THE BULLETIN

UNDERGRADUATE COURSES

1961-1962

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JANUARY, 1961

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323 High Street, Newark 2, N. J.

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

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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 is also open evenings between the hours of 6:00 P.M. and 9:00 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 is open between the hours of 6:00 P.M. and 9:00 P.M., Monday through Thursday.

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The BULLETIN
Published by
THE BOARD OF TRUSTEES OF SCHOOLS FOR INDUSTRIAL EDUCATION
OF NEWARK, N. J.

NEWARK COLLEGE OF ENGINEERING

UNDERGRADUATE COURSES

1961 - 1962

NEWARK 2, NEW JERSEY

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 consists of an Undergraduate Day Division and an Undergraduate Evening Division offering courses leading to bachelor of science degrees in Chemical, Civil, Electrical, Industrial, and Mechanical Engineering. Within these fields certain options are available. There is also a Graduate Division offering master of science and doctoral degrees in the engineering fields. A Special Courses Division offers a wide listing of courses for the up-grading of industrial personnel, and cooperates with Newark Technical School in presenting certain of these courses tuition-free to the residents of the City of Newark. The College also maintains a Counseling Center which cooperates with industry, with individuals requesting counseling, and with high school guidance departments.

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

The College's administrative offices are located at 323 High Street in the City of Newark, convenient to all transportation lines. The College has a predominantly commuting population.

Current enrollment figures show 2918 students enrolled in the undergraduate day and evening divisions of the College, and 664 students taking work leading to the master of science degree. The Special Courses Division numbers 1361 students.

COLLEGE CALENDAR

1961 - 1962

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

1961

Registration — Fall Semester..... September 11 to 14 incl.

Fall Semester Begins..... September 20

Midpoint of Semester..... November 14

Thanksgiving Holidays..... November 22 to 25 incl.

Christmas Holidays..... December 20 to January 2 incl.

1962

Fall Semester Ends..... January 27

Registration — Spring Semester..... February 5 to 8 incl.

Spring Semester Begins..... February 12

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

Midpoint of Semester, except for February Freshmen..... April 6

Spring Vacation..... April 9 to 14 incl.

Good Friday..... April 20

Memorial Day Holiday..... May 30

Spring Semester Ends for February Freshmen..... June 2

Last Day of Attendance
for Seniors..... June 4

Commencement (tentative) ..... June 7

Registration — Summer Semester
for February Freshmen..... June 8

Spring Semester Ends for September
Freshmen, Sophomores
and Juniors..... June 10

Summer Semester Begins for
February Freshmen..... June 11

*Registration — Evening Under-
graduate Summer Session..... June 15

Evening Undergraduate Summer
Session Begins..... June 18

Independence Day Holiday..... July 4

Summer Semester Ends
for February Freshmen..... August 24

Evening Undergraduate Summer
Session Ends..... August 30

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

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NEWARK 2, NEW JERSEY

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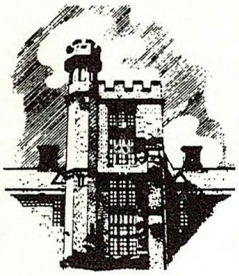
HISTORY OF
NEWARK COLLEGE OF ENGINEERING



The years between 1878 and 1885 are historic ones for the Newark Technical School and Newark College of Engineering. During that period prominent citizens and public officials first discussed the establishment of a technical school and actually got it under way. Before the Civil War the Newark Mechanics' Institute had been in operation. As its name indicates, apprentices and mechanics from local concerns were given some theoretical and practical training in their own trades to help them in their everyday work, but the drain on manpower during the Civil War presumably forced the Institute to close.

By 1878 Newark had grown tremendously as a manufacturing center, and a definite need for a technical school had again risen. The Governor and other influential leaders and organizations, including the Newark Board of Trade, by committee work and investigation, looked into the matter. A bill sponsored by the Board of Trade passed the state legislature in 1881 and $5,000 per year was appropriated for the upkeep of a technical school in Newark, provided citizens would raise a similar amount by subscription or contributions. The citizens raised their share, and a building was secured at 21 West Park Street in Newark. Professor Charles A. Colton of Rose Polytechnic Institute, Terre Haute, Indiana, was named Director.

The first class, numbering 100 students, started courses of evening study which included work in drawing, mathematics, physics, and chemistry. Director Colton, a mining engineer, brought a wide educational vision to the newly formed institution, and constantly made changes and improvements in the courses to meet changing needs.

At this time all the students studied during the evening and were employees of local industries. Director Colton felt by 1912 that the time had come when work of college grade should be given during the daytime, and he took steps to initiate such work. The First World War delayed this procedure somewhat, and it was not until September, 1919 that the first day class matriculated for a degree program. This period also saw hundreds of disabled war veterans assigned to the School by the Veterans' Bureau for study and rehabilitation.

Allan R. Cullimore was appointed Director of the School and head of the College in 1920. Coming from the University of Delaware, the new Director brought with him many forth-

right ideas, and soon both Evening School and College were flourishing in numbers and in prestige.

There was evidence that a great many men engaged in industry during the daytime needed to further their education beyond the night technical school level, and in the middle twenties the college instituted an evening program leading to the bachelor of science degree. The evening division of the college has continued to grow and is now an important factor in the industrial and professional advancement of many hundreds of young men and women in the New Jersey industrial areas. Side by side with the growth of the evening school has been the advancement of the Graduate Division of the College which offers both master of science and doctoral degrees.

The Second World War brought a number of changes in the operation of the college. An Engineering, Science and Management War Training program was instituted, and Newark College of Engineering became a leader among the professional colleges training men and women for essential positions in war industries. Approximately 10,000 residents of the area received training in critical war production work. So successful was the up-grading of this type of personnel that the college has continued a Special Courses Division which implements the experience received on the job by the individual worker. A wide field of subjects is offered by this division which grew from this one part of the College's contribution to the war effort.

Several of the teaching personnel of the college were called into the Armed Forces in their specialized capacities, while others served on scientific and industrial projects of secret nature. The student personnel through enlistments or selective service was cut sharply and this enabled the College to instruct assigned army personnel under the Army Specialized Training Program.

At the conclusion of the war, as in the case of World War I, the College played a leading part in the rehabilitation and retraining of men under the Veterans' Administration, and a Testing and Guidance Center was established, with highly trained personnel, which has now, as the NCE Counseling Center, become an integral part of the college.

