)	(ME 36)	Mechanical Engrg. Design I & II	3-3	4	3-3	4
(ME 45)		Heat Transfer	3-0	2½	-	
(ME 46)	(ME 48)	Mechanical Laboratory II & III	0-3	2½	0-3	2½
		Elective (Humanities)‡	3-0	2½	-	
		Elective (Technical)	-		3-0	2½
		Elective (Technical)	-		3-0	2½
*AEROSPACE STUDIES OPTION						
(IR 38)		Industrial Relations	2-0	1½	-	
	(IR 29)	Contemporary Issues	-		2-0	1½
(AS 4)	(AS 4)	The Professional Officer	3-1	2½	3-1	2½
TECHNICAL ELECTIVES†						
	(Math 31)	Introduction to Partial Differential Equations	-		3-0	2½
	(Math 32)	Introduction to Functions of a Complex Variable	-		3-0	2½
	(Math 33)	Probability and Statistics	-		3-0	2½
	(Math 35)	Vector Analysis	-		3-0	2½
	(ME 37)	Structural Analysis	-		3-0	2½
	(ME 53)	Energy Conversion	-		3-0	2½
	(ME 54)	Gas Dynamics	-		3-0	2½
	(ME 55)	Automatic Controls	-		3-0	2½
	(ME 56)	Fluid Machinery	-		3-0	2½
	(ME 79)	Computer Solutions in M.E.	-		3-0	2½
	(Phys 7)	Nuclear Engineering	-		3-0	2½

† Undergraduate technical or 100-level Graduate courses in other departments may be elected with adviser's approval.

‡ The humanities elective program is outlined on page 70.



HUMANITIES ELECTIVE PROGRAM

All courses in this program consist of 3 hours of lecture and offer 2½ credits. Under the heading "Course Number," 1st Semester courses stand to the left, 2nd Semester courses to the right. The program and courses are described in detail on page 104.

Course Number		Title
ARTS		
(Arts 51)		Appreciation of Music
	(Arts 52)	Period, Style, and Genre in Music
(Arts 53)		Appreciation of Visual Arts
	(Arts 54)	Period, Style, and Medium in the Visual Arts
HISTORY		
(Hist 51)		Aspects of Classical Civilization: The Legacy
	(Hist 51A)	Aspects of Classical and Medieval Civilization: Rome to the End of Byzantium
	(Hist 52)	Aspects of British Civilization: Modern British Society
(Hist 52A)		Aspects of British Civilization: Representative Government
(Hist 53)		Aspects of American Civilization: Recent History
	(Hist 53A)	Aspects of American Civilization: The City
(Hist 54)		Special Areas: Modern Russian Civilization
	(Hist 54A)	Special Areas: Modern Germany
(Hist 54B)		Special Areas: Contemporary Europe
	(Hist 55)	Problems in Modern History: Political and Social Movements
	(Hist 55C)	Problems in Modern History: Intellectual Revolution
LITERATURE		
(Lit 51)		An Era of Literature: The Renaissance
(Lit 51A)		An Era of Literature: Twentieth Century British and American Literature
	(Lit 51B)	An Era of Literature: Twentieth Century European Fiction
	(Lit 51C)	An Era of Literature: Modern Drama
	(Lit 51D)	An Era of Literature: Greek and Roman
(Lit 52)		A Form of Literature: Growth of European Fiction
(Lit 52A)		A Form of Literature: The English Novel
	(Lit 52C)	A Form of Literature: Forms of Modern Drama, Fiction, and Poetry
	(Lit 52D)	A Form of Literature: Satire
(Lit 53A)		A Recurrent Subject of Literature: The Good Life
	(Lit 54)	Principal Works of One Writer: William Shakespeare
(Lit 54A)		Principal Works of One Writer: William Faulkner
PHILOSOPHY		
(Phil 51)		Principles of Philosophy: Philosophical Problems
	(Phil 51A)	Principles of Philosophy: Representative Philosophers
	(Phil 52)	Historical Developments in Philosophy: Development of Modern Thought
	(Phil 52B)	Historical Developments in Philosophy: History of Economic Thought
(Phil 53)		Philosophical Foundations: Science
(Phil 53A)		Philosophical Foundations: Comparative Economic Thought
(Phil 53B)		Philosophical Foundations: Philosophy of Language
	(Phil 53C)	Philosophical Foundations: Comparative Culture
SEMINARS		
(Hu 59)		Seminar: Relationships between Two Areas
	(Hu 59A)	Seminar: Relationships between Two Areas

EVENING DIVISION

OBJECTIVES

The objectives stated on page 33 apply to the Evening Division as well. For students in the Evening Division, however, time is an important consideration.

Evening curriculums are closely coordinated with the Day programs to insure identical educational experiences. Because of the limited evening hours, Evening undergraduates proceed through their curriculum at approximately half the rate of their day counterparts, thereby completing requirements for the bachelor's degree in approximately eight years. The over-all time necessary to complete the work required for the degree may be somewhat reduced by summer study. A list of courses available for summer study is published each spring.

FACILITIES

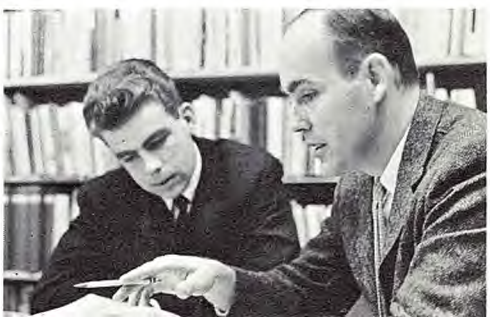
The facilities and services of the College are available to students of both the Day and Evening Division. The College recognizes, however, that limitations of time and circumstances sometimes prevent evening students from taking full advantage of all areas of activity. The College has therefore provided evening hour coverage for those areas that are most important to the academic advancement of Evening students. A complete description of College facilities appears on pages 30-32.

STUDENT ACTIVITIES

Activities concerned with student life, while usually scheduled during the daytime period, are also available to Evening Division students. Students interested in these extracurricular activities, which are described in the section "Student Life," are advised to consult the Dean of Students for additional information.

Inquiries regarding information about scholarships and loan funds available to Evening students should be directed to the Dean of Students.

The Air Force ROTC program is not available to students registered in the Evening Division.



EXPENSES

TUITION AND FEES

JUNOR DIVISION (EVENING)

During 1966-1967, the tuition and regular fees per semester for students taking regular programs of study in the Junior Division (Evening) and Newark Technical School will be as follows:

	Charges per Semester	
	New Jersey Residents	*Non-Residents*
Tuition*	$108.00	$165.00
Regular Fees		
Registration	5.00	5.00
Student Facilities Fee	6.00	6.00
Total Tuition and Regular Fees per Semester	$119.00	$176.00

* Tuition includes charges for services other than instruction, such as library, publications, counseling, placement, etc., but does not cover the breakage or loss of College property.

Tuition charges are somewhat higher for special programs of study differing from those shown in this catalog.

TUITION AND FEES

SENIOR DIVISION (EVENING)

It is necessary for the College to adjust its tuition charges in the Senior Division (Evening) in accordance with the individual Block programs contained therein. These charges vary somewhat in accordance with the number of hours offered under each Block. There are certain fixed fees due and payable at each registration period in addition to these tuition fees. As in the case of the Junior Division (Evening) and the Day Division, every effort has been made to establish these fees at a level which will maintain the proper relation between the State, the City, and the direct beneficiary, the student.

Students taking complete Block programs exactly as published in this catalog are charged tuition at the rate of $12.00 *per contact hour per semester* if residents of the State of New Jersey, and $18.00 *per contact hour per semester* if non-residents. Students taking programs which differ from the Block schedule are charged at the rate of $14.00 *per contact hour per semester* if residents of the State of New Jersey, and $21.00 *per contact hour per semester* if non-residents.

Tuition includes charges for services other than instruction, such as library, publications, counseling, placement, etc., but does not cover the breakage or loss of College property.

APPLICATION, MATRICULATION AND SPECIAL FEES

JUNIOR DIVISION (EVENING)

LATE REGISTRATION FEE

Registration is required for each semester. A LATE REGISTRATION FEE *of $10.00 is required for those who register late.*

For the first semester of the first year, books cost approximately $45.00 with an additional $40.00 covering the cost of a slide rule and general supplies for that semester. Books and supplies for the second semester of the first year cost approximately $35.00.

SENIOR DIVISION (EVENING)

REGISTRATION FEES

A REGISTRATION FEE *of $5.00 per semester is charged for each semester. A* LATE REGISTRATION FEE *of $10.00 is required of those who register late.*

STUDENT FACILITIES FEE

Each evening student is charged a STUDENT FACILITIES FEE of $6.00 per semester.

LABORATORY FEE

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

GRADUATION FEE

A GRADUATION FEE of $25.00 is required of all candidates for the Bachelor's Degree. The graduation fee includes the cost of rental of academic dress.

JUNIOR AND SENIOR DIVISIONS (EVENING)

APPLICATION FEE

Each candidate for admission to the College must pay an APPLICATION FEE of $10.00 at the time the application for admission is submitted. The fee is not returnable, regardless of whether or not the applicant is admitted to the College. This fee covers service which is necessary to evaluate applications for admission.

READMISSION APPLICATION FEE

Any applicant for readmission to Newark College of Engineering must pay a READMISSION APPLICATION FEE of $10.00 at the time the Application for Readmission form is submitted.

(See section "Readmission," page 44.) This fee is not returnable, regardless of whether or not the student is readmitted to the College. This fee covers service which is necessary to evaluate applications for readmission.

MATRICULATION FEE

All students entering the College for the first time as candidates for a degree are charged a MATRICULATION FEE of $5.00.

PHYSICAL EXAMINATION FEE

A fee of $10.00 is charged if, at the discretion of the College, it seems advisable for the student to be given a physical examination.

SCHEDULE CHANGE FEE

A SCHEDULE CHANGE FEE of $3.00 is charged when a student requests a schedule change for reasons other than those beyond his control.

CHANGE OF GRADE FEE

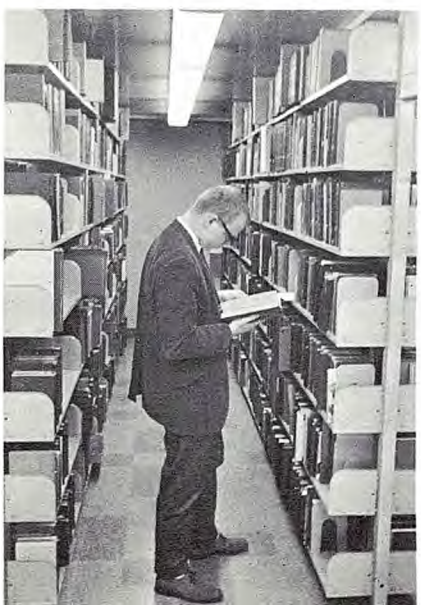
A fee of $1.00 is charged for the removal of a grade of "INC."

SPECIAL EXAMINATION FEE

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

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

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



CURRICULUMS
EVENING DIVISION

The first four years are common to all curriculums. All curriculums of the Evening Division are undergoing revision. Therefore, the courses listed apply only to the 1966-67 academic year. Students should consult with their major departments to determine requirements for the years following the 1966-67 academic year.

The numbers following the course title under the heading "1st Semester" and "2nd Semester" represent, in order: class hours per week, laboratory hours per week, and credits for the semester.

Course Number		Title	1st Semester		2nd Semester	
		FIRST YEAR				
(EG 1)	(EG 2)	Engineering Graphics	1-3	2½	1-3	2½
(Eng 11)	(Eng 12)	Composition and Literature	3-0	3	3-0	3
(IR 31)		Psychology of Personal Adjustment	2-0	1	-	
	(IR 34)	Elements of Industrial Growth	-		3-0	2
(Math 10A)	(Math 10B)	Introductory Mathematics I E & II E	3-0	2½	3-0	2½
		SECOND YEAR				
(Chem 15)	(Chem 16)	General Chemistry	4-3	4½	4-3	4½
(Hist 21)	(Hist 22)	Development of the Modern World I & II	3-0	2½	3-0	2½
(Math 20A)	(Math 20B)	Calculus I E & II E	3-0	2½	3-0	2½
		THIRD YEAR				
(Eng 22)†		English and American Literature after 1850	3-0	2½	-	
	(IR34)†	Elements of Industrial Growth	-		3-0	2
(Math 30A)		Calculus III E	3-0	3	-	
	(Math 30B)	Differential Equations E	-		3-0	3
(Phys 1)	(Phys 2)	Physics I & II	3-2	3½	3-2	3½
		FOURTH YEAR				
(Hist 21)	(Hist 22)	Development of the Modern World I & II	3-0	2½	3-0	2½
	(Math 90)	Computer Programming and Numerical Methods	-		2-2	2½
(Mech 1)		Statics	3-0	2	-	
	(Mech 2)	Dynamics	-		3-0	2
(Phys 3)		Physics III	3-2	3½	-	
	(Phys 4)	Modern Physics	-		3-0	2½

† Offered each semester.

CHEMICAL ENGINEERING
B.S. (Ch.E.)

FIRST, SECOND, THIRD AND FOURTH YEARS

The courses offered in the first four years will be found on page 75.

FIFTH YEAR (Block 41 ChE)

Course Number		Title	1st Semester		2nd Semester	
	(Chem 25)	Principles of Engineering Materials	-		3-0	2½
(Chem 28-A)		Quantitative Analysis	1-3	2	-	
(ChE 21)	(ChE 22)	Physical Chemistry I & II	3-0	2½	3-0	2½
	(ChE 27)	Chemical Engineering Problems	-		3-0	2½
	(ChE 75)	Physical Chemistry Laboratory I	-		0-3	2
(IE 23)		Economics	3-0	2½	-	
(Math 30B)		Differential Equations E	3-0	2½	-	

FIFTH YEAR SUMMER SESSION§

(Mech 6)		Mechanics of Deformable Bodies	3-2	4	-	

SIXTH YEAR (Block 42 ChE)

(ChE 23)	(ChE 24)	Organic Chemistry I & II	3-3	3½	3-3	3½
(ChE 45)	(ChE 46)	Chemical Engineering Thermodynamics	3-0	2½	3-0	2½
	(ChE 63)	Stage Operations	-		3-0	2½
(ChE 76)		Physical Chemistry Laboratory II	0-3	2	-	

SEVENTH YEAR (Block 43 ChE)

(ChE 64)	(ChE 65)	Transport Operations I & II	3-0	2½	4-0	3
(EE 92A)	(EE 92B)	Electrical Engineering I & II	3-0	2½	0-3	1
(IR 46)		Human Relations & Personnel Administration	3-0	3	-	
	(IR 48)	Labor Relations & Social Problems	-		3-0	3
		Elective (Humanities)†	3-0	2½	3-0	2½

EIGHTH YEAR (Block 44 ChE)

(ChE 45)	(ChE 46)	Chemical Engineering Thermodynamics	3-0	2½	3-0	2½
(ChE 57)	(ChE 58)	Unit Operations III & IV	3-3	4	3-3	5
(ChE 59)	(ChE 60)	Process and Plant Design I & II	1-2‡	2½	1-3‡	3½

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§ To complete the program within an eight-year period, a student must take the course indicated during the summer session.

† The humanities elective program is outlined on page 83.

‡ In this course, laboratory hours refer to hours of design.

CIVIL ENGINEERING
B.S. (C.E.)

FIRST, SECOND, THIRD AND FOURTH YEARS

The courses offered in the first four years will be found on page 75.

FIFTH YEAR (Block 41 CE)

Offered in 1966-67 and alternate years.

Course Number		Title	1st Semester		2nd Semester	
(CE 3)*		Surveying	3-3	4	-	
(EE 90)		Electrical Engineering	2-2	3	-	
	(CE 42)	Environmental Sanitation	-		2-0	2
	(CE 61)‡	Electronic Computations	-		3-1	3
	(Eng 41)	Engineering Report Writing	-		3-0	1½
		Elective (Humanities)†	3-0	2½	3-0	2½

* Eight six-hour Saturday field or laboratory periods to be arranged. No field work will be scheduled on the first Saturday of the semester.
† The humanities elective program is outlined on page 83.
‡ Five three-hour Saturday laboratory periods will be arranged.

SIXTH YEAR (Block 42 CE)

Not offered in 1966-67. To be given in 1967-68.

(Chem 25)		Principles of Engineering Materials	3-0	2½	-	
(IE 23)		Economics	3-0	2½	-	
(CE 21)	(CE 22)	Strength of Materials I & II	3-3	3½	3-0	2½
	(CE 40)	Fluid Mechanics I	-		5-0	4½
	(IE 97)	Enterprise Management	-		4-0	3

SEVENTH YEAR (Block 43 CE)

Offered in 1966-67 and alternate years.

(ME 41)		Thermodynamics I	3-0	2½	-	
	(ME 73)	Thermodynamics for C.E. II	-		3-0	2
	(ME 77)	Power & Fluids Laboratory	-		0-3	2
		Electives (Technical)†	9-0	7½	6-0†	5

† Students who have not completed Dynamics must take Mech 2 in lieu of one technical elective in 1966-67.

TECHNICAL ELECTIVES

Students must take three electives in the 1st Semester and two in the 2nd Semester. Only a limited number of technical electives will be offered each year.

Course Number		Title	1st Semester		2nd Semester	
(Chem 200)		Sanitary Microbiology**	3-0	3	-	
	(Chem 201)	Sanitary Chemistry**	-		3-0	3
(CE 5)*		Advanced Surveying I	3-0	2½	-	
	(CE 6)	Aerial Photographic Interpretation	3-0	2½	-	
(CE 17)		Engineering Geology	3-0	2½	-	
(CE 31)	(CE 32)	Construction Management I & II	3-0	2½	3-0	2½
	(CE 45)	Fluid Mechanics	-		3-0	2½
(CE 47)	(CE 48)	Hydr. & San. Engrg. I & II	3-0	2½	3-0	2½
(CE 51)		Urban Planning	3-0	2½	-	
	(CE 52)	Transportation Engrg.	-		3-0	2½
(CE 63)	(CE 64)	Numerical Methods I & II	3-0	2½	3-0	2½
(CE 71)	(CE 72)	Civil Engrg. Projects I & II	3-0	2½	3-0	2½
(IE 98)		Basic Accounting & Finance for Construction Mgmt.	3-0	2½	-	
	(IE 99)	Management & Control of Construction	-		3-0	2½

* Not available to students who have completed Engineering Surveys (140).