Dr. Cullimore retired from the presidency in 1949, and was succeeded by Dr. Robert W. Van Houten, a graduate of the College, who continues as president today.

In reviewing the growth of Newark College of Engineering since its development from the original Newark Technical School, beginning in 1920, it is important to stress the major contributions made by Dr. Cullimore to the field of engineering education.

During the twenty-nine years of his presidency, he estab-

lished the enviable record in opening new frontiers of engineering education that led, in 1951, to his receiving the Lamme Award of the American Society for Engineering Education, the highest national honor which that Society bestows.

He established the study of the humanities on an equal level with technical studies. He made major contributions to the field of guidance, particularly as they apply to engineering students, and was responsible for the excellent Counseling Center which exists at the College today. He based the ruling philosophy of the College on two principles: that engineering is a discipline, requiring the highest ideals of work and ethics, and that the engineer has a duty as a citizen perhaps even greater than do the members of other professions, because of his specialized training in both logical and creative thinking.

The latter emphasis finds expression today in the College's four-year program of orientation to industry and society, particularly, but not exclusively, within the curricula of the departments of English, Professional Development and Industrial Relations, and Industrial and Management Engineering.

In partial recognition of this record, the trustees of the College, shortly after his death in 1956, decided to name NCE's new 41-room classroom building Cullimore Hall. The dedicatory plaque at the building's entrance reads, "In honor of Allan Reginald Cullimore, President, 1920-1949. Engineer, soldier, teacher, administrator, citizen, constructive statesman in engineering education, consecrated to the cause of young engineers. He gave of himself without stint that this college might grow great and strong in the service of the community and the engineering profession."

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 contained equipment used in the courses, and also provided 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 plans were formulated and construction started for a five story extension to Colton Hall which would house departmental offices as well as more modern scientific and technological equipment. 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.

The College has also acquired a building situated at 240-250 High Street through the philanthropy of Mr. Martin F. Tiernan, which after extensive remodeling has been 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 $7,000,000 from a recent bond issue which will enable the College further to expand its facilities between now and 1965 in order to take care of the greatly increased need for opportunities in engineering education created by the State's expanding college-age population.

The present buildings house well-allocated classroom, lecture room, laboratory, and drawing room space, with modern equipment in the engineering and technological departments. There is also a well equipped bookstore for students' books and supplies. The Dining Hall is open from 10:00 A.M. until 7:00 P.M. Two gymnasiums, which are used for intramural sports as well as varsity games, and a well rounded physical education program, are an integral part of the College's educational plan. Administrative offices of the College and of the individual departments are located close to their major work areas.

AIMS AND OBJECTIVES

The philosophy of Newark College of Engineering is simple and involves training along scientific, technological, and humanistic lines those young men and women who have interest and ability irrespective of 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 aca-

demic 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 simple 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 such as Edward Weston, George Phillips, ex-Governor Marcus Ward, ex-Senator William D. Kirk, Thomas B. Peddie and others 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 in the area and passes on to each student the important and fundamental objectives of the industries and their attitudes toward modern engineering techniques. This is accomplished by lecturers from industry, by the Honors Option 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, in addition to the customary items of dress, wear 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 text, 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.

COURSES

The College offers four-year undergraduate courses in Chemical, Civil, Electrical, Industrial and Mechanical Engineer-

ing. In the Civil Engineering program students may elect a General Option, Hydraulic and Sanitary Option, or Structural and Transportation Option. These courses may be taken either on a full-time day program or part-time evening program. (For further information see "Junior and Senior Evening Programs," page 47.)

Courses are also offered at graduate level, leading to the master's or doctoral degree. (For further information see "Graduate Division," page 48.)

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

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 subjects represent the unity in all branches of engineering of basic sciences, mathematics, humanities, and engineering science.

The work of the first two years 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. (See "Student Guidance," page 44.) Requirements for admission to the Senior Division (i.e., to third year classes) are:

1. Completion of all courses in the Junior Division with satisfactory grades,
2. Satisfactory performance on Achievement Tests if administered by the College.

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.

The Bulletin 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	Outstanding or exceptional work
3	Above average work
2	Average work
1	Below average work, but not far enough below to require repetition
O	Failure, requiring repetition of the course
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

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 the Bulletin as being required in the third and fourth years of the professional department in which he desires to earn a Bachelor of Science degree.

ADMISSION TO THE COLLEGE

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.*

The certified record must include the date of graduation; or if the record is submitted prior to graduation, a certificate of

*The $5.00 application fee must accompany the application.

graduation must be submitted before final acceptance can be granted.

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.

That they may be adequately prepared for the course of study which they are to undertake, applicants must have attained sixteen units of secondary school work apportioned as follows:

SUBJECTS REQUIRED FOR ADMISSION

English	4 units	
College Preparatory Mathematics including algebra, geometry, and plane trigonometry	3½ or 4 units	(Effective September, 1962 4 units will be required)
Physics	1 unit	
Chemistry	1 unit	
		9½ or 10 units
6 or 6½ additional units as indicated:		
Foreign language	2 to 5 units	
Social Studies	1 to 5 units	
Science (other than physics or chemistry)	1 to 3 units	
Unclassified subjects having a value of one full unit	3 units	(Effective September, 1962 only 1 unclassified unit will be accepted)
		6 or 6½ units
	TOTAL	16 units

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.

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.

In addition to evidence of proper secondary school preparation, *all candidates must submit official records of their scores on the Scholastic Aptitude Test.* 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 in September, 1961.

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 all high schools in the area.

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 by telephoning the Admissions Office, MA 4-2424, Ext. 257.

The Counseling Center also participates in pre-college guidance. For details see page 44.

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* and, in addition, submit official transcripts and statements

*Including the scores earned on the Scholastic Aptitude Test of the College Entrance Examination Board.

of honorable dismissal from all institutions which they have previously attended. Applicants in this category must submit a transcript evaluation fee of five dollars with their applications. This fee covers a service which is necessary to evaluate transcripts for studies completed at other institutions. This fee is not returnable regardless of whether or not the applicant is admitted to the College.

SPECIAL STUDENTS

1. *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.

2. *Auditor*
   Permission to enroll as an auditor may be granted by the Admissions Office to mature students who cannot meet the admission requirements but who can demonstrate that by virtue of their professional experience 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.