** For a description of this course, refer to the 1966-67 *Catalog of Graduate Programs*.

EIGHTH YEAR (Block 44 CE)

Not offered in 1966-67. To be given in 1967-68.

(CE 13)	(CE 14)	Soil Mechanics I & II	3-0	2½	0-3	1½
(CE 27)	(CE 28)	Structures I & II	3-0	2½	6-0	5½
(IR 46)		Human Relations & Personnel Administration	3-0	3	-	
	(IR 48)	Labor Relations & Social Problems	-		3-0	3
		Elective (Technical)‡	3-0	2½	-	

‡ Technical electives are listed above.

ELECTRICAL ENGINEERING
EIGHT-YEAR PROGRAM, B.S. (E.E.)

The Nine-Year Program appears on the following page.

FIRST, SECOND, THIRD AND FOURTH YEARS

The courses offered in the first four years will be found on page 75.

FOURTH YEAR SUMMER SESSION

Course Number	Title	1st Semester		2nd Semester	
(EE 10)	Electric Circuits and Measurements	3-2	3	-	

FIFTH YEAR (Block 41E)

(EE 20)	Passive Circuits	4-0	3	-	
(EE 40)	Electronic Devices	3-0	2	-	
(EE 60)	Electromagnetics	-		3-3	3½
(Math 30B)	Differential Equations E	3-0	2½	-	
(Math 35)	Vector Analysis	-		3-0	2½
(ME 41)	Thermodynamics I	-		3-0	2½

FIFTH YEAR SUMMER SESSION

(Mech 6)	Mechanics of Deformable Bodies	3-2	4	-	

SIXTH YEAR (Block 42E)

(EE 21)	Communications Networks	3-0	2	-	
(EE 42) (EE 44)	Active Circuits I & II	4-3	4½	3-3	4½
	Elective (Humanities)§	3-0	2½	3-0	2½

SIXTH YEAR SUMMER SESSION

(Chem 25) *or*	Principles of Engineering Materials	3-0	2½	-	
(IE 23) *or both*	Economics	3-0	2½	-	

SEVENTH YEAR (Block 43E)

(EE 22)	Transmission Circuits	-		4-0	3
(EE 25T)	Electromagnetic Fields	3-0	2½	-	
(EE 62) (EE 64)	Electrokinetics I & II	3-0	2½	3-3	3½
(IR 46)	Human Relations & Personnel Administration	3-0	3	-	
(IR 48)	Labor Relations & Social Problems	-		3-0	3
	Elective (Mathematics)‡	3-0	2½	-	

SEVENTH YEAR SUMMER SESSION

(Chem 25) *or*	Principles of Engineering Materials	3-0	2½	-	
(IE 23) *or both*	Economics	3-0	2½	-	

EIGHTH YEAR (Block 44)

(EE 25T)	Electromagnetic Fields	3-0	2½	-	
(IE 91)	Enterprise Management	-		4-0	3
(EE 80)	Advanced Measurements	2-3	3½	-	
	Electrical Engrg. Elective‡	-		3-0	2½
	Elective (Physics)‡	3-0	2½	-	
(EE 86)	Electrical Engrg. Project	-		0-3	2½

‡ Electives are listed on page 65.

§ The humanities elective program is outlined on page 83.

ELECTRICAL ENGINEERING
NINE-YEAR PROGRAM, B.S. (E.E.)

The Eight-Year Program appears on the preceding page.

FIRST, SECOND, THIRD AND FOURTH YEARS

The courses offered in the first four years will be found on page 75.

FIFTH YEAR (Block 51E)

Course Number		Title	1st Semester		2nd Semester	
	(Chem 25)	Principles of Engineering Materials	-		3-0	2½
	(EE 10)	Electric Circuits and Measurements	-		3-2	3
(IE 23)		Economics	3-0	2½	-	
(Math 30B)		Differential Equations E	3-0	2½	-	
	(Math 35)	Vector Analysis	-		3-0	2½
(Mech 6)		Mechanics of Deformable Bodies	3-2*	4	-	

SIXTH YEAR (Block 52E)

(EE 20)		Passive Circuits	4-0	3	-	
	(EE 21)	Communications Networks	-		3-0	2
(EE 40)		Electronic Devices	3-0	2	-	
	(EE 60)	Electromagnetics	-		3-3	4
(ME 41)		Thermodynamics I	3-0	2½	-	

SEVENTH YEAR (Block 53E)

(EE 42)	(EE 44)	Active Circuits I & II	4-3	4½	3-3	4½
(IR 46)		Human Relations & Personnel Administration	3-0	3	-	
	(IR 48)	Labor Relations & Social Problems	-		3-0	3
		Elective (Humanities)†	3-0	2½	3-0	2½

EIGHTH YEAR (Block 54E)

Beginning 1967-68.

	(EE 22)	Transmission Circuits	-		4-0	3
(EE 25)		Electromagnetic Fields	4-0	3	-	
(EE 62)	(EE 64)	Electrokinetics I & II	3-0	2½	3-3	3½
		Elective (Mathematics)‡	3-0	2½	-	
		Elective (Technical)‡	3-0	2½	-	

NINTH YEAR (Block 55E)

Beginning 1968-69.

(EE 80)		Advanced Measurements	2-3	3½	-	
	(EE 86)	Electrical Engrg. Project	-		0-3	2½
		Elective (E.E.)‡	-		3-0	2½
(IE 91)		Enterprise Management	4-0	3	-	
	(ME 78)	Thermodynamics for E.E. II	-		3-0	2

† The humanities elective program is outlined on page 83.
‡ The elective courses are listed on page 65.
* 5-0 on alternate weeks.

INDUSTRIAL ENGINEERING
B.S. (I.E.)

FIRST, SECOND, THIRD AND FOURTH YEARS

The courses offered in the first four years will be found on page 75.

FIFTH YEAR (Block 41 IE)

Course Number		Title	1st Semester		2nd Semester	
	(Chem 25)	Principles of Engineering Materials	-		3-0	2½
(IE 23)		Economics	3-0	2½	-	
(IE 25)		Logic and Scientific Method	2-0	2	-	
	(IE 27)	Digital Computer Programming	-		2-0	2
(Mech 6)		Mechanics of Deformable Bodies	3-2	4	-	
(ME 41)		Thermodynamics I	3-0	2½	-	
	(ME 75)	Thermodynamics for I.E. II	-		3-0	2
		Elective (Humanities)†	-		3-0	2½

SIXTH YEAR (Block 42 IE)

(IE 24A)		Production Process Design	3-0	2½	-	
(IE 37)	(IE 38)	Work Analysis I & II	3-3	4	3-0	2½
	(IE 47)	Accounting for Engineers	-		3-0	2½
(IE 96)		Engineering Economy	2-0	2	-	
	(ME 39)	Machine Design Fundamentals	-		3-0	2½
		Elective (Humanities)†	-		3-0	2½

SEVENTH YEAR (Block 43 IE)

(EE 96)	(EE 97)	Electrical Engineering I & II	3-2	3½	3-2	3½
(IE 39)	(IE 40)	Studies in Management Science I and II	3-3	4	3-0	2½
		Elective (Technical)‡	-		3-0	2½

† The humanities elective program is outlined on page 83.
‡ Technical electives are listed on page 67.

MECHANICAL ENGINEERING
ENGINEERING MANAGEMENT OPTION
B.S. (M.E.)

EIGHTH YEAR (Block 44 MO)
Offered through 1966-67 only.

(EM 56A)	(EM 56A)	Selection, Supervision & Control of Staff II	3-0	2	3-0	2
(EM 64A)	(EM 64A)	Motion and Time Study	1-2	2½	1-2	2½
(EM 68)	(EM 68)	Management of Production and Distribution	3-0	2	3-0	2
(EM 71A)	(EM 71A)	Accounting and Cost Accounting	3-0	2	3-0	2½

MECHANICAL ENGINEERING
B.S. (M.E.)

FIRST, SECOND, THIRD AND FOURTH YEARS

The courses offered in the first four years will be found on page 75.

FIFTH YEAR (Block 41M)

Course Number		Title	1st Semester		2nd Semester	
(Chem 25)		Principles of Engineering Materials	3-0	2½	-	
(IE 23)		Economics	3-0	2½	-	
(IR 46)		Human Relations & Personnel Administration	3-0	3	-	
	(IR 48)	Labor Relations & Social Problems	-		3-0	3
	(Math 30B)	Differential Equations E	-		3-0	2½
	(ME 10)	Manufacturing Processes	-		0-3	1½
(ME 41)	(ME 42)	Thermodynamics I & II	3-0	2½	3-0	2½

SIXTH YEAR (Block 42M)

	(EE 98)	Electrical Engineering I	-		3-0	2½
(ME 18)		Metallurgy	2-3	4	-	
(Mech 6)		Mechanics of Deformable Bodies	3-2‡	4	-	
	(ME 33)	Mechanical Vibrations	-		3-0	2½
	(ME 44)	Fluid Mechanics	-		3-0	2½
		Elective (Humanities)†	3-0	2½	3-0	2½

SEVENTH YEAR (Block 43M)

Course Number		Title	1st Semester		2nd Semester	
(EE 98)	(EE 99)	Electrical Engineering I & II	3-0	2½	3-3	4
(ME 18)		Metallurgy	2-3	4	-	
	(ME 45)	Heat Transfer	-		3-0	2½
		Elective (Humanities)†	3-0	2½	-	
		Elective (Technical)*	-		3-0	2½

EIGHTH YEAR (Block 44M)

(IR 46)		Human Relations & Personnel Administration	3-0	3	-	
	(IR 48)	Labor Relations & Social Problems	-		3-0	3
(ME 33)		Vibration Analysis	3-0	2½	-	
(ME 34)	(ME 36)	Mechanical Engineering Design I & II	3-3	4	3-3	4

† The humanities elective program is outlined on page 83.
‡ 5-0 on alternate weeks.
* Technical electives are listed on page 69.

HUMANITIES ELECTIVE PROGRAM§

Course Number	Title	1st Semester		2nd Semester	
(Arts 53)	Application of Visual Arts	3-0	2½	-	
(Arts 54)	Period, Style and Medium in the Visual Arts	-		3-0	2½
(Hist 53)	Aspects of American Civilization: Recent American History	3-0	2½	-	
(Hist 54A)	Special Areas: Modern Germany	-		3-0	2½
(Lit 51A)	An Era of Literature: Twentieth Century British and American Literature	3-0	2½	-	
(Lit 51B)	An Era of Literature: Twentieth Century European Fiction	-		3-0	2½

§ The humanities electives for the Evening Undergraduate Summer Session will be listed in the Announcement.

DEPARTMENTS AND COURSES OF INSTRUCTION

DEPARTMENTS OF ENGINEERING

Departments granting degrees at Newark College of Engineering include the fields of Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, and Industrial and Management Engineering. The last named department offers the B. S. in Industrial Engineering and the M. S. in Management Engineering.

The Department of Air Science offers Day Undergraduate students the opportunity to take the Air Force ROTC program leading to a commission as a Second Lieutenant in the U. S. Air Force Reserve.

BASIC SCIENCE DEPARTMENTS

Departments providing NCE students with a common background in mathematics and science, especially in the early years of their training are the departments of Chemistry, Engineering Graphics, Mathematics, and Physics and Mechanics. Known as the Technological Group, they also conduct advanced courses on both the undergraduate and graduate level.

HUMANISTIC-SOCIAL DEPARTMENTS

Since engineering education also requires that students receive a thorough grounding in the humanities, two additional departments have a prominent place in the curriculum: the Department of English and Humanistic Studies and the Department of Industrial Relations. Beside basic courses in English, Psychology, and Personnel Relations, these two departments offer a series of elective courses designed to provide students with opportunities for specialized studies in Arts, History, Literature, Philosophy, Sociology and other courses typical of the liberal arts tradition.

DIVISION OF HEALTH, PHYSICAL EDUCATION AND ATHLETICS

Common to the education of all Day Undergraduate students at NCE is a strong emphasis on health and physical activity. For this reason, Health, Physical Education and Athletics has been established as a separate, functional division of the College, gearing its programs to the needs and abilities of all students, and supervising a wide range of activities from formal gymnasium instruction to intramural and informal sports to health services.

DEPARTMENT OF AEROSPACE STUDIES

Chairman: Lt. Colonel James A. MacKenzie.
Associate Chairman: Lt. Colonel Melvyn Fenton.

Professor: MacKenzie; *Assistant Professors:* Dahl, Fenton, Fruth, Proctor; *Instructors:* Abarca, Levans, Maltsberger, Scheel, Williams.

The Department of Aerospace Studies offers qualified students an educational experience leading to a commission as an officer in the U.S. Air Force and is conducted by an instructing staff consisting of professional Air Force officers, most of whom are flying officers, graduate engineers, or both.

The Air Force Education Program (ROTC) qualifies for commission as a Second Lieutenant those college men who desire to serve in the United States Air Force. Emphasis is placed upon student participation and self-expression through seminars, briefings, and discussions.

Enrollment is voluntary. It is open to all regularly enrolled day session students who are citizens of the United States, possess good moral character, are physically qualified, are not less than fourteen years of age, and are approved by the President of the College and the Professor in Aerospace Studies. Entrance into the Professional Officer course is on a selective basis. Selection is based upon composite scores derived from Air Force Officer Qualifying Tests, Air Force ROTC grades, academic grades, and instructors' and Professional Officer Course Selection Committee Members' estimate of the cadet's potential officer qualities and leadership ability. In addition, an applicant for enrollment in the Professional Officer course will not be eligible unless he will be less than 28 years of age at the time of graduation, if enrolling in Categories II, III, or IV, or less than 26½ years of age at time of graduation, if enrolling in Categories IP or IN. Choice of category is made at time of application for enrollment in the Professional Officer course. The categories to choose from are as follows:

Category IP. Included are those cadets who desire to enter pilot training after graduation and who meet the mental and physical standards for this type of training. The active duty obligation is five years.

Category IN. Included are those cadets who desire to enter navigation training after graduation and who meet the mental and physical standards for this type of training. The active duty obligation is five years.

Category II. Included are those cadets who are pursuing Electrical, Mechanical, Industrial, Chemical, or Civil Engineering or other scientific and technical fields, and who meet the

mental and physical standards for an Air Force commission. The active duty obligation is four years.

CATEGORY II (Meteorology). Included are those cadets who meet certain academic prerequisites in physics and mathematics and who desire to serve as weather officers. The active duty obligation is four years.

CATEGORY III (Any Degree). Included are those cadets who are pursuing courses leading to degrees in the liberal arts, and who meet the mental and physical standards for an Air Force commission. The active duty obligation is four years.

CATEGORY IV. Included are veterans of the armed forces who can meet the mental and physical standards for an Air Force commission. They have no mandatory active duty obligation.

The inclusion of Aerospace Studies courses in the student's program does not materially increase his workload, as these courses receive comparable credits and may be substituted for certain courses in the standard curriculum.

Uniforms and textbooks are furnished without cost by the United States Air Force and advanced students receive a subsistence allowance of approximately $40 per month. Each student enrolled in the freshman and sophomore year will be required to pay a $15 uniform deposit.

Cadets entering the Professional Officer course may be selected to receive an Air Force ROTC scholarship. The scholarship will cover the cost of tuition, books, fees and equipment, and a monthly retainer pay of $50. There is no additional service commitment for cadets receiving a scholarship.

Between the Junior and Senior years, advanced students will normally attend a 28-day field training encampment at an Air Force base. While attending summer training, students receive pay, transportation to and from training, medical attention, subsistence, quarters, and uniforms.

COURSES OF INSTRUCTION

AS 1. WORLD MILITARY SYSTEMS I. 1 *credit.*

An introductory course exploring the present world conflict, and the role and relationship of military power to that conflict. A discussion of the factors from which differing political philosophies have evolved continues with analysis of three prime political philosophies. This is followed by a discussion of the means that nations develop to pursue their objectives and how they confront each other in the use of these means. The course then presents the role and functions of the U.S. Department of Defense and the U.S. Air Force. One class hour per week, and one hour of leadership laboratory.

AS 2. World Military Systems II. 1 *credit.*

Prerequisites: AS 1 or 6 months' active military service. A comparative study of world military forces to include Free World land and naval forces, Free World air forces, Communist military systems, and trends in the development and employment of military power. One class hour per week, and one hour of leadership laboratory.

AS 3. Growth and Development of Aerospace Power. 2½ *credits.*

Prerequisite: AS 2 or one year's active military service. A survey course about the nature of war; development of airpower in the United States; mission and organization of the Defense Department; Air Force concepts, doctrine, and employment; astronautics and space operations; and the future development of aerospace power. Includes the United States space programs, vehicles, systems, and problems in space exploration. Three class hours per week, and one hour of leadership laboratory.

AS 4. The Professional Officer. 2½ *credits.*

Prerequisite: AS 3. A study of professionalism, leadership, and management. Includes the meaning of professionalism, professional responsibilities, the Military Justice System; leadership theory, functions, and practices; management principles and function; problem solving; and management tools, practices, and controls. Three class hours per week, and one hour of leadership laboratory.

DEPARTMENT OF CHEMICAL ENGINEERING

Chairman: JOSEPH JOFFE.
Associate Chairman: GEORGE C. KEEFFE.