Those who wish to be considered for enrollment as Special Students should obtain the proper application from the Office of Admissions. Favorable consideration will be given only if the application, the application fee (and transcript evaluation fee if required), and all necessary supporting data are received at least two weeks prior to the beginning of any semester.

Students qualified according to the above requirements will be accepted for courses in which there is still room after students registered for a degree program have had an opportunity to enroll.

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.

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.

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 35).

READMISSION

Any applicant for readmission to Newark College of Engineering must submit an Application for Readmission to the Dean of Students. A statement of acceptance is necessary from this office before registration will be permitted. (See Application, Matriculation, and Special Fees.)

Applicants for readmission who have been dismissed for academic reasons are not eligible to apply until one semester has elapsed since 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 to both Day and Evening undergraduate students.

TUITION AND FEES

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.

	Residents of New Jersey
TUITION	$155.00 per semester
REGULAR FEES	
Registration	7.50 per semester
*General Fee	38.00 per semester
Total Tuition and Regular Fees	$200.50 per semester

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

As the College receives State aid, the New Jersey State Board of Education requires that the tuition charge for nonresidents of New Jersey be double that for residents of the State.

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

APPLICATION, MATRICULATION AND SPECIAL FEES

Each candidate for admission to the College must pay an application fee of $5.00 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.

Any applicant for readmission to Newark College of Engineering must pay an application fee of $5.00 at the time the Application for Readmission form is submitted. (See section "Readmission," page 34). 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.

A fee of $5.00 will be charged for the evaluation of official college transcripts submitted in accordance with the instructions set forth on page 32 of this catalog under the heading "Admission by Transfer." This fee is *in addition* to the application fee of $5.00 which *all* applicants must pay and covers service which is necessary to evaluate transcripts of study completed at other institutions of higher education. It is not returnable, regardless of whether or not the applicant is admitted to the College.

Prospective students are charged a fee of $7.00 if they are required to take admission tests other than the required College Entrance Examination Board tests.

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

Registration is required for each semester. An extra registration fee of $5.00 is required of those who register late.

A fee of $2.00 is charged for the physical examination.

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 nonresidents.

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

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

A graduation fee of $5.00 is required of all candidates for graduation from the Junior Division.

A graduation fee of $20.00 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.

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 $75.00 with an additional $45.00 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 $20.00.

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

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 drops a course, or courses, he must fill out a set of authorized 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.

WITHDRAWAL AND REFUND

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 2.00 or better, the instructor will report a grade of "W": if below a 2.00, 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

A student who is forced to withdraw from college for reasons other than induction by selective service may, if the reasons are beyond his control, apply to the Business Manager for a refund. The application should state fully the reasons for the withdrawal and should include necessary verification such as, in the case of illness, a doctor's certificate. Refunds are based on the date on which the application is received. If the Committee on Refunds, to which the Business Manager will refer the application, approves it, a refund will be recommended to the Board of Trustees for consideration.

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

If a refund is approved by the Board of Trustees, 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, PRIZES, AND STUDENT AID

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.

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

A scholarship is awarded by Chapter 14, A.S.T.E. every four years to a freshman student of sound scholastic ability who has a need for financial assistance. The payment of $150 will be made each year for four years, provided the recipient maintains his scholastic average. The student must elect those courses in the Mechanical Engineering curriculum which are specific to the Tool Engineering field. In addition to the monetary award, there will be provided a free student membership in A.S.T.E. for the four year period.

Bendix Corporation Scholarship

The Bendix Corporation Scholarship is awarded annually to a third-year student in the Electrical Engineering Department. The award is the amount of tuition and fees for the senior year and is made on the basis of academic achievement.

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).

The recipient of the award is to be selected during the latter half of the junior year by the faculty of the electrical engineering department, who may consider the need of the student in making the determination. The proceeds of the award are to be applied against tuition and fees for the senior year.

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.

Arthur Silverman Boy Scout Scholarship

Commencing with the year 1954-1955 a scholarship was established for a first year student of the college who is a member of Robert Treat Council of the Boy Scouts of America. This scholarship of $350 to be applied to tuition and fees, has been made possible by Arthur Silverman NCE '39. The recipient for the first year will automatically become a candidate for this award in his subsequent years at the college. A committee for Robert Treat Council will recommend candidates for this award and a committee at the college will make the final selection of the recipient.

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 an-

nually 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.

Damon G. Douglas Company Scholarships

Each year the Damon G. Douglas Company of Newark makes available one $310 freshman scholarship. Every four years the Company provides a $310 scholarship renewable for a maximum of four years provided the recipient continues to maintain a high level of academic excellence. Scholarship applications for these awards must be filed with the College by March 1 preceding the September admission date.

Each applicant is judged on the basis of scholastic achievement and potential promise of becoming a good engineer, which would include evaluation of character, personality, health, and participation in school and community activities. In the consideration of applicants, the sons and grandsons of members of five locals associated with the Essex County Building Trades Council are given preference, with students planning to major in civil engineering being given first consideration.

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.

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.

International Telephone and Telegraph Corporation Scholarships

Two scholarships of $500 each have been established for students majoring in electrical engineering for award on the basis of scholastic excellence, professional promise, and need.

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.

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.

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.

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.

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.

THE PAUL G. KAYSER AND GEORGE SNELL AWARD

The Paul G. Kayser and George Snell Award in Personnel Relations is made annually to the senior who is judged to have the greatest promise in his understanding of personnel and labor-management problems.

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.

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, and the David Steinman Foundation 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.

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

INFORMATION FOR VETERANS

All of the programs of the College are available under Public Law 550.

A newly-accepted student who is eligible for, and wishes to take his college program under V.A. benefits should, without delay, apply to the Veterans Administration Regional Office, Newark, N. J., for a Certificate for Education and Training. Once certified by the Veterans Administration, it is the responsibility of each veteran to see the Veterans' Coordinator of the College at each registration.

Veterans' Administration regulations state that any course which has been completed satisfactorily may be repeated only at the veteran's own expense.

Veterans eligible for training under Public Law 550 should be prepared to meet their financial obligations to the College at each registration.

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. 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.

STUDENT GUIDANCE

The guidance of students in the College is under the general direction of the Dean of Students. Particularly in the Junior Division the Dean of Students directs a system of guidance aimed at the reduction of those losses of effectiveness which stem from the inability of the occasional student to adjust to the requirements of an engineering education. To complement the formal orientation course, each entering student is placed under the charge of an adviser, a member of the faculty, who will be one of his instructors during the first semester. The student is invited to consult his adviser upon all matters connected with the successful prosecution of his college work.

In the Senior Division the degree-granting departments assume the obligation of advisement to assist in the development of the student's professional outlook.

COUNSELING CENTER

The Dean of Students and the advisers have at hand the facilities of the Counseling Center of the College. The Center is a complete unit organized for vocational and educational counseling, located in especially designed quarters in Eberhardt Hall. Its personnel includes trained and experienced counselors and a professional psychometrist for the administration of standard psychological and other diagnostic tests, with the necessary scoring and stenographic staff. It is arranged to give the privacy desirable for counseling and has facilities for individual or group testing. Modern apparatus is available for detection of possible vision deficiencies.

The organization has had extended experience in the counseling of more than 14,000 veterans referred for its service by the Veterans' Administration, and over 7,000 individuals from the College, industry, and other sources. It aims to assist the student, by conference and testing, in analyzing his strengths and weaknesses, so that in conjunction with the adviser, the path to improvement may be discovered. Similar assistance is offered to men who may be leaving college, to avoid, if possible, a severance without a plan for the immediate future.

The organization administers a battery of tests to all freshmen during Orientation Week. The Center is a designated station for administration of the Miller Analogies Test and the Minnesota Engineering Analogies Test. The Center is approved by the American Board of Professional Standards in Vocational Counseling and by the American Board for Psychological Services as a counseling center.

Testing and counseling is available to the public and to business and industry at fees which express the approximate

cost of the service. Aptitude testing for high school groups in cooperation with their guidance staffs is an established feature of its activities.

The Center is open from 9:00 a.m. to 5:00 p.m. Monday through Friday and by special appointment on occasional Saturday dates. While students may request conferences at any time the Center is open, all other persons should telephone or write for an appointment (see inside front cover).

COLLEGE LIBRARY

The College Library occupies the entire third floor of the new 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 33,000 bound volumes and a considerable number of unbound periodicals, government bulletins, and miscellaneous booklets. Over two hundred and 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.

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 Society of Plastics Engineers, Newark Section, has established a library committee and a fund for the purpose of selecting and acquiring books and periodicals to contribute to the library's plastics collection.

In addition to the resources of the College Library, students are near and have access to other excellent libraries: The Newark Public Library grants book-borrowing privileges to students attending Newark schools; the Public Service Corporation Library is available for limited use; the Engineering Societies Library and the Chemists' Club Library, both in New York, are available for student use; and the New York Public Library may be used upon special application for items not available locally.

Interlibrary loan relationships with other libraries along with the use of microfilm equipment and copying machines enable students to have almost unlimited access to the printed materials needed.

HONORS OPTION

Those who have completed the Sophomore or Junior year and who have achieved a scholastic rank in the upper part of the class are eligible for the Honors Option Program. Participants are given first consideration for placement in cooperative industrial work during the summer. For years, many companies in this area and in other sections of the country have given our students the opportunity to obtain pre-engineering work experience. This type of experience supplements theoretical classroom work, makes it more meaningful and provides a better understanding of industrial personnel problems. While students are at work, the Department of Professional Development and Industrial Relations maintains contact with employers regarding their progress.

This industrial experience can be of real value when it is shared with students in Personnel Relations and Labor Relations class discussions. Recognition is given when the student meets the requirements of maintaining a high academic standing, and satisfactory progress on the job, together with assistance in class discussions. Recognition also includes a special citation on the diploma at graduation which signifies that the student has satisfactorily completed all requirements of the Honors Option Program for a period of two years.

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 Professional Development and 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.

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.

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 the company representatives, the College has made available modern and comfortable interviewing facilities.

For use during his stay at the College, each company representative is supplied a folder on each student he will see which contains a transcript, grade point averages, and a personal summary which has been prepared by the student for this purpose. In the case of the Honors Option participants, there will also be included Summer Employment Work Evaluation Forms.

The department maintains a file of all job openings received for candidates for graduation as well as for alumni. The placement office is open all year during business hours and on designated evenings as a service to students and to industry.

During the undergraduate period, part-time openings are available for students as technical assistants in the various departments of the College and in industry. Since the best interest of the student requires unqualified attention to his course of study, the Department of Professional Development and Industrial Relations supervises such placements and feels that outside activity should be limited to the ability of the individual student.

JUNIOR AND SENIOR DIVISION EVENING PROGRAMS

The evening program of Newark College of Engineering is 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. Upon satisfactory completion of the courses taken in this four year period a student receives the diploma of the Junior Division (Evening). The program of the Senior Division is five years in length if taken on .. 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.

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

GRADUATE DIVISION

Newark College of Engineering offers courses in the Graduate Division 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. Courses and research leading to the degree of Doctor of Engineering Science are also offered in the fields of Chemical and Electrical engineering.

Admission to a course carrying graduate credit is generally restricted to graduates of accredited institutions in which satisfactory records were made in courses which provide a suitable preparation for a program of graduate study in engineering.

To be admitted to the graduate division of Newark College of Engineering as a Graduate Student, an applicant must have received a Bachelor's Degree, or an equivalent degree in engineering, science, or closely allied field, from an accredited college or university, and his academic record and credentials must be such as to indicate that he has the ability to pursue satisfactorily an approved program of graduate study. Application should be made to the Dean of Admissions.

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 Chairman, Graduate Division.

Through the College and its Research Foundation, fellowships are available to graduate students to enable them to pursue a combined program of research, teaching and study leading to the master's degree. It normally takes two years to earn the degree under the fellowship program, and the fellowships are renewable for the second year. Inquiries and applications should be directed to the Vice-President.

All inquiries for information or for catalogues on the graduate program should be addressed to the Dean of Admissions.

NEWARK COLLEGE OF ENGINEERING RESEARCH FOUNDATION

The Newark College of Engineering Research Foundation, 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.