Professor Emeritus: MANTELL; *Distinguished Professor:* JOFFE; *Professors:* ANDERSEN, CARLSON, FREDERICK, KEEFFE, KREPS, SALAMONE; *Associate Professor:* MCCORMICK; *Assistant Professors:* CASCIANO, HANESIAN, SNYDER; *Instructor:* DRUIN; *Assistant Instructor:* BARNER; *Adjunct Instructing Staff:* AXELSON, KEMME, LOVENGUTH, MEISINGER, WOLKSTEIN.

The Chemical Engineering curriculum is designed to give the student a thorough background in the fundamental sciences and engineering subjects. It prepares the student for a professional career in chemical engineering in the process industries involving the development of practices in chemical manufacture and related operations, the design and operation of plants, as well as chemical and engineering application in non-chemical organizations.

To this end, the organic, unit operations and specialized laboratories are so equipped that the student may follow a particular process from test tube scale to semi-commercial scale and allow estimation of large scale production. The equipment in the unit operations and process laboratories is, for the most part, of modern design. This equipment has been adapted to the teaching of basic scientific principles and for quantitative and economic evaluation. The Physical Chemistry Laboratory and Instrument Laboratories are equipped for control and instrumentation studies for general and fundamental training in the physicochemical field. The course in Process and Plant Design coordinates and utilizes all of the engineering work in the chemical engineering curriculum. All equipment with associated design rooms, research laboratories and specialized areas is located in the Tiernan laboratories at 240 High Street.

The department encourages active participation of its students in the Student Chapters of the American Institute of Chemical Engineers and of the American Chemical Society. These student groups arrange for guest speakers from industry and for plant trips, both of which are important in orienting professional interest and attitude.

In addition to the one day trips arranged by the student chapters, the chemical engineering students, with the cooperation of the department, visit industries outside the Newark area. This extended trip is usually taken during one of the regular college vacation periods and is required of all chemical engineering students. All expenses incident to this trip are to be paid by the individual student.

ChE 21. PHYSICAL CHEMISTRY I. 2½ *credits.*

Prerequisites: Math 22, Phys 4, Chem 28, ChE 27. The topics covered include the properties of ideal and non-ideal gases, liquids, solids, solutions, thermochemistry, and elementary thermodynamics. The relationship between physical properties and molecular structure is shown.

ChE 22. PHYSICAL CHEMISTRY II. 2½ *credits.*

Prerequisite: ChE 21. The topics covered are homogeneous and heterogeneous equilibria, phase rule, electrolytic transference and conductance, ionic equilibria, electromotive force, and kinetics.

ChE 23. ORGANIC CHEMISTRY I. 3½ *credits.*

Prerequisite: Chem 28. Lectures, problems, and laboratory exercises in the principles and practice of organic chemistry presenting an integrated study of aliphatic, aromatic, and heterocyclic compounds. Modern concepts of structure and mechanism are considered.

ChE 24. ORGANIC CHEMISTRY II. 3½ *credits.*

Prerequisite: ChE 23. A continuation of the integrated study of organic chemistry. Laboratory work will emphasize more advanced analytic and synthetic procedures.

ChE 27. CHEMICAL ENGINEERING PROBLEMS. 2½ *credits.*

Prerequisite: Math 12, Phys 2, Chem 16. A course in the application of principles of physics and chemistry and the quantitative solution of industrial chemical process problems. Emphasis is placed on material and heat balance of complex chemical reactions.

ChE 45. CHEMICAL ENGINEERING THERMODYNAMICS I. 2½ *credits.*

Prerequisites: ChE 27, 21 or 35, Math 22. The thermal properties of matter are studied and interpreted in terms of the fundamental concepts and laws of thermodynamics. Generalized methods for handling p-V-T relations and thermodynamic properties of fluids are considered. Applications are made to batch and flow processes.

ChE 46. CHEMICAL ENGINEERING THERMODYNAMICS II. 2½ *credits.*

Prerequisite: ChE 45. The concepts and methods developed in ChE 45 are applied to the treatment of compressors, heat engines, refrigeration, and phase equilibria. The student is introduced to the thermodynamic analysis of practical processes as a method for the evaluation of energy utilization.

ChE 49. REACTION KINETICS. 2½ *credits.*

Prerequisites: ChE 22, 45. A study of the kinetics of homogenous chemical reactions in batch and flow reactors and of the applications of kinetics to chemical reactor design. Problems also stress economic choice among alternate designs.

ChE 57. CHEMICAL ENGINEERING UNIT OPERATIONS III. 4 *credits.*

Prerequisites: ChE 44, 35. A lecture-problem course in diffusional operations which will include molecular diffusion in fluids, analogy between heat, mass and momentum transfer and quantitative calculations in simultaneous heat and mass transfer. The laboratory will include experiments in fluid flow, heat transfer, evaporation, fluidization, mixing, crushing and grinding, filtration and sedimentation on a quantitative basis. Process instrumentation will be emphasized.

ChE 58. Chemical Engineering Unit Operations IV. 5 *credits.*

Prerequisite: ChE 57. A lecture-problem course covering the unit operations of distillation, liquid extraction, drying and adsorption. The laboratory will include experiments in distillation, gas absorption, liquid extraction and drying. Process instrumentation will be emphasized.

ChE 59. Process and Plant Design I. 2½ *credits.*

Prerequisites: ChE 27, 28, 35, 42, 44. Co-ordination and application of knowledge gained in other courses is applied to the design of chemical engineering equipment, foundations, outer connection, material of construction, corrosion and preservation. An intensive study is made of economic factors.

ChE 60. Process and Plant Design II. 3½ *credits.*

Prerequisites: ChE 57, 59. Literature search, experimental work, design calculations, specifications, interconnection and selection of equipment for a coordinated process and plant, plant layout, cost studies, labor and management economics, codes and related factors.

ChE 63. Stage Operations. 2½ *credits.*

Prerequisites: ChE 27, Math 22, Phys 4. Physical separation processes involving multistage contacting equipment are studied. Processes such as distillation, absorption, and extraction are considered.

ChE 64. Transport Operations I. 2½ *credits.*

Prerequisites: ChE 63, Math 22. This course includes the principles of molecular and turbulent transport of momentum, heat, and mass.

ChE 64H. Transport Operations I. 2½ *credits.*

Prerequisites: ChE 63, Math 31. An honors course. Principles of the molecular and turbulent transport of momentum, heat, and mass with an emphasis on mathematical description of physical phenomena.

ChE 65. Transport Operations II. 3 *credits.*

Prerequisite: ChE 64. A continuation of ChE 64 with an emphasis on the application of transport theory and empirical relationships to the design and analysis of chemical process equipment.

ChE 65H. Transport Operations II. 3 *credits.*

Prerequisite: ChE 64H. A continuation of ChE 64H at the honors level.

ChE 67. Chemical Engineering Laboratory I. 2 *credits.*

Prerequisite: ChE 64. Laboratory experiments in fluid mechanics, heat transfer, evaporation, fluidization, mixing, sedimentation, crushing and grinding and filtration. Process instrumentation are emphasized. All experiments are on a quantitative basis.

ChE 68. Chemical Engineering Laboratory II. 2 *credits.*

Prerequisite: ChE 67. A continuation of ChE 65, with experiments in distillation, gas absorption, liquid extraction, and drying. Experimental projects will be conducted dealing with any phase in chemical engineering depending upon the interests of the students.

ChE 71. Process and Plant Design I. 2½ *credits.*

Prerequisites: ChE 22, 24, 27, 45, 64. Chemical economics, market analysis and process development; patents, trade secrets, and licenses; adaptation of available raw materials as factors in design. Development of the project; process, equipment, and utility flowsheets and material balances; plant location, foundations, water and raw material supplies; engineering materials and corrosion. Optimization of process and control. Process dynamics and instrumentation.

ChE 72. PROCESS AND PLANT DESIGN II. 2½ *credits.*

Prerequisites: ChE 49, 65, 71. The development of a plant design for a specific product selected by groups so that equipment can be designed and purchase specifications written and coordinated into a dimensioned plan and elevation at a selected location. Economic evaluation of process, design, and production.

ChE 73. CHEMICAL ENGINEERING PROBLEMS II. 2½ *credits.*

Prerequisite: Math 30. A course in applied mathematics in fields of interest to the chemical engineer. A short treatment of Fortran type programming for computer use and a study of the method of computer operation is included to provide a sound basis for understanding the limitations of computers. Matrix methods are studied as they are used with computers. Problem setup and solution of differential equations for both steady state and unsteady state processes are studied. Particular reference is made to the use of Bessel functions, error functions, the Laplace transforms and the principles of coupling and superposition.

ChE 74. PROCESS DYNAMICS AND CONTROL. 2½ *credits.*

Prerequisites: ChE 49, 65, Math 30. An introduction to the principles of process dynamics and control with application to the automatic control of chemical processes. Mathematical description and analysis of chemical process systems is included.

ChE 74H. PROCESS DYNAMICS AND CONTROL. 2½ *credits.*

Prerequisites: ChE 49, 65, 73. An introduction to the principles of process dynamics and control with application to the automatic control of chemical processes. Mathematical description and analysis of chemical process systems. This course is similar in content to ChE 74, but covers the subject matter in greater depth.

ChE 75. PHYSICAL CHEMISTRY LABORATORY I. 2 *credits.*

Prerequisites: Chem 28, ChE 21. This course consists of laboratory experimentation in which the student applies and extends the basic knowledge of physical chemistry acquired in ChE 21 and ChE 22. Some of the experiments performed are on physical properties such as surface tension, vapor pressure, and viscosity, and on heats of reaction, equilibria, and kinetics. Laboratory reports must include an analysis of experimental errors and a quantitative treatment of the reliability of calculated results.

ChE 76. PHYSICAL CHEMISTRY LABORATORY II. 2 *credits.*

Prerequisites: ChE 22 or 35, ChE 75. This course extends the laboratory experimentation of ChE 75. Included are experiments on the determination of rate constants, distribution constants, ionization constants, conductance and electrode potentials. The student is introduced to the use of instruments, such as spectrophotometers, gas chromatographs, and electrometric apparatus.

ChE 77. CHEMICAL ENGINEERING METALLURGY. 2½ *credits.*

Prerequisites: ChE 22, 64. Application of chemical engineering unit operations to pressure leaching of ores and slimes, to benefication, flotation, vaporization of metallic compounds and vapor phase separation, rare earth fractionation by adsorption, non-aqueous solvent extraction of minerals, liquid-liquid extraction applied to metallurgy, continuous recovery of by-products from recycling operations, and recovery of base metals from complex ores.

ChE 78. CHEMICAL REACTOR DESIGN. 2½ *credits.*

Prerequisite: ChE 49. A project and problem course emphasizing the application of thermodynamics, kinetics, and economics to the design of chemical processes. Procedures for process optimization and scaling up of designs are considered.

DEPARTMENT OF CHEMISTRY

Chairman: M. LELYN BRANIN
Associate Chairman: JOSEPH M. FITZGERALD
Assistant Chairman: VINCENT N. CAGNATI

Professor Emeritus: BAUDER; *Professors:* BISHOP, BRANIN, FITZGERALD, RAM; *Associate Professors:* KWEI, POETZ, SHILMAN, WENISCH; *Assistant Professors:* CAGNATI, PERLMUTTER, SUCHOW; *Instructors:* BULSARA, DAVIS, KNAPP, LOONKAR, POIGNANT, RZUCIDLO, SARFATI; *Special Instructing Staff:* GETZIN, GOTTSCHALL; *Adjunct Instructing Staff:* DESANTIS, HOFFMAN, LI, REIFENBERG.

The increasing awareness of the importance of science and engineering in our national economy has been taken cognizance of in planning the various courses presently being offered by the Department of Chemistry. Since the responsibility of establishing a solid foundation for the student's engineering education rests largely with those departments teaching the physical sciences and mathematics, the chemistry courses have been designed to develop the student's understanding of fundamentals by placing maximum emphasis on the principles and the methods of science. Both in the classroom and in the laboratory, the emphasis generally is directed to the quantitative more than to the qualitative aspects of the subject. Frequent references also are made to the relationships existing between fundamental principles and their application to the solution of engineering problems.

A second important objective is the establishment of an adequate scientific foundation upon which the student may build after graduation from college and during the course of his subsequent professional career.

The Department of Chemistry offers courses in general college chemistry, including some analytical chemistry, quantitative analysis, and principles of engineering materials. In addition to these, certain special courses, such as sanitary chemistry and sanitary microbiology, are offered as technical options for students majoring in Chemical or Civil Engineering.

COURSES OF INSTRUCTION

Chem 15. GENERAL CHEMISTRY. 4½ *credits.*

Fundamental chemistry, including general inorganic, analytical, and some organic and nuclear chemistry, with particular emphasis on those concepts which are basic to an engineering education. Both the pace and content of the course presuppose a full year of high school chemistry prior to entering college.

Chem 15H. HONORS CHEMISTRY. 4½ *credits.*

This is an honors course in chemistry which follows in general the course content of Chem 15 but differs from it in that the fundamental theory is covered more comprehensively and in somewhat greater depth. Admission to the course is restricted.

Chem 16. General Chemistry. 4½ *credits.*

Prerequisite: Chem 15. A continuation of Chem 15.

Chem 16H. Honors Chemistry. 4½ *credits.*

Prerequisite: Chem 15. This is a continuation of Chem 15H. Admission to the course is restricted.

Chem 25. Principles of Engineering Materials. 2½ *credits.*

Prerequisites: Chem 15, 16. A study of the basic principles which underlie the behavior of materials. The influence of structure and bonding forces on properties is emphasized.

Chem 28. Introduction to Quantitative Analysis. 2 *credits.*

Prerequisites: Chem 15, 16. A brief course in which the student is introduced to the methods of volumetric and gravimetric analysis. Emphasis is placed upon errors which are common to all types of analysis.

DEPARTMENT OF CIVIL ENGINEERING

Chairman: WILLIAM S. LA LONDE, JR.
Associate Chairman: JAMES M. ROBBINS.

Distinguished Professor: LA LONDE; *Professors:* LEHMAN, MANGASARIAN, ROBBINS; *Associate Professors:* METZGER, RAAMOT; *Assistant Professors:* DISKO, GALANDAK, LAW, MONAHAN, NALEZNY; *Assistant Instructor:* KULHAWY; *Teaching Fellows:* DUL, FUSCO.

Modern civil engineering includes within its scope the economic planning, design, construction, operation, and maintenance of the fixed structures and works required by our present industrial civilization. Its coordinated subdivisions comprise: structural engineering, which provides bridges, dams, industrial plants, foundations, buildings, tunnels, and other important stationary structures; transportation engineering, which provides highways, railroads, airways, inland waterways and the terminal facilities requisite thereto; hydraulic engineering, covering the development of water supplies, irrigation, drainage, hydro-electric power, flood control and shore protection; sanitary engineering, which provides potable water supplies, treatment and disposal facilities for sewage and industrial wastes, and measures incident to the engineering control of communicable disease; surveying, which furnishes the engineering surveys required by all construction operations, the proper delineation of property, and the base maps of the nation; and construction management, which provides the planning and direction required to get things built.

A field so varied requires that the academic training of those who enter it have breadth as well as depth. Rigorous education in the basic sciences is fundamental. A knowledge of numerical methods is necessary to enable the practicing engineer to program his long and complex problems for solutions by electronic computers. Economics and finance are of the essence in this field. Knowledge of the properties of engineering materials is essential not only in design but in research. A rational approach to personnel problems is vital. Chemistry, biology and bacteriology are required by the sanitarian. The operation of highly mechanized construction plants requires basic training in mechanical and electrical engineering. The ability to write clearly and to speak convincingly must be inculcated. Liberal training must be provided in the humanities if the student is to develop to take his proper part, as engineer and citizen, in the community. Integrated with, and built upon, this broad foundation we have the applications of the engineering method to the professional work of the field.

To provide for breadth of training in a four-year undergraduate program, the hours devoted to courses which are primarily vocational in character have been reduced to a minimum. Depth of training is obtained by permitting the student to select

approximately one full semester of technical electives best suited to his graduate professional or academic interests. Highly specialized instruction of an advanced character has been definitely placed in the graduate program.

COURSES OF INSTRUCTION

CE 3. SURVEYING. 4 *credits.*

Prerequisite: Math 10. Theory, fieldwork, drafting and computations dealing with plane, cadastral, topographic, and route surveys.

CE 5. ADVANCED SURVEYING I. 2½ *credits.*

Prerequisite: CE 3. The theory of engineering astronomy, of satellite and space vehicle tracking, and of geodetic and hydrographic surveying will be considered in class. An occasional day or evening field period will be held in lieu of classes to permit the student to make field observations on the sun, stars or other heavenly bodies for the determination of latitude, longitude, time and azimuth.

CE 6. AERIAL PHOTOGRAPHIC INTERPRETATION. 2½ *credits.*

Analysis and study of 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 aerial photography to materiels surveys, land surveying, traffic engineering, highway construction and general construction is discussed in detail.

CE 13. SOIL MECHANICS AND FOUNDATIONS I. 2½ *credits.*

Prerequisite: CE 22. A study of all soil types and properties; the significance of soil tests; the methods of compaction, consolidation and settlement; bearing capacity and pile tests and formulas; lateral pressures; frost heaving; soil stabilization; and problems relating to the proper design of soil supported foundations for engineering structures.

CE 14. SOIL MECHANICS AND FOUNDATIONS II. 1½ *credits.*

Prerequisite: CE 13. The theoretical studies carried out in CE 13 are supplemented by experimental work in the soil mechanics laboratory.

CE 17. ENGINEERING GEOLOGY. 2½ *credits.*

A study of physical geology and physiography with particular emphasis placed on the applications of the material considered in Civil Engineering work.

CE 21. STRENGTH OF MATERIALS I. 3½ *credits.*

Prerequisites: Mech 1, Math 21. A consideration of the relations between external forces acting on engineering structures and the resulting internal forces and stresses, and the relations between external forces and strains. Many practical problems are worked out illustrating the use of the derived principles. In the laboratory, tests are conducted to investigate some of the physical characteristics of materials and to verify the assumptions used in theoretical analysis. The results of each test are summarized in an engineering report.