SPECIAL COURSES DIVISION

This Division offers terminal programs, individual courses, conferences and seminars in technical subject matter for men and women in industry who wish to further their scientific, technical, and mathematical training, but are not concerned with credits toward a degree. The Division operates on a quarter term basis with its major offerings in the fall, winter, and spring terms. Approximately 150 courses are offered under the supervision of the various departments of the College, and these are conducted during the evening hours or on Saturdays. They generally run 12 weeks, and a modest tuition charge is set on each course. Certain courses are tuition-free to residents of Newark, New Jersey. A list of these courses is published in brochure form and may be obtained from the Director of Special Courses. Thirteen certificate programs of two or three years duration in certain specific fields are available.

STUDENT LIFE

The aim of the College is to train and educate earnest students to become competent in their profession. This is the first and supreme duty of the College. It is felt, however, that in addition to high level professional training, the student should have a well rounded vision of the world and society. He is therefore encouraged to take an active part in the affairs of the "college community" above and beyond the scientific and humanistic studies of his curriculum.

Ample opportunity is provided for the development of extracurricular programs, particularly those which are compatible with the areas of activity into which the graduates as professional engineers enter in later life, and which are consistent with the professional aims of the College.

Student government is in the form of a Student Council, acting with a Director of Student Activities, who serve to coordinate various interest-areas into programs which meet the needs of the individual student according to the basic purposes of the College. Student interests are organized under Student Council leadership into various administrative groups. The Athletic Association administers the sports program, the Interfraternity Council represents social fraternities, and the Professional Societies Council coordinates the programs of the student chapters of the professional engineering societies. Student leaders from these areas and others constitute the Student Council.

The College is among the leading engineering colleges of America 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 non-technical fields. Freshmen who rank in the upper 20 per cent of their class will be considered for membership in Phi Eta Sigma, national scholarship society for freshmen.

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 to the end that the most representative leaders in all phases of campus life can cooperate in worthwhile endeavor. Four honor societies are associated with particular professional departments: Omega Chi Epsilon, Chemical Engineering Society for juniors and seniors; Pi Tau Sigma, Mechanical Engineering society to which junior and senior M.E. students may be elected; Eta Kappa Nu, Electrical Engineering honor society, which likewise limits its membership to juniors and seniors; and Chi Epsilon, national honor Civil Engineering society.

The Arnold Air Society is the honor society of the Air Force Reserve Officers Training Corps. The purpose of the society 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 the advanced students who qualify academically, who show an interest in the Air Force program, and who are considered favorably in voting sessions of the active members of the squadron.

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

The professional departments expect student participation in the activities of the student branches of the national professional engineering societies.

A newspaper, "The Vector", is published and operated entirely by student members of the staff, and there is also a Yearbook published by each senior class. Staffs of student publications may be elected to membership in Pi Delta Epsilon, national collegiate journalism society.

Social gatherings range from dinner meetings and lectures conducted by various student professional societies to class or fraternity sponsored dances or outings.

PHYSICAL EXAMINATIONS

All students entering the College for the first time are required to report to the Consulting Physician for a physical examination in accordance with a schedule arranged by the staff in Health and Physical Education. The physical examination required by the College also serves as one of the criteria for the qualification of beginning students in the Air Force ROTC program.

PHYSICAL EDUCATION

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 the physical education instructor.

ATHLETICS

The student-governed 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 satisfactory participation.

Intercollegiate competition is usually provided in soccer, basketball, baseball, bowling, tennis, golf, fencing and riflery. On an intramural level, competition is college-wide in the form of tournaments in basketball, bowling, softball, table tennis, volleyball and badminton. Club participation in physical recreation activities is popular in skiing, rod and gun, yachting and golf.

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

DEPARTMENTS OF INSTRUCTION

COURSES OF INSTRUCTION IN FIRST AND SECOND YEAR OF COLLEGE

The Faculty has approved a revision of curriculums. This revision began with the class entering in September, 1960. Each year following will bring revision of the next year's curriculum (i.e., September, 1961 —revision of the Second Year, etc.). The complete new curriculums are available on request.

The following lists of subjects will be taken by students in the first two years of their college course.

Note that the sophomore year requires a choice of department of major study. Much of the curriculum is common to all departments; but to provide the proper sequence of courses, certain differences appear in each departmental program. The courses common to all departments are listed first, followed by those peculiar to each department.

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 in the first two years are one-semester courses; currently, in the third and fourth years, they may be either one- or two-semester courses.

Students taking the Air Force ROTC program will find the necessary course substitutions listed on pages 54-57.

FIRST YEAR

Course Number		Title	1st Semester		2nd Semester	
(Chem 15)	(Chem 16)	Chemistry	4-3	4½	4-3	4½
(EG 1)	(EG 2)	Engineering Graphics	2-3	2½	2-3	2½
(Eng 11)	(Eng 12)	English	4-0	3	4-0	3
(Math 10)	(Math 15)	Mathematics	4-0	4	4-0	4
(Phys 1)	(Phys 2)	Physics	3-2	3½	3-2	3½
(IR 21)		Psychology of Personal Adjustment	1-0	½		
	(IR 22)	Preface to the Engineering Profession			1-0	½
		Physical Education	0-1	0	0-1	0

SECOND YEAR

(Beginning September, 1961)

Course Number		Title	1st Semester		2nd Semester	
(Eng 21)	(Eng 22)	English	3-0	2	3-0	2
(Math 20)	(Math 25)	Calculus II & III	4-0	4	4-0	4
(Phys 3)	(Phys 4)	Physics	3-3	3½	3-3	3½
(Mech 1)	(Mech 2)	Mechanics	3-0	2	3-0	2
(IE 23)		Economics	3-0	2½		
(IR 23)	(IR 24)	Elements of Industrial Growth	2-0	1	2-0	1
Chemical Engineering						
(Chem 25)		Principles of Engineering Materials	3-0	2½		
(HU 25)	(HU 26)	Development of the Modern World	3-0	2½	3-0	2½
	(Chem 28)	Quantitative Analysis			1-4	2

Civil Engineering			1st Semester		2nd Semester	
(Chem 25)		Principles of Engineering Materials	3-0	2½		
	(CE 1)	Surveying			4-3	5
Electrical Engineering						
(HU 25)	(HU 26)	Development of the Modern World	3-0	2½	3-0	2½
(Chem 25)		Principles of Engineering Materials	3-0	2½		
	(EE 10)	Electric Circuits and Measurements			3-2	3
Industrial Engineering						
(Chem 25)		Principles of Engineering Materials	3-0	2½		
(IE 25)		Logic and Scientific Method	2-0	3		
	(IE 24)	Production Process Design			2-3	3
	(IE 26)	Introduction to Industrial Engineering			3-0	2
Mechanical Engineering						
(HU 25)	(HU 26)	Development of the Modern World	3-0	2½	3-0	2½
	(Chem 25)	Principles of Engineering Materials			3-0	2½

AIR FORCE RESERVE OFFICERS' TRAINING CORPS PROGRAM

FIRST 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.

Course Number		Title	1st Semester		2nd Semester	
Students will take:						
(AS 1)	(AS 1)	First Year Basic	*0-1	½	2-1	1½
(IR 31)		Personal Adjustment to the College and the Profession	2-0	1		
In Place of:						
(IR 21)		Psychology of Personal Adjustment	1-0	½		
	(IR 22)	Preface to the Engineering Profession			1-0	½

* A six-hour orientation program will be given.

SECOND YEAR
(1961-62 only)

Course Number		Title	1st Semester		2nd Semester	
Students will take:						
(Eng 23)	(Eng 24)	English	4-0	2½	4-0	2½
(AS 2)	(AS 2)	Second Year Basic	2-1	1½	2-1	1½
In Place of:						
(Eng 21)	(Eng 22)	English	3-0	2	3-0	2
(IR 23)	(IR 24)	Elements of Industrial Growth	2-0	1	2-0	1

THIRD YEAR
(1961-62 only)

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
Chemical Engineering Students will take:								
AS	3	First Year Advanced Course	4	1	2½	4	1	2½
PR	19	Staff Control	2	0	2½	3	0	1½
In Place of:								
Eng	70	History of Industrial Civilization	1	0	½	1	0	½
PR	13	Staff Control	2	0	2½	2	0	2½
		Electives	2	0	2½	2	0	2½
Civil Engineering Students will take:								
AS	3	First Year Advanced Course	4	1	2½	4	1	2½
In Place of:								
Eng	70	History of Industrial Civilization	1	0	½	1	0	½
		Electives	2	0	2½	2	0	2½
Electrical Engineering Students will take:								
AS	3	First Year Advanced Course	4	1	2½	4	1	2½
In Place of:								
Eng	70	History of Industrial Civilization	1	0	½	1	0	½
PR	13	Staff Control	2	0	2½	2	0	2½
Mechanical Engineering Students will take:								
AS	3	First Year Advanced Course	4	1	2½	4	1	2½
In Place of:								
Eng	71	History of Industrial Civilization	—	—	—	2	0	1
PR	13	Staff Control	2	0	2½	2	0	2½

Subject			Hours Per Week					
Mechanical Engineering (Management Option) Students will take:			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
AS	3	First Year Advanced Course	4	1	2½	4	1	2½
PR	13	Staff Control	2	0	2½	2	0	2½
Ind E	51	Business Law	1	0	2	—	—	—
In Place of:								
EM	55	Selection, Supervision and Control of Staff I	3	0	1½	3	0	4½
EM	69	Law	3	0	3	—	—	—
		Electives	2	0	2½	2	0	2½

FOURTH YEAR

Subject			Hours Per Week					
Chemical Engineering Students will take:			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
AS	4	Second Year Advanced Course	4	1	2½	4	1	2½
Ch E	53	Process and Plant Design	1	3	3½	1	3	2
In Place of:								
Ch E	52	Process and Plant Design	1	3	3½	1	3	8
PR	14	Staff Control	3	0	1½	1	2	1½
Civil Engineering Students will take:								
AS	4	Second Year Advanced Course	4	1	2½	4	1	2½
In Place of:								
Ind E	51	Business Law	1	0	2	—	—	—
ME	58	Mechanical and Hydraulic Laboratory	—	—	—	0	3	1½
		Electives	2	0	2½	2	0	2½
Electrical Engineering Students will take:								
AS	4	Second Year Advanced Course	4	1	2½	4	1	2½
PR	19	Staff Control	2	0	2½	3	0	1½
In Place of:								
Ind E	22	Industrial Management	—	—	—	3	0	6
Ind E	51	Business Law	1	0	2	—	—	—
PR	14	Staff Control	3	0	1½	3	0	1½
Mechanical Engineering Students will take:								
AS	4	Second Year Advanced Course	4	1	2½	4	1	2½
PR	19	Staff Control	2	0	2½	3	0	1½
In Place of:								
Ind E	21	Industrial Management	3	0	4½	2	0	2½
Ind E	51	Business Law	—	—	—	1	0	2
PR	14	Staff Control	3	0	1½	3	0	1½

Subject			Hours Per Week					
Mechanical Engineering (Management Option) Students will take:			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
AS	4	Second Year Advanced Course	4	1	2½	4	1	2½
PR	14	Staff Control	3	0	1½	3	0	1½
In Place of:								
EM	56	Selection, Supervision and Control of Staff II	3	0	1½	3	0	1½
EM	65	Plant Visitations and Reports	—	—	—	0	3	1½
		Electives	2	0	2½	2	0	2½

DEPARTMENT OF CHEMICAL ENGINEERING

CHARLES L. MANTELL, *Chairman*
GEORGE C. KEEFFE, *Executive Associate*
Professors: BRADLEY, JOFFE, KEEFFE, KREPS, MANTELL, SALAMONE; *Associate Professors:* CARLSON, FREDERICK; *Assistant Instructors:* BARBAZ, CASCIANO.

The course in Chemical Engineering 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, industrial organic, unit operations, unit process 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 is equipped for control and instrumentation studies for general and fundamental training in the physico-chemical 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 senior chemical engineering students with the cooperation of the department visit industries outside the Newark area. These extended trips are usually taken during one of the regular college vacation periods.

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

FIRST AND SECOND YEARS

The subjects offered in the first and second years will be found on pages 53-54.

Students taking the Air Force ROTC program will find Air Science Options for substitutions listed on pages 54-57.