CE 22. STRENGTH OF MATERIALS II. 2½ *credits.*

Prerequisite: CE 21. A continuation of the stress-strain relations begun in CE 21. There is no laboratory verification.

CE 27. STRUCTURES I. 2½ *credits.*

Prerequisites: Mech 1, CE 22. A course in statically determinate and indeterminate structural theory. The practical design considerations will be carried out by those interested in the civil engineering projects courses.

CE 28. STRUCTURES II. 5½ *credits.*

Prerequisites: Mech 1, CE 22, 27. This course covers the fundamentals of structural design and the elements of reinforced concrete theory and design involving indeterminate structural applications. Further practical design considerations will be carried out by those interested in the civil engineering projects courses.

CE 31. CONSTRUCTION MANAGEMENT I. 2½ *credits.*

Prerequisite: IE 97. A study of engineered construction with emphasis on planning and management. Organization of projects with special attention to critical path analysis for control. Detailed discussion of contract documents, construction methods, materials handling and expedition of projects.

CE 32. CONSTRUCTION MANAGEMENT II. 2½ *credits.*

Prerequisite: CE 31. A study of the economic feasibility and financing of various construction projects. Detailed analysis of bid procedures and methods used in estimating cost including the use of critical path scheduling with programming for computer solutions.

CE 41. FLUID MECHANICS I. 4 *credits.*

Prerequisites: Math 21, Mech 1, 2. A problem course treating the static and dynamic behavior of fluids with a majority of applications dealing with the flow of water and other incompressible fluids. Emphasis is placed on the understanding of fundamental laws and the equations derived from them. Problems of compressible fluids and of similitude are also studied as well as the means for measuring fluid flow by theoretical and semi-empirical methods.

CE 42. ENVIRONMENTAL SANITATION. 2 *credits.*

Prerequisite: Chem 16. A study of the engineering control of man's environment through: the proper collection, treatment, and disposal of domestic and industrial wastes; the provision of potable water supplies; milk and food sanitation; the control of rodents and insects; the sanitation of public buildings; swimming pool sanitation; the construction of proper housing; air pollution control; radiological sanitation; and industrial hygiene. Water purification and waste water treatment, are dealt with in detail.

CE 45. FLUID MECHANICS II. 2½ *credits.*

Prerequisite: CE 40. A problem course treating with fluid flow in pipe networks, flow in open channels, backwater curves, hydraulic jump, and some dynamic problems.

CE 47. HYDRAULIC AND SANITARY ENGINEERING I. 2½ *credits.*

A study of the occurrence, distribution and utilization of water and of the analyses required for the design of regulatory works for water supplies, hydro-electric developments, irrigation, flood control, erosion control and inland navigation. Design problems deal with the development of the water resources of a river basin, the determination of the safe yield of a reservoir, flood routing and the design of hydrologic structures.

CE 48. HYDRAULIC AND SANITARY ENGINEERING II. 2½ *credits.*

Prerequisite: CE 42. A course covering the principles of the design, construction and operation of water supplies, distribution systems and treatment works, of storm drains and sanitary sewers, and of waste water treatment and disposal structures. Design problems deal with water distribution lines, storm drains and sanitary sewers.

CE 51. URBAN PLANNING. 2½ *credits.*

Topics will include the interrelated concept of planning, politics, and the public interest; land use and its interaction with traffic and transportation; and the problems of the older city including urban renewal and rehabilitation. Practical applications will be presented in the form of case studies. Assignments will consist of readings from the available literature and a number of short problems.

CE 52. TRANSPORTATION ENGINEERING. 2½ *credits.*

A study of the principal modes of transportation, with emphasis on the planning, design, and construction of facilities for modern transportation systems. The practical design considerations will be carried out by those interested in the Civil Engineering Projects courses.

CE 61. ELECTRONIC COMPUTATIONS AND DATA PROCESSING. 3 *credits.*

Prerequisite: Math 22. Digital and analog systems are studied from the viewpoint of their use in solving engineering problems and processing data. Both computer oriented and problem oriented languages are studied. Coding is treated from a logical basis. Problem solutions are tested at the Computing Center.

CE 63. NUMERICAL METHODS IN ENGINEERING ANALYSIS I. 2½ *credits.*

Prerequisite: Math 22. Modern powerful methods of analysis will be introduced through a number of simplified engineering problems of current interest. Students will use the College Computing Center for some of the solutions. Topics will include matrix methods, iteration and relaxation, methods of finite calculus, and polynomial approximations.

CE 64. NUMERICAL METHODS IN ENGINEERING ANALYSIS II. 2½ *credits.*

Prerequisite: Math 22. The method of approach is the same as in CE 63. Topics will include simulation and mathematical models, principles of linear programming, and the application of probability and random processes to quality control, treatment of data, and the waiting line problem.

CE 71. CIVIL ENGINEERING PROJECTS I. 2½ *credits.*

Prerequisite: Limited to seniors who ranked in the upper half of their Junior class. Upon the completion of a common project in structural design, the student works on one or more individually selected projects, guided by the Civil Engineering Department staff. The projects may include planning, research (library or laboratory), engineering reports, statistical or analytical investigations, and designs. Any of these may follow class inspired direction or the student may branch out on his own. The project or projects of each student must be completed and professionally presented by assigned due dates for appropriate review and recording of accomplishment. Critiques will be held and the student will present his work to other students having similar interests.

CE 72. CIVIL ENGINEERING PROJECTS II. 2½ *credits.*

Prerequisite: Satisfactory Senior Standing. CE 71 is a prerequisite for students electing a structural problem or problems in this course. One or more individually selected projects conforming to the specifications given in the description for CE 71.

DEPARTMENT OF ELECTRICAL ENGINEERING

Chairman: FREDERICK A. RUSSELL.
Associate Chairman: ROBERT E. ANDERSON.
Assistant Chairmen: CHUNG-WEI CHOW, ROBERT R. MEOLA.

Professors: ANDERSON, DICKEY, FISHMAN, JORDAN, MISRA, PADALINO, RUSSELL, ZAMBUTO; *Associate Professors:* CHING, KUO, LAWRENCE, MEOLA, MEYER, REDMON, RIPS, ROSE, WINSTON; *Assistant Professors:* AYOUB, CARLUCCIO, CHOW, CLEMENTS, GOODMAN, ITTLESON, RICCI, ROSENSTEIN, STRANO, YEH; *Instructors:* COHEN, EISENBERG, MISHRA; *Assistant Instructors:* BIONDI, FISCHER, MCMILLAN, TROOP; *Teaching Fellows:* ADDEO, HAFNER, HENN, PERRY; *Adjunct Instructing Staff:* ALBANESE, COHEN, COLANANNI, DAY, FALCONE, FIGULAR, HENDROCK, HODDE, HOLLINGSWORTH, KOSONOCKY, KURLAND, LENZING, LYONS, MADSEN, MAGID, NORMANDO, RANSOM, SALVATORE, SCHENBERG, SCHLICK, SCHOENBLUM, SCHRAMM, SMITH, TORCICOLLO, WEINBERG, WOERNER, YADVISH, YAWORSKY.

The Electrical Engineering curriculum provides a broad, basic engineering education. A student will have completed his preparatory education in mathematics, the physical sciences, English, and the humanities during the first half of his college curriculum. During the final years his education is broadened into associated fields of engineering and includes increased specialization in his chosen field, electrical engineering.

The electrical engineering courses emphasize basic principles, concepts, and their interrelations upon which the design and operation of electrical devices of our present electrical age depend.

The aim is to educate an electrical engineer who can think analytically and creatively, work efficiently, and convey the results of his work effectively to others. He is prepared for responsibilities as a professional engineer and citizen in a democracy by his experiences within the group of fellow students and laboratory co-workers.

His electrical engineering education is as broad as possible so that employment opportunities upon graduation will not be restricted. His education is adequate for further advanced study in his chosen field if his interest lies in research or development. However, the curriculum can serve as a terminal engineering program leading to industrial work or activity as an engineer dealing with production, operation, or service.

Branches of the Institute of Electrical and Electronic Engineers and Eta Kappa Nu are active and stimulate interest in the practical and professional aspects of electrical engineering.

COURSES OF INSTRUCTION

EE 10. ELECTRIC CIRCUITS AND MEASUREMENTS. 3 *credits.*

Prerequisites: Phys 3, Math 20 or 21. A class and laboratory introductory course in Electrical Engineering. Definitions of electric circuit parameters, Kirchhoff's rules for instantaneous values in differential equation form, and special solutions to these using complex quantities. Mesh and nodal analysis, resonance, and balanced polyphase circuits. The laboratory work covers electrical measurements over a wide range of frequencies. The class work features problem solving, and the laboratory work emphasizes basic measurement techniques.

EE 20. PASSIVE CIRCUITS. 3 *credits.*

Prerequisites: EE 10, Math 22 or 25 and approval by EE Department. Loop and nodal analysis of network, pole-zero diagrams and complex-frequency variable response analysis, Matrix algebra, max. power transfer analysis, Thevenin and Norton Theorems, Laplace transform, initial and final value theorems, convolution integral, impedance function manipulation, superposition and reciprocity theorem, Fourier series and frequency spectrum, and Fourier integral and Fourier transform.

EE 20H. PASSIVE CIRCUITS FOR HONORS STUDENTS. 3 *credits.*

Prerequisites: EE 10, Math 22 or 25. Students cover the subject material of EE 20 at an accelerated rate. In addition, there will be a presentation of advanced analysis in the frequency domain, matrix manipulation, numerical analysis and computer applications.

EE 21. COMMUNICATION NETWORKS. 2 *credits.*

Prerequisite: EE 20. This course covers two-port networks with the use of matrix algebra, synthesis of RL, RC, Foster and Cauer networks, tuned-circuit coupling networks including Butterworth, Chebyshev and feedback systems, frequency response plots, Bode diagrams, Fourier series, and the Fourier integral.

EE 22. TRANSMISSION CIRCUITS. 3 *credits.*

Prerequisite: EE 21. This course includes the study of four-terminal networks with linear passive circuit elements. Hyberbolic functions, image and characteristic impedance, transmission equations and propagation are dealt with. Distributed parameter transmission lines at the variety of frequencies at which they are used are covered. Other topics include: lossless lines, Smith Chart applications, transient response of lines, insertion loss, and electric wave filters.

EE 22H. TRANSMISSION CIRCUITS FOR HONORS STUDENTS. 3 *credits.*

Prerequisites: EE 21 and approval by EE department. This course provides the honors student with the opportunity to cover the regular material of transmission circuits through a planned summer program of self-study. A final examination is given just prior to the start of Fall classes.

EE 25. ELECTROMAGNETIC FIELDS. 3 *credits.*

Prerequisites: Math 22, 35. This is a foundation course to develop an understanding of the static and dynamic characteristics of electric and magnetic fields. Static fields are studied so that subsequently the motion of charges in fields can be comprehended, and the magnitudes of important voltage gradients determined. Dynamic electromagnetic fields are presented to indicate their wave characteristics which are important in transmission and radiation applications.

EE 25T. ELECTROMAGNETIC FIELDS. 2½ *credits.*

Prerequisite: Math 35. An interim course, similar to EE 25.

EE 40. ELECTRONIC DEVICES. 2 *credits.*

Prerequisites: Phys 3, 4, EE 10. This course is a study of the conduction of current in vacuum, gas, and semiconductors, as applied to diodes, triodes and multiterminal electronic devices. Also included is a study of the applications of these devices in elementary circuits.

EE 42. ACTIVE CIRCUITS I. 4½ *credits.*

Prerequisites: EE 20, 40. This class and laboratory course covers four areas of communication theory, including two terminal nonlinear circuit elements, vacuum tube circuits, gas tube circuits, and semiconductor circuits. Basic equivalent circuits for the transistor, vacuum triode, and the pentode are covered. Small signal amplifiers are studied using both vacuum tubes and transistors. Other subjects covered are single-ended power amplifiers and push-pull amplifiers operating in the audio range.

EE 44. Active Circuits II. 4½ *credits.*
Prerequisite: EE 42. This course extends the work of the preceding course into the area of active nonlinear circuits, including class B and C amplifiers and oscillators; coding, transmission, and decoding of information, including amplitude, frequency, and pulse modulation and demodulation. The course includes class and laboratory work in the above areas.

EE 60. Electromagnetics. 3½ *credits.*
Prerequisites: EE 10, Math 22 or 25. This course consists of a class and laboratory study of the theory of magnetic circuits, magnetic materials, and electromagnetic devices. It includes magnetic circuit calculations, losses, saturable reactors, magnetic amplifiers, transformers at all frequencies, characteristics of inductively coupled circuits, and three-phase transformer connections. Theory of force in relays and loudspeakers, and the generation of voltage in rotating machines is covered.

EE 62. Electrokinetics I. 2½ *credits.*
Prerequisite: EE 60. A course in the theory of electromechanical energy conversion as applied to devices producing rotational and translational motion. Basic concepts of electric machine analysis and performance. Analysis and applications of direct-current machines.

EE 64. Electrokinetics II. 3½ *credits.*
Prerequisite: EE 62. A class and laboratory course with laboratory work covering the material of this and EE 62. Electromechanical energy conversion in terms of the interactions of the magnetic fields, polyphase synchronous machines, polyphase induction machines, fractional-horsepower a-c motors; dynamic coupled-circuit theory, d-q variables, matrix or tensor methods of solving dynamic equations for machine performance.

EE 69. Power System Analysis. 2½ *credits.*
Prerequisite: EE 62. The function of electric power systems, the equivalent circuit of a power transmission line, the use of circle diagrams, representation of power systems, per-unit computations, load flow studies on A-C board and digital computer, economic operation of power systems and automatic load dispatching, symmetrical components and unsymmetrical faults calculations, power system steady-state and transient stability studies.

EE 70. Transistor Circuits. 2½ *credits.*
Corequisite: EE 44. Topics to be covered include low frequency parameters and equivalent circuits, circuit characteristics of various configurations, biasing and bias stability; design of R-C coupled amplifiers and power amplifiers; high frequency parameters and equivalent circuits; design of wide-band amplifiers, feedback amplifiers and oscillators; and other selected topics.

EE 71. Control Systems. 3 *credits.*
Prerequisites: EE 22, 44, Math 32 or 25H or 256. This is an introductory course in the theory of automatic control. General analysis, design and stability studies of linear control systems is made. Applications of this theory to physical systems familiar to the students such as electromechanical control systems are investigated.

EE 72. Feedback Amplifiers. 3 *credits.*
Prerequisites: EE 44, Math 32 or 25H or 256. A course oriented toward the application of electronic closed-loop systems of principles developed in preceding electronics and networks courses. Additional analytical methods are introduced, including signal-flow graphs and block diagrams. Design techniques are developed which include the use of Bode diagrams, Nyquist plots, and root-locus plots.

EE 73. Electronic Devices. 2½ *credits.*
Corequisite: Phys 5. Prerequisite: Math 32 or 25H or 256. An introduction to the principles and technology of molecular electronics. Included are fundamentals of quantum theory, properties of gases and solids, interaction of energy and matter, and selected topics on maser and laser devices, plasma and solid state power conversion techniques, parametric amplifiers, and other high frequency generators and amplifiers.

EE 74. Analog Computation in Analysis and Design. 3 *credits.*

Prerequisite: EE 44. This course will introduce the analog computer as a tool in engineering analysis and design. Emphasis will be placed on programming procedures for the study of linear and nonlinear systems. Electrical engineering applications will be stressed. The use of the computer in the laboratory will be required to complete several extensive analysis and design problems.

EE 75. Digital Computer Circuits. 3 *credits.*

Prerequisite: EE 44. This course develops the mathematics and minimization techniques necessary for the design of combinational and sequential digital solid state logic circuits. Adders, multipliers, comparators, translators, counters, and other sample circuits are designed. After design, some of the circuits are connected using laboratory logic modules.

EE 76. Microwaves. 3 *credits.*

Prerequisite: EE 25. This course is concerned with a study of guided electromagnetic waves and radiation from antennas. The topics to be covered include plane waves, waves between parallel plates, waves in rectangular and circular guides, radiation from dipole antennas, and characteristics of antenna arrays.

EE 77. Introduction to Reliability Problems in E.E. 2½ *credits.*

Prerequisite: Math 30, 33. Status of reliability and its impact on engineering will be introduced. Reliability and stability factors in electron tubes, transistors, capacitors, and dielectrics will be studied in some detail, particularly from the design point of view. Generalized factors on mechanisms of failure will be derived. A brief introduction to the noise theory and its implications on reliability for series and parallel cases will be developed. Reliability factors of systems will be considered and methods for calculation of M.T.B.F. covered. Where required, statistical concepts will be introduced.

EE 78. Information Transmission. 2½ *credits.*

Prerequisites: EE 177, Math 30. Corequisite: EE 44. A study of the encoding of information for transmission, its survival in transmission through networks and noisy environments, and its ultimate recovery for use. The techniques permit comparative analysis of information transmission systems.

EE 79. Pulse Techniques. 2½ *credits.*

Corequisite: EE 44. This course deals with the analysis and design of circuitry for the generation and shaping of waves. Fundamental applications are covered, including linear and diode waveshaping, diode logic, voltage and current sweeps, multivibrators, blocking oscillators, basic switching and counting circuits; introduction to memory devices; and selected topics from television, computer, radar, and control applications.

EE 80. Advanced Measurements. 3½ *credits.*

Prerequisites: EE 22, 25, 44, Math elective. Advanced techniques in circuit measurements over a wide range of frequencies are studied in this class and laboratory course. Included are a-c bridge measurements, filters, harmonic analysis, resonance measurements and square-wave testing, transients in circuits, very-high and ultra-high frequency measurements, noise and field analogs.

EE 86. Electrical Engineering Project. 2½ *credits.*

Prerequisites: EE 44. A synthesis and focusing of the student's previous experience, in college and out, upon one or more electrical engineering projects selected by the student. Library research, design, cost analysis, construction, and testing are usually involved. Class members are in touch with all projects through seminar discussions. Projects are available in optional fields of power and communications.

EE 86H. Electrical Engineering Project for Honors Students. 2½ *credits.* Prerequisites: EE 44, 22H, and approval by EE department. This course, similar to EE 86, allows honors students to select projects of a research nature and work in close liaison with a research staff member of the department. Informal seminar meetings are held during the semester preceding registration for this course, and the students are expected to have their research well under way before being permitted to register for the course.

EE 90. Electrical Engineering for Civil Engineers. 3 *credits.* Prerequisites: Phys 4, Math 22 or 25. A class and laboratory course in the basic principles of electrical engineering theory and practice. The course begins with the study of a-c circuits, including polyphase circuits. Magnetics, transformers, direct-current and alternating-current machines are covered with an emphasis on significant operating characteristics and ratings. Basic electronics is included, with applications of electron tubes and transistors to rectification and amplification. Measurement techniques, including the use of vacuum-tube voltmeters and the oscilloscope, is part of the laboratory work.

EE 92. Electrical Engineering for Chemical Engineers. 3½ *credits.* Prerequisites: Phys 4, Math 22 or 25. A class, laboratory and problem course in the basic principles of electrical engineering as related to instrumentation and chemical process control. Laboratory techniques in electrical measurements, including a-c and d-c devices are included.

EE 92A. Electrical Engineering I. 2½ *credits.* Prerequisites: Phys 4, Math 22 or 25. This course is similar in context to the first part of EE 92, described above.

EE 92B. Electrical Engineering II. 1 *credit.* Prerequisite: EE 92A. A continuation of EE 92A, similar to the second part of EE 92, described above.

EE 93. Electrical Engineering for Civil Engineers. 4½ *credits.* Prerequisites: Phys 4, Math 22 or 25. A class, laboratory, and problem course in the basic principles of electrical engineering theory and practice as related to civil engineering. The principles, significant operating characteristics, and ratings of electrical machinery and electronic devices will be discussed.

EE 96. Electrical Engineering for Mechanical and Industrial Engineers I. 3½ *credits.* Prerequisites: Phys 3, Math 25. This is a comprehensive laboratory and class course surveying broadly the fields of electrical engineering. Basic a-c circuits, three-phase circuits, power and reactive power, resonance, steady-state frequency-response, and elementary transients. Included are basic principles of thermionic vacuum tubes, transistors, gas-filled thermionic tubes; and applications to rectifier and amplifier circuits, cathode-ray, photoelectronic and other special electronic devices and their applications are considered.

EE 97. Electrical Engineering for Mechanical and Industrial Engineers II. 3½ *credits.* Prerequisite: EE 96. A continuation of EE 96, this course considers the theory and applications of transformers and goes then into the area of rotating machines, stressing applications of the various types. Introduction to the physical aspects of rotating machines, including the generation of voltage and torque follows. Performance and characteristics of d-c and a-c machines. The course concludes with an elementary study of electronic control of motors and processes, both open and closed-cycle systems, including servomechanisms.

EE 98. Electrical Engineering for Mechanical Engineers I. 2½ *credits.* Prerequisites: Phys 3, Math 22. A course in linear circuit analysis with emphasis on electrical networks. Topics covered include definitions of circuit parameters, methods for solutions to the circuit equations, the impedance concept, steady state frequency response, and special network theorems applicable to the analysis of electrical analogs of mechanical systems.

DEPARTMENT OF ENGINEERING GRAPHICS

Chairman: FRANCIS J. BURNS.
Associate Chairman: ROBERT G. SALAMON.

Professors: BURNS, SALAMON; *Associate Professor:* DUJETS; *Assistant Professors:* GOLDEN, HANUS, RIGHTS; *Instructors:* KETZNER, O'HARA; *Adjunct Instructing Staff:* FREY, PETRELLA.

The Graphics courses, through application of a carefully considered system of disciplines, aim at preparing our beginning students for those engineering experiences which are to follow. Chief among these lessons is a development of the ability to interpret data and properly apply it to the graphical solutions of engineering problems. We teach Graphics as an initial experience in professional engineering and as the primary means of communication in that field. The emphasis in these courses is on problem solving and the application of principles of descriptive geometry to engineering design. In addition, stress is placed on freehand sketching as a means of rapidly conveying engineering information.

COURSES OF INSTRUCTION

EG 1. ENGINEERING GRAPHICS. 2½ *credits.*

This course deals mainly with descriptive geometry and its application to engineering problems. It develops the orthographic system which represents three dimensional space data, so as to solve problems by projective principles. The fundamentals thus established are then used to examine related points, lines and planes as abstract elements. The system is then extended to such areas as engineering measurements, mining and geology, data reorientation and warped surfaces. Selected freehand sketching and lettering assignments are included to develop the student's ability to convey information quickly and neatly.

EG 2. ENGINEERING GRAPHICS. 2½ *credits.*

Prerequisite: EG 1. This course consists of solving design problems in various engineering fields where solutions are possible graphically. Included in this study are applications in vector problems, reinforced concrete structures, structural steel construction, piping layouts, space travel, calculus and topography. Covered also are the various ASA and SAE standards, such as sections and conventions, dimensioning, tolerances, fasteners and welding. Techniques for presenting data pictorially through the use of perspectives, axonometrics, isometrics and freehand sketching are also presented.

DEPARTMENT OF ENGLISH AND HUMANISTIC STUDIES

Chairman: SAMUEL K. WORKMAN.
Associate Chairman (English): JAMES J. NAPIER.
Associate Chairman (History): STANLEY B. WINTERS.

Professors: CRATER, ESTRIN, NAPIER, WORKMAN; *Associate Professors:* FERNSLER, KEABLES, LYNGSTAD, STEINBERG, WINTERS; *Assistant Professors:* CAMP, GOLDBERG, JOHNSON, PATTINSON, RICHARDSON, WACKER, WISE; *Instructors:* BECKER, BOCHNER, CHABROWE, EPSTEIN, EVANS, FLEISCHER, GROVER, HELD, HERZSTEIN, LEVINSON, PLOTKIN, TOBIAS; *Special Instructing Staff:* ANGLE, FEINSTEIN, OTIS, UMANSKY; *Adjunct Instructing Staff:* FLATTO, GUIMOND, HESSE, HILL, METZGER, RIEDMAN, SIMMS, TURCHICK.

An engineering college makes special demands upon its English Department. An engineer has to write down his ideas and directives efficiently. In both technical and non-technical reading he must be rapid and accurate. Calling on a less tangible skill, many of his professional judgments will involve imponderables for which his perception is best cultivated by experience with the imaginative verbal expression of others, usually writers.

His career and his personal desires will take him more and more often into areas outside his immediate profession. He will want a sympathetic understanding, and a sense of judgment and taste, for the varied interests and activities of widely various people. Literature and other arts do much to develop such faculties, and so does the study of cultural history, a study largely carried out through reading.

This department provides all these areas of study, and is a principal participant in the broader program of electives in humanistic-social studies.

The Department also provides honors courses in English and in history. These include two separate semesters in composition and literature for freshmen (Eng 11H, 12H), two separate semesters in history for sophomores (Hist 21H, 22H), and two separate semesters in literature for juniors (Eng 21H, 22H). These honors courses run parallel with the regular required courses but are adapted to the abilities and needs of superior students. Entrance is voluntary, subject to Department approval, and may be applied for in any semester; continuation also is voluntary, after any one semester.

Qualified students may also earn the designation of "Distinction in English and Humanistic Studies" by meeting the following requirements:

1. Completion of at least the second semester of the freshman English honors course (Eng 12H); and completion of both semesters of honors courses *either* in literature (Eng 21H and Eng 22H *or* in history (Hist 21H and Hist 22H).

2. *Either* completion of two elective courses in literature for students who have taken Eng 21H and Eng 22H; *or* completion of two elective courses in historical studies for students who have taken Hist 21H and Hist 22H; *or,* for either group of students, completion of The College Seminar in the Humanities (Hu 59 and Hu 59A).

3. Maintenance of a high level of scholarship in college work generally as well as in English and humanistic studies. This shall ordinarily be construed as maintenance of a minimum grade-point average of "3," exception to be made at the discretion of the Department of English and Humanistic Studies.

COURSES OF INSTRUCTION

Eng 11. COMPOSITION AND LITERATURE. 3 *credits.*

A course to develop the skills of reading and writing. The writing is expository, of various types. The reading includes the principal literary forms.

Eng 11H. COMPOSITION AND LITERATURE. 3 *credits.*

An honors course. While paralleling Eng 11 in nature and purpose, this course offers opportunity for training in other forms of writing besides expository. Special areas of study will be in the relation of language and structure to the particular purpose of an expository writing; in the relation between the literary forms and the purposes of literature; and in the criticism and evaluation of writing.

Eng 12. COMPOSITION AND LITERATURE. 3 *credits.*

Prerequisite: Eng 11. A continuation of Eng 11.

Eng 12H. COMPOSITION AND LITERATURE. 3 *credits.*

Prerequisite: Eng 11 or 11H, and departmental approval. A continuation of Eng 11 or of Eng 11H at the honors level.

Eng. 21. ENGLISH AND AMERICAN LITERATURE TO 1850. 2½ *credits.*

Prerequisite: Eng 12 or 12H, Hist 22 or 22H. A study of significant literary figures of England and America which introduces these writers as individuals and as participants in historical and intellectual movements. The students will prepare written assignments related to the reading.

Eng 21H. ENGLISH AND AMERICAN LITERATURE TO 1850. 2½ *credits.*

Prerequisite: Eng 12 or 12H, Hist 22 or 22H, and departmental approval. An honors course. While the basic material is the same as in Eng 21, discussion is both deeper and broader, and the student is specially encouraged to pursue for himself, both in reading and in writing, the lines of these discussions that interest him most.

Eng 22. ENGLISH AND AMERICAN LITERATURE AFTER 1850. 2½ *credits.*

Prerequisite: Eng 21 or 21H. A continuation of Eng 21.

Eng 22H. ENGLISH AND AMERICAN LITERATURE AFTER 1850. 2½ *credits.*

Prerequisite: Eng 21 or 21H, and departmental approval. A continuation of Eng 21 or 21H, at the honors level.

Eng 41. ENGINEERING REPORT WRITING. 1½ *credits.*

Prerequisite: Eng 12 or 12H. The principles of report writing are studied, with careful attention to models of sound technical writing. Instead of preparing unmotivated practice reports, the student is guided in fulfilling actual assignments of reports for his professional department. Finished work is judged by professional standards. Required for Civil Engineering students.

Eng 80. MODERN FOREIGN LANGUAGE. 3 *credits, two semesters.*

Prerequisite: A minimum of 2 units of high school credit in the subject—except for Russian. A year of advanced study of French, German, Italian, Spanish, or Russian, or an introduction to Russian, as may be elected by the student. Sections will be instituted in those subjects for which a sufficient number of students register.

Hist 21. DEVELOPMENT OF THE MODERN WORLD I. 2½ *credits.*

Prerequisite: Eng 12 or 12H. A study of significant ideas, institutions, and events in European and European-influenced civilizations from the Renaissance to the Congress of Vienna, using source readings to encourage critical thinking and illuminate various historical eras.

Hist 21H. DEVELOPMENT OF THE MODERN WORLD I. 2½ *credits.*

Prerequisite: Eng 12 or 12H, and departmental approval. An honors course. While this course parallels Hist 21, it offers added opportunity to observe the modes of life and thought in the past and to weigh and criticize our present theories as to the forces that have shaped history. The individual interests of the student may be developed through discussion and outside research.

Hist 22. DEVELOPMENT OF THE MODERN WORLD II. 2½ *credits.*

Prerequisite: Hist 21 or equivalent. A continuation of Hist 21, covering the era of Romantic Nationalism through the early 1950's.

Hist 22H. DEVELOPMENT OF THE MODERN WORLD II. 2½ *credits.*

Prerequisite: Hist 21 or 21H, and departmental approval. A continuation of Hist 21 or Hist 21H at the honors level.

SENIOR COURSES IN HUMANITIES

At preregistration for these courses, students will have the opportunity to indicate their order of preference. Prerequisites for all courses in this program are: Eng 11 or 11H, 12 or 12H, 21 or 21H, 22 or 22H, and Hist 21 or 21H, 22 or 22H.

ARTS

Arts 51. APPRECIATION OF MUSIC. 2½ *credits.*

The purpose of this course is to develop creative listening through perception and appreciation of the basic materials of melody, harmony, rhythm, dynamics, tonality, tone, color, form, style, texture, and design. The course is not concerned with the history of the art of music, but with the elements of its structure and content, and does not assume previous training in music.

Arts 52. PERIOD, STYLE, AND GENRE IN MUSIC. 2½ *credits.*

Representative Music of the Main Eras of Western Music. The purpose of this course is to develop creative listening to carefully programmed representative forms, styles, and schools of all the main eras of the historical development of Western music down to and including the "New Music."

Arts 53. APPRECIATION OF VISUAL ARTS. 2½ *credits.*

Examples from historic and modern painting and sculpture, and from some actual design problems in class, illustrate visual fundamentals and the significance of the principal styles.

Arts 54. PERIOD, STYLE, AND MEDIUM IN THE VISUAL ARTS. 2½ *credits.*

New Concepts in Architecture. Examples of Twentieth Century building are used to illustrate, on the one hand, the place in architecture of fundamentals common to all visual arts, and, on the other hand, the relation between available materials and architectural expression. Buildings examined, from photographs or from visit to the site, include examples by Wright, Mies van der Rohe, Le Corbusier, Saarinen, Nervi, and many others.

HISTORY

Hist 51. ASPECTS OF CLASSICAL AND MEDIEVAL CIVILIZATION. 2½ *credits.*

The Legacy of Ancient Greece and the Roman Republic. A survey of the political, institutional, and cultural developments of Ancient Greece, the Hellenistic states, and the Roman Republic. The aim is to provide an articulated perspective of the heritage of Ancient Greece and Rome.

Hist 51A. ASPECTS OF CLASSICAL AND MEDIEVAL CIVILIZATION. 2½ *credits.*

The Roman Empire to the Fall of Constantinople in 1453. A survey of the Roman Empire from its creation by Augustus to its fall in 1453 to the Ottoman Turks. This course attempts to trace the Roman and Byzantine world and its heritage through fifteen centuries of development and transition. It includes the rise of Christianity, the rise of Islam, and the emergence of the Russians, Serbs, Bulgars, Hungarians, and Turks.

Hist 52. ASPECTS OF BRITISH CIVILIZATION. 2½ *credits.*

The Emergence of Modern British Society. The evolution of the British people during the social, economic, and political changes of the last one hundred and fifty years: the Industrial Revolution, Victorianism, Imperialism, the rise of democracy, the welfare state. Lectures and discussions focus on modern British life.

Hist 52A. ASPECTS OF BRITISH CIVILIZATION. 2½ *credits.*

The Emergence of Representative Government. A study of the origin and nature of representative government with emphasis upon Great Britain: Magna Carta, the development of the common law, Parliament and its victory over absolutism, the growth of political parties, and the English influence on American institutions.

Hist 53. ASPECTS OF AMERICAN CIVILIZATION. 2½ *credits.*

Recent American History. A study of the twentieth century internal history of the United States, with emphasis on political responses to social change: the Progressive Movement, the 1920's, the New Deal, the Fair Deal, and the Eisenhower years.

Hist 53A. ASPECTS OF AMERICAN CIVILIZATION. 2½ *credits.*

The City in American Life and Thought. The growth and transformation of the American city in the 19th and 20th centuries with industrialization and technological change; the impact of the Irish, the Italians and other immigrants and Negro and Puerto Rican in-migrants; and the reactions of sensitive observers to these social changes as expressed in novels and scholarly studies.

Hist 54. SPECIAL AREAS. 2½ *credits.*

Introduction to Modern Russian Civilization. A survey of Tsarist and Soviet Russian society in the 19th and 20th centuries. Serfdom, industrialization, revolutionary movements, the 1917 revolutions, and Soviet governmental policies. Readings in history, philosophy, the novel, and the drama.

Hist 54A. SPECIAL AREAS. 2½ *credits.*

The Development of Modern Germany. This course, beginning about 1870, considers the economic and political foundations of Germany's world position, aspects of its literature, science, and philosophy, and such movements as liberalism, Pan-Germanism, Nazism, and democracy.

Hist 54B. SPECIAL AREAS. 2½ *credits.*

Contemporary Europe. European society in the twentieth century with an emphasis on major events and trends of lasting importance. Nationalism, imperialism, the growth of totalitarianism, movements toward European unity, and prominent cultural developments will be among the topics to be discussed.

Hist 55. PROBLEMS IN MODERN HISTORY. 2½ *credits.*

Political and Social Movements. The nature and impact of such seminal theories and movements as democracy, conservatism, liberalism, anarchism, communism, fascism, and non-violent resistance; as seen through the lives and works of their proponents: Jefferson and Paine, Burke and John Adams, Marx and Lenin, Bakunin, Mussolini and Hitler, and Thoreau, Gandhi, and Martin Luther King.

Hist 55C. PROBLEMS IN MODERN HISTORY. 2½ *credits.*

The Intellectual Revolution of the 18th Century. A study of the creative genius of the Age of the Enlightenment in its political and social background, the impact of Newtonian science, the growth of religious toleration and skepticism, and its influence on the American Revolution. The writings of Locke, Bayle, Voltaire, Rousseau, Jefferson, and others.

LITERATURE

Lit 51. AN ERA OF LITERATURE. 2½ *credits.*

The Renaissance. The cultural advancements of Europe during the fifteenth and sixteenth centuries in thought, religion, science, education, literature, art and music are examined. The "rebirth" of learning is seen through the works of such authors as Sir Thomas More, Niccolo Machiavelli, Francois Rabelais, Miguel de Cervantes, and Christopher Marlowe. Lectures, some illustrated by reproductions of the art of the period and by recordings, will develop the Renaissance concept of the well-educated man, the humanist whose province was the whole world of thought and whose aims predicated the reform of early modern times.