THIRD YEAR
(1961-62 only)

Subject			Hours Per Week 1st Semester Class	Lab.	Prep.	2nd Semester Class	Lab.	Prep.
ChE	30	Inorganic Chemical Technology	—	—	—	3	0	4½
ChE	31	Physical Chemistry	3	0	3	3	0	3
ChE	36	Unit Operations	3	0	7½	3	0	6
ChE	38	Organic Chemistry	3	3	4½	3	6	3
ChE	39	Industrial Chem. Calculations	3	0	4½	—	—	—
EE	7	Applied Electricity	3	0	3	—	—	—
EE	84	Applied Electricity	—	—	—	1	3	3½
PR	13	Staff Control	2	0	2½	2	0	2½
ME	59	Fuel and Instrument Lab	0	3	1½	—	—	—
Eng	70	Historyof Industrial Civ.	1	0	½	1	0	½
		Electives	2	0	2½	2	0	2½

FOURTH YEAR

Subject			Hours Per Week 1st Semester Class	Lab.	Prep.	2nd Semester Class	Lab.	Prep.
ChE	40	Chemical Engrg. Thermodynamics	3	0	4½	3	0	4½
ChE	48	Industrial Organic Chem.	3	3	3	—	—	—
ChE	50	Physical Chemistry Lab.	0	3	4½	0	3	3
ChE	51	Chemical Engineering	2	3	4	2	3	7
ChE	52	Process and Plant Design	1	3	3½	1	3	8
IndE	31	Economics	3	0	6	—	—	—
Phys	35	Strength of Materials (Recitation)	—	—	—	4	0	3½
Phys	38	Strength of Materials (Laboratory)	—	—	—	0	3	1½
PR	14	Staff Control	3	0	1½	3	0	1½

ELECTIVES
(1961-62 only)

First Semester			Second Semester		
Chem	50	Biology	Chem	51	Biology
Eng	72	Contemporary English and American Literature	Eng	73	Modern Drama
Eng	74	Modern United States History	Eng	75	International Relations
Eng	76	Public Speaking	Eng	77	Debating
Eng	78	Music Appreciation	Eng	79	The Fine Arts
PR	15	Psychology	PR	16	Sociology
PR	17	Principles of Philosophy	PR	18	Representative Philosophers

Students with superior scholastic standing may be given permission by the Department to take Math 31 and Math 32 in the Junior and Senior year in addition to the above required courses.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF CHEMICAL ENGINEERING

ChE 30 INORGANIC CHEMICAL TECHNOLOGY. Prerequisite, ChE 39.

A study of various inorganic chemical processes giving consideration to raw materials, chemical reactions, energy relationships and equipment.

One semester, two and one-half credits.

ChE 31 PHYSICAL CHEMISTRY. Prerequisites, Phys 16,* Math 21,* Chem 24,* 26.*

The main topics considered in this course are: the gaseous, liquid, and solid states of matter, thermodynamics, thermo chemistry, ideal and nonideal solutions, homogeneous and heterogeneous equilibria, chemical kinetics, electrochemistry, atomic and molecular structure. Attention is also given to experimental methods and the precision of measurements.

Two semesters, four credits.

ChE 36 UNIT OPERATIONS. Prerequisites, Math 21,* Phys 16.*

A lecture-problem course in fluid mechanics and heat transfer embracing Newtonian and Non-Newtonian fluids. The unit operations covered will include fluid flow, heat flow, evaporation, size reduction, solids handling, mixing and mechanical separations.

Two semesters, six and one-half credits.

ChE 38 ORGANIC CHEMISTRY. Prerequisites, Chem. 24,* 26.*

This is a course in principles and practices of organic chemistry. In the lectures and recitations a systematic study of the aliphatic and aromatic compounds is undertaken. In the laboratory certain selected experiments in the analysis and synthesis of organic compounds are carried out as well as exercises in the study of the chemical properties of various classes of compounds.

Two semesters, seven and one-half credits.

ChE 39 INDUSTRIAL CHEMICAL CALCULATIONS. Prerequisites, Math 21,* Phys 16,* Chem 24.*

This course will include a study of energy and material balances of industrial processes involving simple and complex chemical reactions and physical processes.

One semester, two and one-half credits.

* Not offered after 1960-61.

ChE 40 Chemical Engineering Thermodynamics. Prerequisites, ChE 31, 39.

The thermal properties of matter are studied and interpreted in terms of the fundamental concepts and laws of thermodynamics. Applications are made to batch and flow processes, compressors, heat engines, and refrigeration. The effects of high pressures on chemical equilibrium are considered.

Two semesters, five credits.

ChE 48 Industrial Organic Chemistry. Prerequisite, ChE 38.

This course will include advanced and critical studies of organic synthesis with special emphasis on commercial methods. The laboratory work is intended to develop techniques preliminary to large scale laboratory operations.

One semester, three credits.

ChE 50 Physical Chemistry Laboratory. Prerequisite, ChE 31.

This course consists of laboratory experimentation, in the course of which the student applies and extends the basic knowledge of physical chemistry acquired in the junior year. Laboratory reports are expected to include the analysis of experimental errors and a quantitative discussion of the reliability of calculated results.

Two semesters, four and one-half credits.

ChE 51 Chemical Engineering. Prerequisites, ChE 31, 36.

The portion of the course devoted to lecture and recitation will cover those unit operations not covered in ChE 36, such as evaporation, distillation, absorption and extraction, drying, etc. In the laboratory the student will attempt to correlate theoretical and actual performance in the various unit operations.

Two semesters, seven credits.

ChE 52 Process and Plant Design. Prerequisites, ChE 30, 31, 36, 38, 39.

In this course students coordinate and apply knowledge gained in other courses to the initiation, design, and operation of an industrial chemical process. An intensive study is made of the economic factors involved. Laboratory time is devoted to literature search, experimental work, design calculations, specification and selection of equipment, plant layout, and cost studies.

Two semesters, six and one-half credits.

ChE 53 PROCESS AND PLANT DESIGN. Prerequisites, ChE 30, 31, 36, 38, 39.

This course for AF ROTC students, applies knowledge gained in prerequisite courses to the planning and operation of an industrial chemical process. Laboratory time is devoted to investigation, experiment, design, specification and selection of equipment, plant layout and cost analysis.

Two semesters, four and one-half credits.

NOTE: *With respect to* ChE 52 *and* ChE 53, *there will be a visitation during the period between semesters to process industry plants and chemical engineering industries over a three to four day period. All expenses are to be paid by the individual student. Required for all chemical engineering seniors.*

DEPARTMENT OF CIVIL ENGINEERING

WILLIAM S. LALONDE, JR., *Chairman*
JAMES M. ROBBINS, *Executive Associate*
Professors: LALONDE, ROBBINS; *Associate Professors:* LEHMAN, MANGASARIAN, SHAPIRO; *Assistant Professor:* METZGER; *Assistant Instructors:* MONAHAN, DISKO.