Lit 51A. AN ERA OF LITERATURE. 2½ *credits.*

Twentieth Century British and American Literature. An examination of some of the more provocative Twentieth Century British and American works in fiction, drama, and poetry. The student acquires critical criteria whereby he is able to distinguish between popular forms and literature.

Lit 51B. AN ERA OF LITERATURE. 2½ *credits.*

Twentieth Century European Fiction. An examination of significant stories and novels drawn from the literatures of four continental European countries—France, Germany, Sweden, and Russia. The individual works, representative of such figures as Gide, Malraux, Sartre, Camus, Kafka, Mann, Lagerkvist, and Pasternak, will be approached principally as literary formulations of intellectual problems and beliefs, with consideration of social and biographical factors as demanded by the nature of the materials.

Lit 51C. AN ERA OF LITERATURE. 2½ *credits.*

Modern Drama. An examination of some of the dramas from the latter nineteenth and from the twentieth century with the purpose of gaining some understanding of how dramatists in both subject matter and technique reflect the spirit of the times. Representative playwrights include Ibsen, Shaw, Wilde, Strindberg, O'Neill, Chekhov, O'Casey, Pirandello, Williams, Miller, Brecht, and Ionesco.

Lit 51D. AN ERA OF LITERATURE. 2½ *credits.*

Greek and Roman Classics in Translation. An examination of some of the masterpieces of classical literature: the epics by Homer and by Vergil; Greek comedy and tragedy; selections from the philosophical work of Plato and Lucretius; some Greek and Roman lyric poems; and examples of Roman satire. These works are studied primarily as literary masterpieces in their own right, but some account is given of their historical setting and of their influence upon subsequent literature.

Lit 52. A FORM OF LITERATURE. 2½ *credits.*

The Growth of European Fiction. A study of some outstanding novels and short stories, mostly of the nineteenth century. Major figures, including Balzac, Flaubert, Dostoyevsky and Tolstoy, are seen as contributors to the expanding art of modern fiction.

Lit 52A. A FORM OF LITERATURE. 2½ *credits.*

The English Novel. A study of selected English novels from the first masterpieces to the present day. The works will be approached primarily as distinctive achievements in the art of prose narrative, but some account will be taken of their place in a continuous and varied tradition and of their relation to the changing social and intellectual scene.

Lit 52C. A FORM OF LITERATURE. 2½ *credits.*

Forms of Modern Drama, Fiction, and Poetry. This course is not a survey of Twentieth Century literature. Its main purpose is to develop an understanding of the *forms* and the *modes* of literature which are new and peculiar to our time. Typical writings will be read closely and descriptively, often in comparison to older writing, and related to other developments of this century.

Lit 52D. A FORM OF LITERATURE. 2½ *credits.*

Satire. A course in the satire of such writers as Rabelais, Jonson, Swift, Pope, Byron, France, Huxley, and Orwell. By defining techniques used, follies and vices attacked, and wisdom and virtues implicitly affirmed, the course analyzes each work by itself, and then relates it to the tradition of satire.

Lit 53A. A RECURRENT SUBJECT OF LITERATURE. 2½ *credits.*

The Good Life and the Search for Value. The course is to be a survey of various views of the Good Life as reflected in certain literary works of our culture. The course will begin with traditional values of Western Civilization derived from the ancient Greeks and the Judeo-Christian ethos. The second half of the course will deal with some of the more important challenges, and the conflicts of values in the modern world.

Lit 54. THE PRINCIPAL WORKS OF ONE WRITER. 2½ *credits.*

William Shakespeare. The reading will include about ten plays from the histories, comedies, and tragedies, and some short poems, chosen to typify the various facets of this writer. There will be attention to Shakespeare's times and to the basis for his distinction among dramatists.

Lit 54A. THE PRINCIPAL WORKS OF ONE WRITER. 2½ *credits.*

William Faulkner. A close reading of some of Faulkner's most reputed novels and short stories, with attention to the meaning of Faulkner's way of writing and to the twentieth century beliefs and forms of expression with which Faulkner was familiar.

Philosophy

Phil 51. Principles of Philosophy. 2½ *credits.*

Philosophical Problems. An examination of problems of a social, ethical, aesthetic, religious, and scientific nature and a study of the related principles and methods of philosophy. Particular attention is given to the application of these principles in everyday living.

Phil 51A. Principles of Philosophy. 2½ *credits.*

Representative Philosophers. A study of the ideals of important philosophers from the time of the Greeks to the present day. This course does not attempt a survey of philosophy but concentrates on the work of a few great thinkers so that the student may perceive at first hand how these men once accelerated intellectual progress and how their work may still contribute to the solution of modern problems.

Phil 52. Historical Developments in Philosophy. 2½ *credits.*

The Development of Modern Thought. A survey, analysis, and evaluation of the basic concepts which have moulded man's view of nature, of the political and societal environment, and of the individual from ancient Egypt to the present, as they are a requisite for an understanding of the modern world. In brief: A history of the ideas which have affected modern thought in science, religion, political theory, and aesthetics.

Phil 52B. Historical Developments in Philosophy. 2½ *credits.*

The History of Economic Thought. The historical evolution of man's intellectual efforts to understand economic phenomena, and the effect of the particular cultural environments which influenced thought. Theories and schools thus considered include Mercantilist, Cameralist, Physiocrat, Classical, Historical, Austrian, Dissenter, and the present-day Keynesian.

Phil 53. Philosophical Foundations. 2½ *credits.*

Science and First Principles. This course is a brief introduction to the philosophy of science: the impact of scientific theories and hypotheses on the subject matter of philosophy. After the nature, function, and scope of philosophy are examined, the concepts of science are introduced as providing a formulation of, and avenues of approach to, the basic problems of philosophy itself. The implications of this relationship are then extended to the problem of values, involving man's place in the universe about him.

Phil 53A. Philosophical Foundations. 2½ *credits.*

Comparative Economic Thought. A consideration of the philosophical and ethical foundations of systems that man has devised to secure his livelihood. These systems range from a society placing an emphasis on individualism wherein the constituents are free to pursue their own self interest, to organizations wherein the "state" plays the dominant role.

Phil 53B. Philosophical Foundations. 2½ *credits.*

The Philosophy of Language. After a survey of the history of language the course turns to theories of language—Richards, Cassirer, Sapir, Skinner, and others—pointing to the nature and the philosophic significance of linguistic experience. There will be discussion of positive and of ethical problems of verbal expression and communication.

Phil 53C. Philosophical Foundations. 2½ *credits.*

Comparative Culture and World Community. The purpose of this course is to attempt a comparative analysis of world cultures in the light of traditional philosophies, religions, and especially law and jurisprudence. The major areas of study will be the application of Western philosophy to non-Western cultures and the cultural foundation for a more effective international law, with reference taken to the problems of the United Nations.

Hu 59. COLLEGE SEMINAR IN THE HUMANITIES. 2½ *credits.*

Prerequisites: Those for other electives, as cited above; a grade-point average of 3.00 or higher; recommendation by former instructors in English, History, and social studies. An honors course. Investigation and discussion of the relationships between two or more areas, such as science and political philosophy or art and religion. The subjects for the seminar will be announced at the time of preregistration for a senior course in humanities. This course is limited to 12 students.

Hu 59A. COLLEGE SEMINAR IN THE HUMANITIES. 2½ *credits.*

Prerequisites: As for HU 59. An honors course. Investigation similar to that cited for HU 59 but on different topics, which will be announced. This course is limited to 12 students.

DEPARTMENT OF INDUSTRIAL AND MANAGEMENT ENGINEERING

Chairman: OLIVER J. SIZELOVE.
Assistant Chairmen: ROBERT C. GORDAN, WILLIAM J. JAFFE.

Distinguished Professor: SIZELOVE; *Professors:* JAFFE, RICH; *Associate Professors:* DUBLIN, GOLDSTEIN, LA VERDA, MIHALASKY, RIGASSIO; *Assistant Professors:* GORDAN, MLANDINEO, WOLF, ZIMMERMAN; *Assistant Instructor:* NEFF; *Special Instructing Staff:* KEREKES, MURAVIEV, PAULES; *Adjunct Instructing Staff:* BENNETT, BLOU, FREYBERGER, KELLY, KOPF, MAZIE, O'CONNOR (P), O'CONNOR (W), SCHNEIDER, THOMAS, TIERNEY.

The curriculums of the department meet the needs of industry for engineers who are not only competent in the areas of mathematics, the physical and engineering sciences, and engineering analysis and design, but who are equally well qualified to apply the fundamentals of these areas to the design, improvement, and installation of integrated systems of men, materials, and equipment. Individuals thus trained—Industrial Engineers—solve the problems that arise in the management of an enterprise and make these solutions available for administrative decision within the functional areas of research, design and development, manufacture, personnel, and distribution.

The Industrial Engineering curriculum combines three professional stems: production process design, work design, and management science. During the early years the student is primarily concerned with the mathematics, the physical sciences, and the engineering sciences, upon which depends the material presented in the later years. The courses stress fundamental principles and concepts, and culminate in a systems design which classifies either within or between the three professional stems of the curriculum.

The Day Division class of 1964 was the first to complete the Bachelor of Science in Industrial Engineering curriculum. In the Evening Division, the class of 1968 will be the first to complete the Industrial Engineering curriculum. The predecessor curriculum, the Engineering Management Option in Mechanical Engineering, will phase out for the Evening Division in 1967. Hence, the Industrial Engineering Curriculum is shown on pages 66-67 and the Engineering Management curriculum is shown on page 80. In addition, service courses in Economics and Enterprise Management are in operation for the other engineering departments.

The new modern laboratories of the Department include a Work Methods and Measurement Laboratory and adjacent Experimental Shops, an Accounting and Statistics Laboratory, and a Plant Design Laboratory. In addition, the facilities of the new NCE Computing Center allows use of electronic computers in applicable courses.

For early indoctrination in professional development, Day and Evening Division students in the department become affiliated with the NCE student chapter of A.I.I.E. In addition to their local meetings at the College, the student members attend the meetings and conferences of the sponsoring North Jersey Chapter of A.I.I.E.

COURSES OF INSTRUCTION*

IE 23. ECONOMICS. 2½ *credits.*

This course is designed to combine the classical and contemporary approaches to economics. It presents basic principles which form the groundwork for analysis and discussion of contemporary problems of economic life. Attention is also given to other economic systems, the stock market, and problems of economic development and foreign trade.

IE 24. PRODUCTION PROCESS DESIGN. 2½ *credits.*

Introduction to design and control of manufacturing processes. Study covers theory and practice of machine tool selection, production tooling, measurement and quality control, automated processes and tape controlled machines. Selection of the best and most economical process to meet design specifications is stressed. In addition to lecture and discussion the student observes equipment in operation in the laboratory and in plants which are visited. Where practical, films of special tooling research or materials processing and fabrication are shown. A student project is included in which the student determines manufacturing feasibility, prepares specifications and operation sheets, selects equipment and tooling, and prepares flow charts for the fabrication of a metal, plastic, ceramic, wood or rubber product.

IE 25. LOGIC AND THE SCIENTIFIC METHOD. 2 *credits.*

This course is designed as an introduction to decision theory. It includes the logical systems, basic rules of decision making, experimentation, and symbolic reasoning applied to modern management procedures. The basic concepts to be discussed are inductive and deductive logic, syllogistic reasoning, symbolism, logical operations, probability, measurement, statistical methods, experimentation, etc.

IE 37. WORK ANALYSIS I. 3½ *credits.*

Prerequisite: IE 24. Integration of plant flow, layout design, material handling systems, and work place layout and design. Emphasis is placed on the interrelationship of organization, production planning and control, service activities, work simplification, human factors, methods, and tool design. Included are the use of motion economy, jig and fixture design, and micromotion analysis techniques.

IE 38. WORK ANALYSIS II. 3 *credits.*

Prerequisite: IE 37. Quantitative analysis of manufacturing activities, man and machine systems, wage payment plans, line balancing problems, and plant location decisions. Involved is the use of standard data, method measurement systems, work sampling, time study, value analysis, predetermined time systems and simulation of production systems.

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* The courses prefixed by IE represent the offerings in the new curriculum. The courses prefixed by EM are offered in the Engineering Management Option.

IE 39. Studies in Management Science I. 3½ *credits.*

Prerequisites: Math 34, IE 23. Introduction to quantitative and analytical techniques useful in managerial decision making. Treated are such techniques as model formulation, linear and non-linear programming, queueing theory, game theory, statistical applications, Markov processes, Monte Carlo techniques, and multi-stage processes.

IE 40. Studies in Management Science II. 3 *credits.*

Prerequisite: IE 39. Application of the quantitative and analytical techniques of IE 39 to selected topics such as organization, production and distribution management including plant location, layout, inventory control, transportation, scheduling and market research.

IE 43. Systems Design and Control I. 3 *credits.*

Prerequisites: IE 24, 37, 38, Math 33, 34. The concepts of industrial engineering systems and sub-systems design; principles, procedures, and techniques of systems design; the management control as an integral system component. Selection of a specific system design for the project of IE 44, establishment of plant contacts, determination of the system specifications, preliminary collection, classification, and analysis of the system data.

IE 44. Systems Design and Control II. 3½ *credits.*

Prerequisite: IE 43. A continuation of IE 43 with the project culminating in a system design, including the related management controls. The design will draw upon the applicable mathematical, scientific, engineering, and humanistic principles included in the curriculum. Whether theoretically and/or practically oriented the design will classify within or between the broad curriculum areas of Process Design, Work Design, or Management Science.

IE 46. Law. 2 *credits.*

Prerequisite: IE 23. This course familiarizes the student with basic principles of common and statutory law applicable to business and professional relationships, emphasizing contracts, negotiable instruments, sales of goods, agency and business organization.

IE 47. Accounting for Engineers. 3 *credits.*

Prerequisite: IE 23. This course is devoted to a study of the accounting cycle; development and preparation of financial statements; accounting for manufacturing; an introduction to cost accounting covering job order, process, and standard costs systems; and statement analysis.

IE 58. Tool Engineering. 2½ *credits.*

Prerequisite: IE 24. The planning and fabrication of production tools will be treated from an economic viewpoint as well as from the engineering aspects. Included are classifications of tools, make or buy decisions, and the use of mathematical models for optimum design.

IE 59. Computerized Production Control. 2½ *credits.*

Prerequisite: IE 27. A study of the components and functioning of integrated production planning and control systems. Consideration is given to material, equipment, and manpower requirements for optimizing continuous and intermittent manufacturing operations. The use of a computer to simulate such models is introduced.

IE 60. INVENTORY MODELS. 2½ *credits.*

Prerequisites: Math 33, 34, IE 27. A scientific approach to inventory problems under conditions of known and probabilistic demand. Order quantities, order times, shortage considerations, and price breaks are some of the topics investigated. Cost minimization for both discrete and continuous cases are discussed.

IE 61. STATISTICAL QUALITY CONTROL. 2½ *credits.*

Prerequisites: Math 33, 34. This course is designed to present the application of statistics and probability to the control of product and process quality. The subject matter to be studied includes process and machine capability studies, statistical control charting, and sampling plans. The management and engineering associated with a quality control program will also be considered.

IE 62. BUDGETARY PLANNING AND CONTROL. 2½ *credits.*

Prerequisite: IE 47. Introduction of budgeting procedures as a tool for planning and control in the areas of production, sales, indirect expense, cash, inventory, and capital expenditures. Emphasis will be made on the application of industrial engineering principles in the preparation and execution of budgets for profit planning and management.

IE 63. ORGANIZATION PLANNING AND CONTROL. 2½ *credits.*

A study of classical and behavioral approaches to organization planning, this course integrates both functional and adoptive points of view in an applied atorgenics approach to the delineation of the duties, responsibilities, authorities, and relationships of the positions of a business enterprise. Included in the course is a survey of current practice in organization design and control.

IE 64. PRODUCT AND PROCESS RELIABILITY. 2½ *credits.*

Prerequisites: Math 33, 34. Treated in this course will be the methods of planning, organizing, and control needed to assure the reliability of a product or process. Inherent in this treatment will be a study of the various statistical and non-statistical means of attaining and measuring this reliability.

IE 65. PATENT LAW. 2½ *credits.*

A broad coverage of the principles and philosophy of patent law is treated in this course. The main goal is to point out more effective protection and exploitation of ideas and inventions. Also, trademark selection and protection will be considered.

IE 81H. INVESTIGATIONS IN INDUSTRIAL ENGINEERING I. 2½ *credits.*

Prerequisites: Senior I.E. standing and a minimum G.P.A. of 3.0 Independent investigation through readings, visits with recognized authorities and institutions which deal with specialized and contemporary industrial engineering theory and problems, and reports in seminar. Each student will explore in depth and report on an area in which he has an interest.

IE 82H. INVESTIGATIONS IN INDUSTRIAL ENGINEERING II. 2½ *credits.*

Prerequisites: Senior I.E. standing and a minimum G.P.A. of 3.0. A continuation of IE 81H.

IE 91. ENTERPRISE MANAGEMENT. 3 *credits.*

Prerequisite: IE 23. A survey course for electrical and mechanical engineering students which includes sources of investment funds; organizational structure; product development and distribution, production management; engineering economy analysis of alternatives; estimating collecting, analyzing and control of enterprise costs; and the legal aspects of contracts; agency, and patents. Emphasis is on the operational management problems with orientation to the overall planning, organization, and control of the enterprise.

IE 96. ENGINEERING ECONOMY. 2 *credits.*

Treats the principles and practices of engineering economy. It specifically applies these principles and practices to various industries. Among topics discussed are: depreciation, replacement policy, valuation studies, break-even analysis, increment costs, minimum costs points and cost estimating.

IE 97. ENTERPRISE MANAGEMENT. 3 *credits.*

Prerequisite: IE 23. A survey course for civil engineering students concerned with the organization, design, administration, and operation of enterprises, and the economic evaluation of projects and alternatives with special emphasis on their application to civil engineering. Legal aspects such as contracts, agency, and workmen's compensation are examined.

IE 98. BASIC ACCOUNTING AND FINANCE FOR CONSTRUCTION MANAGEMENT. 2½ *credits.*

A basic background course in the principles of accounting and cost accounting necessary for the understanding of financial data and statistics in connection with the supervision of engineering projects. Sources and methods for financing these projects, both public and private, are discussed.

IE 99. MANAGEMENT AND CONTROL OF CONSTRUCTION. 2½ *credits.*

Prerequisite: IE 98 or permission of the instructor. Introduction to financial and management techniques employed by construction management to maintain operating control. Topics include pre-job procedures, subcontracting policies, insurance problems, change order routines, and profit controls.

EM 56A. SELECTION, SUPERVISION, AND CONTROL OF STAFF II. 4 *credits, two semesters.*

Prerequisite: EM 55A. A continuation of the Junior course of the same title, stressing the control aspect by the application of the previous treatment to practical situations, through student reports presented in seminar.

EM 64A. MOTION AND TIME STUDY. 5 *credits, two semesters.*

Prerequisites: EM 62A, 67; and EM 75A for Second Semester. The charting and micromotion techniques of the Gilbreths, project work including design and construction of improved methods. Stop watch techniques, element analysis, rating and leveling, practice studies of hand and machine operations, elemental times and standard data.

EM 68. MANAGEMENT OF PRODUCTION AND DISTRIBUTION. 4 *credits, two semesters.*

Prerequisites: EM 62A, 67. The objective of this course is to present the modern techniques of progressive management in the fields of production and distribution. It includes plant location and layout, material handling, production planning and control, standardization, wage plans, traffic control, warehousing, sales, and marketing. The lecture-project method is utilized to demonstrate existing management techniques.

EM 71A. Accounting and Cost Accounting. 4½ *credits, two semesters.*

This course treats both general and cost accounting. It includes a study of the accounting cycle, basic books, worksheets, subsidiary ledgers, valuation, depreciation and depletion, development and analysis of financial statements, costing methods and classifications, material and inventory costs, overhead accumulations and distribution, job order, process, and standard cost systems, and budgets.

DEPARTMENT OF INDUSTRIAL RELATIONS

Chairman: ROBERT E. KIEHL.
Associate Chairman: JOHN H. METZLER.

Professors: CAMBRELENG, KIEHL, STEPHENS, ZANER; *Associate Professors:* LORD, LUBIN, METZLER, STOCHAJ; *Assistant Professors:* GILROY, KANG, RUCKER, SPITZ; *Assistant Instructor:* MURRAY; *Special Instructing Staff:* ILIVICKY, KRIEGER, MALONE, MINNIS, NOYES; *Adjunct Instructing Staff:* BEVERLEY, BURNS, CHEATHAM, HABER, HAMILTON, KATZ, MCKOWN, MENK, VAN PELT, YAROSZ.

The guiding philosophy of the Department of Industrial Relations, derived from the stated aims and objectives of the College, is based on a recognition that the student must understand himself as a maturing individual if he is to take his place in the community as a genuinely educated man.

To assist in the achievement of this important goal, the courses are planned to provide a broad foundation upon which to build an understanding, not only of the relationship of the individual to other individuals, which is the province of human relations, but also an appreciation of the complex industrial world. With this knowledge, the scientific and mathematical proficiency of the engineer will be complemented by insights important to leadership and success.

The Department of Industrial Relations is associated with the Placement Office and the Counseling Center in assisting students with career choices and placement.

COURSES OF INSTRUCTION

IR 25. HUMAN RELATIONS. 1½ *credits.*

This course is designed to develop and sharpen the student's awareness of the "human" side of industrial life, giving appropriate emphasis to basic principles which might be used in dealing with human relations problems. It is intended to provide a particular ethical orientation towards industrial life consistent with our democratic society, encouraging an attitude of respect for human potential and human dignity. The basic needs of the individual employee and the ways in which modern industry satisfies these needs in on-the-job relationships are discussed.

IR 26. PERSONNEL ADMINISTRATION. 1½ *credits.*

Prerequisite: IR 25. A study of methods that are used in supervising people and in administering work situations. Such aspects of personnel administration as recruitment, selection, rating, promotion, training, incentive systems, and benefit programs are evaluated.

IR 27. LABOR RELATIONS. 1½ *credits.*

Prerequisite: IR 34. Labor-management relations are explored and specific attention is given to the organization and policies of unions, collective bargaining, employers' associations, the settlement of disputes, and the social control of activities through appropriate legislative acts. The conference method and lectures are used.

IR 28. CONTEMPORARY ISSUES. 2 *credits.*

Prerequisite: IR 26. The student studies an integrated picture of human society through the emphasized interrelationships of anthropology, sociology, economics, and political science. Special emphasis is placed upon the culture concepts, developed through a senior convocation program, class conferences and lectures.

IR 29. CONTEMPORARY ISSUES. 1½ *credits.*

A series of senior convocations combined with class discussion and student readings to emphasize the interrelationships of anthropology, sociology, economics, and political science. For AFROTC students only.

IR 31. PSYCHOLOGY OF PERSONAL ADJUSTMENT. 1 *credit.*

This course is designed to assist in the development of insight with respect to human behavior. With engineering education as the point of reference the psychological principles involved in heredity and environment, studying and learning, motivation, frustration, adjustment, sensation, perception, thinking, reasoning, intelligence and special abilities and group processes are studied.

IR 34. ELEMENTS OF INDUSTRIAL GROWTH. 2 *credits.*

A comprehensive survey of the growth of industry in the United States. Consideration is given to the social, economic, cultural, and political forces which helped shape America. There is an examination of the problems encountered by management and labor in a growing and expanding U. S. A. Emphasis is on the relation of the individual to other individuals and the role of the engineer in an industrial society.

IR 38. INDUSTRIAL RELATIONS. 1½ *credits.*

Prerequisite: IR 34. Prepared especially for the AFROTC student. This course includes a study of the union organization, an analysis of collective bargaining, the legislation affecting labor-management relations and the effects of technological change on society.

IR 46. HUMAN RELATIONS AND PERSONNEL ADMINISTRATION. 3 *credits.*

Prerequisite: IR 34. This is a series of conferences and lectures designed to explore the human relationships in industry and to study existing personnel programs which are intended to maintain high morale. The broad area of manpower management and personnel administration is investigated.

IR 48. LABOR RELATIONS AND SOCIAL PROBLEMS. 3 *credits.*

Prerequisite: IR 46. Labor-management relations and other current social problems are studied through conferences and lectures. The organization and policies of unions, collective bargaining, employers' associations, the settlement of disputes and social control through legislation and other appropriate activities are studied.

DEPARTMENT OF MATHEMATICS

Chairman: HENRY ZATZKIS.
Associate Chairman: POMPEY MAINARDI.
Assistant Chairman: CARL KONOVE.

Professors: BARKAN, FOSTER, KONOVE, KOREN, MAINARDI, ZATZKIS; *Associate Professors:* FLATLOW, FOX, LIONE, WASSON; *Assistant Professor:* BROWER; *Instructors:* ANDRUSHKIW, BERLINER, KATZEN, LEVINE, LIEB, MARX, TEKEL, VORONKA, WEISS; *Assistant Instructors:* CAVERLY, MANOCHIO, RIPPETOE, SPENCER, TARNAWSKY, YEE; *Adjunct Instructing Staff:* ALOISIO, GODDERZ, HAUBNER, KIZNER, MEGIBOW, MOSKOWITZ, ROCHE, SIMPSON, SQUIRES, TRACHTENBERG, VAN MEERBEKE.

The principal aim of the various courses offered by this department is to impart a knowledge of mathematics which will be useful to students during their study of science and which will also be of use to them later, in actual engineering practice. In keeping with the trend for greater emphasis on the humanities in engineering education, other aspects of mathematics relative to philosophical and cultural values are considered whenever opportunities arise.

COURSES OF INSTRUCTION

Math 10A. INTRODUCTORY MATHEMATICS I E. 2½ *credits.*

This course contains topics from college algebra, trigonometry, and introductory analytic geometry.

Math 10B. INTRODUCTORY MATHEMATICS II E. 2½ *credits.*

Prerequisite: Math 10A. This course continues with additional topics in analytic geometry and covers the remaining subject matter of Math 11, described below.

Math 11. INTRODUCTORY MATHEMATICS. 4 *credits.*

This course begins with an introduction to the concepts of differentiation and integration. Other subject matter includes coordinate geometry, elementary vectors and matrices, and an introduction to linear programming.

Math 11H. INTRODUCTORY HONORS MATHEMATICS. 4 *credits.*

This is the first semester of a six-semester program in Honors Mathematics. Topics covered include rates of change, continuity, theory of differentiation and integration, as well as applications to engineering problems. Admission to this course is restricted as described on page 34.

Math 12. CALCULUS I. 4 *credits.*

Prerequisite: Math 10 or 11. This course considers the theory and techniques of differentiation and integration with applications of both to engineering and physics.

Math 12H. HONORS MATHEMATICS I. 4 *credits.*

Prerequisite: Math 11 or 11H. This is the second semester of a six-semester program in Honors Mathematics. Topics covered include methods of integration, determinants and linear equations, advanced analytic geometry, hyperbolic functions, polar coordinates and curves by methods of analysis, introduction to vector analysis and parametric equations. Admission to this course is restricted as described on Page 34.

Math 20A. CALCULUS I E. 2½ *credits.*

Prerequisite: Math 10 or 10B or 11. This course includes most of the material covered in Math 12, described above.

Math 20B. CALCULUS II E. 2½ *credits.*

Prerequisite: Math 12 or 15 or 15A or 20A. This course includes certain topics from Math 12 and subject matter of the first part of Math 21, described below.

Math 21. CALCULUS II. 4 *credits.*

Prerequisite: Math 12 or 15 or 15B or 20B. This course is a continuation of Math 12. Topics considered include further methods of integration, vectors and parametric equations, solid analytic geometry and vector differentiation, partial differentiation, multiple integrals, infinite series, and expansion of functions.

Math 21H. HONORS MATHEMATICS II. 4 *credits.*

Prerequisite: Math 12H. This is the third semester of a six-semester program in Honors Mathematics and is a continuation of Math 12H. Topics covered include solid analytic geometry and vector analysis, partial differentiation, multiple integrals, infinite series, an introduction to the theory of complex variables and differential equations.

Math 22. DIFFERENTIAL EQUATIONS. 4 *credits.*

Prerequisite: Math 21 or 25 or 25B or 30A. Methods for solving ordinary differential equations are studied, together with physical and geometrical applications. Laplace transforms and an introduction to Fourier series are included.

Math 22H. HONORS MATHEMATICS III. 4 *credits.*

Prerequisite: Math 21H. This is the fourth semester of a six-semester program in Honors Mathematics. Subjects considered are vector analysis and linear algebra.

Math 30. MATHEMATICS FOR ENGINEERS I. 2½ *credits.*

Prerequisite: Math 25 or 25B or 30A. This is a practical course in ordinary differential equations. Topics include equations of first and second order, linear equations with constant coefficients, systems of equations, and solutions in series. It applies the methods developed to the solution of various engineering problems.

Math 30A. CALCULUS III E. 3 *credits.*

Prerequisite: Math 20 or 20B or 25A. This course includes subject matter from the second half of Math 21 and the first part of Math 22.

Math 30B. DIFFERENTIAL EQUATIONS E. 3 *credits.*

Prerequisite: Math 25 or 25B or 30A. This course is identical to Math 30, described above.

Math 30H. HONORS MATHEMATICS IV. 4 *credits.*

Prerequisite: Math 22H. This is the fifth semester of a six-semester program in Honors Mathematics. It is a rigorous first course in complex variables.

Math 31. INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS. 2½ *credits.*

Prerequisite: Math 22 or 30 or 30B. This course is an introduction to some of the important partial differential equations encountered in engineering and physics. It deals mainly with problems arising in fluid flow, heat conduction, and diffusion.

Math 32. Introduction to Functions of a Complex Variable. 2½ *credits.*

Prerequisite: Math 22 or 30 or 30B. This is designed as a first course in complex variables. Emphasis is placed on techniques. Topics considered include the complex plane, Cauchy-Riemann equations, geometrical aspects, residues, and poles. Proofs requiring a knowledge of advanced calculus will not be included.

Math 33. Probability and Statistics. 2½ *credits.*

Prerequisite: Math 21 or 25 or 25B or 30A. This is essentially a course in modern probability, statistics, and statistical inference. Specific topics include discrete and continuous distributions of random variables, probability models in science, and statistical inference.

Math 34. Mathematics for Management Science. 2½ *credits.*

Prerequisite: Math 33. This course considers mathematical methods found especially useful in contemporary fields such as operations research and reliability engineering. Topics are selected from set theory, finite mathematics, difference equations, matrices and determinants, functions of several independent variables, and special functions.

Math 35. Vector Analysis. 2½ *credits.*

Prerequisite: Math 21 or 25 or 25B or 30A. This course begins with a review of the algebra of vectors and develops the calculus of vectors. Applications to physical phenomena are considered throughout.

Math 35H. Honors Mathematics V. 4 *credits.*

Prerequisite: Math 31H. This is the last semester of a six-semester program in Honors Mathematics. The course includes further complex variables theory and additional topics chosen at the discretion of the instructor.

Math 90. Computer Programming and Numerical Methods. 2½ *credits.*

Prerequisite: Math 12 or 20B. This course introduces the student to the computer field. Emphasis is placed on modern electronic computers as tools for solving engineering problems. Programming techniques and numerical methods suitable for use with a digital computer are discussed and applied.

DEPARTMENT OF MECHANICAL ENGINEERING

Chairman: GEORGE B. THOM.
Associate Chairman: EDWARD MILLER.
Assistant Chairman: HARRY HERMAN.

Professors: HSIEH, LEVY, MILLER, POLANER, PREDALE, SMITHBERG, THOM; *Associate Professors:* BANNON, BUTEAU, HRYCAK, JACOBS, MARTIN, MICHELS, SCHMERZLER, SCHNEIDER, STAMPER; *Assistant Professors:* COCHIN, DEUTSCHMAN, DROUGHTON, GAAL, HERMAN, JAFFE, PAWEL, PEARCE, WILSON; *Instructors:* KIRCHNER, PAPPAS, RAICHEL, SCHRAM; *Assistant Instructor:* CHAMBERLAIN; *Foundation Teaching Fellow:* GERECKE; *Adjunct Instructing Staff:* BERNICKER, COMINSKY, ELIADES, GROSSMANN, MANDELTORT, PREUSSE, WILNER, WOLOWODIUK, YOST.

Mechanical Engineering is concerned with the design, development, manufacture and operation of a wide variety of machines and apparatus devoted to the creation, conversion or use of power.

Practicing mechanical engineers may perform one or more of the above functions in such technological areas as aircraft engines and structures, including gas and gasoline engines, rockets and missiles; large scale power plants such as steam, hydraulic, gas and nuclear plants; materials of engineering construction; automatic control systems; production methods; and in the creation, design and use of equipment to accomplish these ends.

The curriculum for the first two years centers about the basic sciences of mathematics, physics, chemistry, and mechanics along with departmental courses in manufacturing processes and basic thermodynamics. Supplementing this core of science courses are service courses in the humanities area including English and history, engineering graphics, computer programming and problem solving, and a program of orientation toward the engineering profession and related human relations problems.

During the third and fourth years, major emphasis is directed toward the establishment of a thorough grounding in the sciences of thermodynamics, fluid mechanics, and heat transfer; in metallurgy and the properties of engineering materials; and in stress and vibration analysis. These are implemented through application courses in the areas of machine design and applied thermodynamics. The courses are supplemented by laboratory work, where appropriate, to develop an understanding of and a respect for testing procedures and also by special projects which enable the student to creatively apply engineering principles. Courses in the humanities and in the business side of the profession are continued, and various terminal courses are provided to give the student an insight into the methods available for applying theory to practice.

The undergraduate curriculum is designed to prepare the student for professional work in his field of major interest. It does more than this, however, for by virtue of the abundance of

training in the basic and engineering sciences it provides the student with the background needed for continued study at the graduate level.

The Department feels strongly that a professional attitude should be developed early in an engineering career and that professional and honorary engineering societies provide substantial encouragement in its development. The Department has a student section of the American Society of Mechanical Engineers and a chapter of Pi Tau Sigma, the honorary mechanical engineering society. Students are encouraged to meet the requirements for membership in both organizations.

COURSES OF INSTRUCTION

ME 10. MANUFACTURING PROCESSES. 1½ *credits.*

A combined lecture and laboratory course dealing with basic machining and fabrication processes. The lectures emphasize the advantages, disadvantages, accuracies, and economics of various machines and methods. Laboratory experiments are performed to study the generation of motion, power requirements, machineability, surface finishes, and joining methods.

ME 14. METALLURGY. 2½ *credits.*

Prerequisite: Chem 25. A course designed to acquaint the student with the nature of a metal and the characteristics of the various types of alloys. Plastic deformation, phase-change interruption, and precipitation-hardening are emphasized. These are illustrated by frequent reference to such common commercial metals as brass, steel and aluminum alloys.

ME 18. METALLURGY. 4 *credits.*

Prerequisite: Chem 25. A course which acquaints the student with the effects of various thermal and mechanical treatments upon the stability and properties of the various phases in alloy systems. The laboratory sessions implement and emphasize the effects of these treatments. Sample preparation and photomicrographic techniques are included.

ME 31. THEORY OF MACHINES. 3½ *credits.*

Prerequisites: EG 2, Mech 2 or 8. A course in the kinematics and dynamics of machines with an introduction to the synthesis of motion transfer devices. Vector and other analytical methods will be employed to determine the velocity, acceleration and inertial characteristics of such mechanisms as linkages, gear trains, and cam systems.

ME 33. VIBRATION ANALYSIS. 2½ *credits.*

Prerequisites: Math 22 or 30, Mech 2 or 8. The purpose of this course is to present the fundamentals of vibration theory and to provide a general background for advanced study in this field. The basic theory of systems with single and multiple degrees of freedom is developed and applied. Damped vibration, vibration isolation, vibration of continuous media, and electrical-mechanical analogies are among the topics considered.

ME 34. MECHANICAL ENGINEERING DESIGN I. 4 *credits.*

Prerequisites: ME 31, Mech 6 or 8. A lecture and project course devoted to the analysis and design of basic machine elements such as linkages, shafts, power screws, and springs. The methods studied in the classroom are applied to the investigation of mechanical assemblies and devices. Efforts will be directed toward creative thinking and the efficient use of engineering materials.

ME 36. MECHANICAL ENGINEERING DESIGN II. 4 *credits.*

Prerequisites: ME 33, 34. A continuation of ME 34 from a more advanced and integrated viewpoint. Some of the machine elements considered are spur gears, helical gears, hydrodynamic bearings, and rolling-contact bearings. The projects will be of a comprehensive nature, emphasizing creativity and professional engineering judgement.

ME 37. STRUCTURAL ANALYSIS. 2½ *credits.*

Prerequisite: Mech 6 or 8. A course designed to acquaint mechanical engineering students with the fundamentals of structural analysis. Consideration is given to such topics as moving loads, deflections, beams and columns, members and connections for both steel and reinforced concrete structures. Methods for graphical and analytical solution are developed.

ME 39. MACHINE DESIGN FUNDAMENTALS. 2½ *credits.*

Prerequisites: EG 2, Chem 25, Mech 2 and 6 or 8, IE 24. A lecture and problem course for Industrial Engineering students. Major emphasis is on techniques of analysis as related to the design of basic machine components and mechanical drives. Some of the topics considered are kinematics of machines, design methods for fatigue loading, power screws, springs, brakes and clutches, belt and chain drives, gear drives, bearings and lubrication, and vibration fundamentals.

ME 41. THERMODYNAMICS I. 2½ *credits.*

Prerequisites: Math 21 or 25B or 30A, Phys 2. A course in thermodynamic fundamentals. Among those principles introduced are the first and second laws of thermodynamics, physical properties of pure substances including real and ideal gases, entropy and availability.

ME 42. THERMODYNAMICS II. 2½ *credits.*

Prerequisite: ME 41. A continuation of ME 41 including a study of gas-vapor mixtures and combustion. The principles are applied to analyses of gas power cycles, vapor power cycles, refrigeration cycles and air conditioning systems.

ME 43. MECHANICAL LABORATORY I. 2 *credits.*

Prerequisite: ME 41, 44. A laboratory course in instrumentation and measurement for mechanical engineering students. Applications for the sensing of such variables as pressure, temperature, displacement and time under steady and transient conditions. Particular attention will be directed towards the range of applicability and sensitivity of instruments studied.

ME 44. FLUID MECHANICS. 2½ *credits.*

Prerequisites: Math 21 or 25B or 30A, Phys 2. A course in the fundamentals of fluid mechanics treating the principles of fluid statics, one dimensional incompressible flow, dimensional analysis, dynamic similarity, laminar and turbulent flow, and an introduction to two dimensional flow of an ideal fluid.

ME 45. HEAT TRANSFER. 2½ *credits.*

Prerequisites: Math 22 or 30. Corequisites: ME 42, 44. A course for mechanical engineering students dealing with the principles of heat transfer as an engineering science. The subject matter includes steady and non-steady state conduction in one and two dimensions, fundamentals of convection including boundary layer concepts, experimental correlations based on dimensional analysis, radiation and heat transfer during phase change. These are applied to the design and analysis of heat exchangers.

ME 46. MECHANICAL LABORATORY II. 2½ *credits.*

Prerequisites: ME 42, 43. A laboratory course for mechanical engineering students applying the principles of thermodynamics, fluid flow and heat transfer to energy conversion systems.

ME 48. MECHANICAL LABORATORY III. 2½ *credits.*

Prerequisites: ME 45, 46. An advanced laboratory course for mechanical engineering students in the testing and evaluating performances of complete energy conversion systems associated with steam power plants, internal combustion engines, air conditioning and refrigeration, and power absorption units.

ME 53. ENERGY CONVERSION. 2½ *credits.*

Prerequisites: ME 42, 44, Math 22 or 30, Phys 4. A course in the analysis of energy conversion and applications to power systems. Introduction to chemical, nuclear, thermoelectric, thermionic, photovoltaic, and magneto-hydrodynamic energy conversion devices and the analysis of cycles using these concepts.

ME 54. GAS DYNAMICS. 2½ *credits.*

Prerequisites: ME 42 and 44 or ChE 45 and 64, and Math 22 or 30. Equations of one dimensional compressible flow. Included are flows with variable area, friction, mass addition, heat addition, normal shocks, and combination of these effects. Special topics in two dimensional flows including oblique shocks.

ME 55. AUTOMATIC CONTROLS. 2½ *credits.*

Prerequisites: Math 22 or 30, Mech 2 or 8, Phys 3. An introductory course covering the principles of automatic controls. Emphasis is placed on mechanical systems considering hydraulic, pneumatic, thermal, and displacement aspects. First and second order linear systems are studied. Various system analysis techniques such as Nyquist and Bode diagrams are introduced.

ME 56. FLUID MACHINERY. 2½ *credits.*

Prerequisites: ME 42, 44, Math 22 or 30. An introduction to the underlying principles of rotating fluid machinery. The fundamentals of gas dynamics are introduced. Analytical, graphical, and dimensional analysis methods are used in analyzing axial and centrifugal machines. Airfoil, cascade and channel flow theories are introduced.

ME 73. THERMODYNAMICS FOR CIVIL ENGINEERS II. 2 *credits.*

Prerequisite: ME 41. A continuation of ME 41, for civil engineering students. The principles of thermodynamics are applied to combustion processes, air conditioning, gas power and vapor power cycles and compression processes. The fundamentals of heat transfer are introduced.

ME 75. THERMODYNAMICS FOR INDUSTRIAL ENGINEERS II. 2 *credits.*

Prerequisite: ME 41. An introduction to fluid mechanics, continuity, momentum and energy equations. Fundamentals of heat transfer, including basic laws of conduction, convection and radiation. Applications of thermodynamics to air conditioning systems, gas and vapor power cycles, and combustion processes.

ME 77. Power and Fluids Laboratory. 2 *credits.*

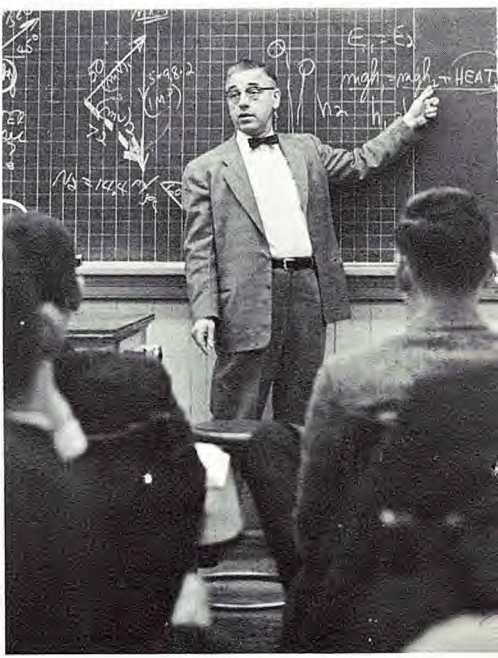
Prerequisites: CE 40, ME 41. A laboratory course for civil engineering students in which the fundamentals of thermodynamics and fluid mechanics are applied to the experimental investigation of flow in pipes, fluid meters and open channels. Tests are run on pumps, compressors, turbines, weirs and other hydraulic and pneumatic equipment.

ME 78. Thermodynamics for Electrical Engineers II. 2 *credits.*

Prerequisite: ME 41. A continuation of ME 41. The subject matter includes an introduction to fluid mechanics with fluids in static equilibrium, energy, continuity, Bernouilli's equation, momentum equations, heat transfer including conduction, convection and radiation and an introduction to direct energy conversion devices.

ME 79. Computer Solutions in Mechanical Engineering. 2½ *credits.*

Prerequisite: Math 21 or 25B. An introduction to digital and analog computing machine techniques for the solution of mechanical engineering problems. Topics include numerical methods and Fortan programming. Problems relating to thermodynamics, fluid mechanics and vibrations are solved at the Computing Center.



DEPARTMENT OF PHYSICS AND MECHANICS

Chairman: PAUL O. HOFFMANN.
Associate Chairman: ACHILLE CAPECELATRO.
Assistant Chairman (Applied Mechanics): EIVIND G. F. RAMBERG.
Assistant Chairman (Physics): LEONARD M. SALZARULO.

Professors: BERTSCH, CAPECELATRO, HOFFMANN, MAINARDI, NIELSEN, ORENS, RAMBERG, REFF, SAGURTON, SMITH; *Associate Professors:* DUURSEMA, GRANIK, MONACK, SALZARULO, TOWFIK, WELLER, WILLIAMS; *Assistant Professors:* AARON, CIESLA, DISTEFANO, KINGERY, KUHARETZ, LANDSMAN, LOVERIDGE, MCGURN, NEIDHARDT, OLECK, REISMAN, REIZISS, RUSSO, SHUKUR, WITTES; *Instructors:* AUSTEN, FABRICIUS, GIORDANO, RATZBURG, TAYLOR; *Assistant Instructor:* STEVENSON; *Special Instructing Staff:* SCHWEIZER; *Adjunct Instructing Staff:* ALLEN, DEMCHAK, DILORENZO, DOOLIN, GERHARD, JACKSON, KIVEN, KRAMER, RAFFAY, RAUPPIUS, STEADY, TOMECEK, WEI.

The Department of Physics and Mechanics has arranged the content of its courses to give the engineering student a sound background in physics and engineering mechanics. It is the aim of the department to have the student realize that physics and engineering mechanics serves as the foundation upon which his engineering knowledge must be based. Emphasis is placed upon the fact that the fundamental principles of those sciences must be applied in later professional studies.

The schedule of instruction includes a rather small amount of formal lecturing with a large number of informal recitations, problem work and demonstration periods, together with laboratory work in general physics and stress and strain analysis. The Department of Physics and Mechanics is supplied with four General Physics laboratories completely equipped to enable the student to perform experiments in mechanics, electricity, heat, sound and light. The stress analysis laboratories have equipment approximating industrial laboratories, and the performance of experiments is carried out in such manner as to verify the theory studied in the classroom.

COURSES OF INSTRUCTION

Mech 1. STATICS. 2 *credits.*

Prerequisites: Phys 1, Math 12. This course is devoted entirely to statics. Topics include elementary vector algebra, scalar and vector products applied to two and three dimensional force systems, equilibrium, friction (sliding, belt, and bearing) second moments of areas and of masses, flexible cables, virtual work, and engineering applications of statics. The emphasis in this course is on engineering mechanics in which a maximum use is made of the free body diagram approach, together with vector analysis methods.

Mech 2. DYNAMICS. 2 *credits.*

Prerequisites: Mech 1. This course covers kinematics and kinetics. The topics of instruction include curvilinear motion with respect to fixed and rotating axes of particles and rigid bodies, Newton's Laws of motion for particles and rigid bodies, principle of work and energy, and principle of impulse and momentum. The free body diagram approach and vector analysis methods are used.

Mech 5. MECHANICS OF DEFORMABLE BODIES. 4 *credits.*

Prerequisites: Mech 1, Math 25. The physical basis of stress and strain analysis is studied in theory and demonstrated by laboratory experiments. The principles and methods are applied to practical problems involving the elements of which structures and machines are composed such as axial, flexural, and torsional members and combinations of these.

Mech 6. MECHANICS OF DEFORMABLE BODIES. 4 *credits.*

Prerequisites: Mech 1, Math 25. Similar to Mech 5, except that less time is devoted to laboratory experiments.

Mech 7. MECHANICS OF RIGID AND DEFORMABLE BODIES I. 4 *credits.*

Prerequisites: Phys 1, Math 12. The first eight weeks (approximately) are devoted to statistics. Topics include elementary vector algebra, scalar and vector products applied to two and three dimensional force systems, equilibrium including friction, and second moments of areas and of masses. The emphasis is on engineering mechanics in which maximum use is made of the free body diagram approach, together with vector analysis methods. In the last weeks the physical basis of stress and strain analysis is studied in theory and demonstrated by laboratory experiments. Topics include plane stress and strain, axially loaded members, bending torsion, and combinations of these.

Mech 8. MECHANICS OF RIGID AND DEFORMABLE BODIES II. 4 *credits.*

Prerequisite: Mech 7. A continuation of Mech 7. In the first eight weeks (approximately) the study of the physical basis of stress and strain analysis is continued both in theory and in laboratory demonstrations. Topics include shear and bending moment diagrams, bending stresses, shearing stresses, deflection of beams, combination of bending and torsion, and columns. In the last weeks kinematics and kinetics are studied. Topics include curvilinear motion with respect to fixed and rotating axes of particles and rigid bodies, Newton's laws of motion for particles and rigid bodies, principles of impulse and momentum. The free body diagram approach and vector analysis methods are used.

Phys 1. PHYSICS I. 3½ *credits.*

This course deals with the study of elementary mechanics. Emphasis is placed on the fundamental concepts and laws of mechanics, especially the conservation laws. Topics discussed are: scalar and vector quantities of mechanics; rectilinear, circular and simple harmonic motion; equilibrium and Newton's laws of motion; work, energy, momentum, and the conservation laws. Correlated experiments and computations run concurrently with lectures and recitations.

Phys 2. PHYSICS II. 3½ *credits.*

Prerequisite: Phys 1. Elements of heat, sound, and light form the contents of this course. The concept of wave motion and the transfer of energy by means of wave motion is emphasized. The First Law of Thermodynamics serves as a further example of the conservation laws. In the study of light the principles of geometric optics are applied to lenses and optical instruments. Correlated experiments and computations run concurrently with lectures and recitations.

Phys 3. PHYSICS III. 3½ *credits.*

Prerequisite: Phys 2. Electricity and magnetism are presented from the point of view of the field concept and the conservation laws. The study of the electric field and the magnetic field culminates in the important re-

lationships between electric and magnetic concepts which can be used in later courses as foundations upon which Maxwell's equations can be built. The laws of conservation of charge, mass and energy are used throughout the course, particularly in the study of capacitors, direct currents and alternating currents. Correlated experiments and computations run concurrently with lectures and recitations.

Phys 4. MODERN PHYSICS. 2½ *credits.*

Prerequisite: Phys 3. The wave and particle duality of nature is emphasized and made plausible by an examination of the important experiments and theories which lead to the modern concepts of matter and radiation. The conservation laws are now broadened to include the law of equivalence of mass and energy. Elements of solid state and nuclear physics are introduced.

Phys 6. ENGINEERING PHYSICS. 2½ *credits.*

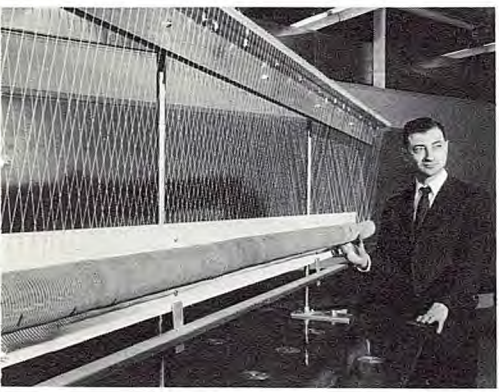
Prerequisites: Phys 4, Mech 2, Math 30. Lagrange's and Hamilton's equations are studied. Field concepts are applied to elasticity, fluid flow, elastic waves and heat flow. Boundary value problems are solved, based on the wave equation, Laplace's equation and the equation of heat flow.

Phys 7. NUCLEAR ENGINEERING. 2½ *credits.*

Prerequisites: Phys 4, Math 30. Neutron physics is applied to elementary nuclear reactor design. Topics included are nuclear reactions, nuclear fission, neutron diffusion, criticality, reactor start-up and reactor transients, radiation detection and shielding.

Phys 8. SEMICONDUCTOR PHYSICS. 2½ *credits.*

Prerequisite: EE 40. The physics of semiconductors is examined and applied to problems of interest to the electrical engineer. The course includes the following topics: the band theory of solids, conduction in solids, hole and electron statistics, and P-N junction theory with emphasis placed upon low-level and high-level injection. Metal semiconductor contacts and P-N-P transistor theory are also discussed.



DIVISION OF HEALTH, PHYSICAL EDUCATION AND ATHLETICS

Director: ROBERT F. SWANSON.
Associate Director: PAUL C. HAUSSER.
Associate Professors: HAUSSER, SIMON, SWANSON; *Consulting Physician:* WARD.

The acquisition and maintenance of an optimal condition of health for the purpose of pursuing an engineering education is the primary purpose of the Division. To accomplish this purpose the Division coordinates the health-related needs of the college community through a health services area, and conducts a formal instruction program in physical education for freshmen students. The Division also coordinates and advises students in the operation of numerous intramural and intercollegiate athletic activities. In athletics there is a strong emphasis on programs of an intramural nature, while intercollegiate athletics are supported to the extent that they contribute to the primary purpose of the Division.

The health services program is of a consultative nature, bringing reliable, authentic advice to students where investigation and experience indicates a need. A consulting physician, nurses, and health educators comprise the staff. The facilities of a modern college infirmary are available day and evening in the event of sudden illness or injury. Students are urged to use the ample facilities of the health services area to solve health-related problems effecting their educational goals.

PHYSICAL EDUCATION. *No credit, two semesters.*

Physical Education is required of all freshman students. Those freshmen who submit evidence of a disability, or who have been examined by the College physician and declared physically unable to participate in strenuous physical activity, take part in an individualized program under the guidance of a physical education instructor.

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