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; and surveying, which furnishes the engineering surveys required by all construction operations, the proper delineation of property, and the base maps of the nation.

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. 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. Highly specialized instruction of an advanced character has been definitely placed in the graduate program.

The Department maintains a fully equipped soil mechanics laboratory, apparatus required for model analysis, and a surveying instrument room supplied with the instruments required for all types of surveys.

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

FIRST AND SECOND YEARS

The subjects offered in the first and second year will be found on pages 53-54.

Students taking the Air Force ROTC program will find Air Science Options for substitutions listed on pages 54-57.

THIRD YEAR
(1961-62 only)

Subject			Hours Per Week 1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
CE	7	Engineering Geology	—	—	—	2	0	1
CE	14	Public Health Engineering	—	—	—	1	0	2
CE	32	Materials of Construction	—	—	—	1	0	2
CE	41	Hydraulics	3	0	3	—	—	—
CE	60	Surveying	3	3	4½	—	—	—
CE	61	Engineering Surveys	—	—	—	2	6	4
CE	75	Structural Theory	2	0	2½	—	—	—
CE	76	Structural Theory	—	—	—	2	0	4
CE	81	Strength of Materials	3	3	3	—	—	—
CE	82	Strength of Materials	—	—	—	3	0	3
Eng	70	History of Industrial Civilization	1	0	½	1	0	½
Ind E	31	Economics	3	0	6	—	—	—
Ind E	43	Financing of Engineering Projects	—	—	—	2	0	4
Phys	22	Kinematics and Kinetics	2	0	2½	2	0	2½
PR	13	Staff Control	2	0	2½	2	0	2½
		Electives	2	0	2½	2	0	2½

FOURTH YEAR

Subject			Hours Per Week 1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
CE	56	Construction Planning & Plant	3	0	3	—	—	—
CE	80	Reinforced Concrete	3	0	6	—	—	—
CE	83	Soil Mechanics & Foundations	2	3	2½	—	—	—
Options		See Options on page 66	4	0	5	18	0	16½
		or	4	0	5	15	3	16½
		or	6	0	4½	14	0	19
Eng	81	Engineering Report Writing	3	0	1½	—	—	—
Ind E	51	Business Law	1	0	2	—	—	—
ME	57	Mechanical Engineering	—	—	—	3	0	3

ME	58	Mech. & Hyd. Laboratory	—	—	—	0	3	1½
Phys	60	Thermodynamics	3	0	3	—	—	—
PR	14	Staff Control	3	0	1½	3	0	1½
		Electives	2	0	2½	2	0	2½

GENERAL OPTION

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
CE	15	Hydrology	2	0	2½	—	—	—
CE	16	Water Supply & Purification	2	0	2½	—	—	—
CE	18	Hydraulic & Sanitary Design	—	—	—	3	0	1½
CE	19	Sewerage & Sewage Treatment	—	—	—	2	0	2½
*CE	24	Transportation Engineering	—	—	—	4-3	0	8
*CE	78	Structural Design	—	—	—	0-6	0	4½

HYDRAULIC & SANITARY OPTION

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
CE	15	Hydrology	2	0	2½	—	—	—
CE	16	Water Supply & Purification	2	0	2½	—	—	—
*CE	18	Hydraulic & Sanitary Design	—	—	—	0-3	0	1½
CE	19	Sewerage & Sewage Treatment	—	—	—	2	0	2½
*CE	78	Structural Design	—	—	—	0-6	0	4½
Chem	48	Sanitary Chemistry & Bacteriology	—	—	—	4	3	8

STRUCTURAL & TRANSPORTATION OPTION

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
*CE	24	Transportation Engineering	—	—	—	4-3	0	8
CE	73	Construction Estimates & Schedules	—	—	—	3	0	6
*CE	78	Structural Design	0-6	0	4½	—	—	—
*CE	79	Advanced Structural Design	—	—	—	0-4	0	5

*The first number under Class Hours refers to hours of recitation. The second number refers to hours of design.

ELECTIVES
(1961-62 only)

First Semester			Second Semester		
CE	8	Physical Geography	CE	9	Economic Geography
CE	53	Local Planning Administration	CE	54	Municipal Public Works Adm.
Chem	50	Biology	Chem	51	Biology
Eng	72	Contemporary English & American Literature	Eng	73	Modern Drama
Eng	74	Modern United States History	Eng	75	International Relations
Eng	76	Public Speaking	Eng	77	Debating
Eng	78	Music Appreciation	Eng	79	The Fine Arts
PR	15	Psychology	PR	16	Sociology
PR	17	Principles of Philosophy	PR	18	Representative Philosophers

The courses offered in any one semester will depend upon the registration figures.

In general, the course taken during the first semester of any year should be followed in sequence by the parallel course of the second semester.

Students in Civil Engineering must present a total of 6 credits in these electives prior to graduation.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF CIVIL ENGINEERING

CE 1 SURVEYING.

Theory, fieldwork, drafting and computations dealing with plane, cadastral, topographic, hydrographic, route, photogrammetric and geodetic surveys.

One semester, five credits.

CE 7 ENGINEERING GEOLOGY.

A study of basic physical geology and physiography with particular emphasis placed on the practical application of the material considered to Civil Engineering work.

One semester, one credit.

CE 8 PHYSICAL GEOGRAPHY.

A study of the climatic and physiographic regions of the earth and of the effects of climate, land forms, and natural resources upon the development of civilization and upon the progress of mankind.

One semester, one and one-half credits.

CE 9 ECONOMIC GEOGRAPHY.

A study of the world distribution of natural resources, of their development and utilization, and of their influence upon productive employment and population growth. Particular attention is given to those occupations and industries concerned with the conversion of the riches of nature to the use of mankind.

One semester, one and one-half credits.

CE 14 PUBLIC HEALTH ENGINEERING.

A study of the engineering control of communicable disease through the proper collection, treatment, and disposal of wastes; the provision of potable water supplies; milk and food sanitation; the control of rodents and insects; the sanitation of public buildings; the construction of proper housing; and industrial hygiene.

One semester, one credit.

CE 15 HYDROLOGY. Prerequisite, Satisfactory Senior Standing.

A study of the occurence, distribution, and utilization of water and of the analyses required for the design of regulatory works for water supply, hydro-electric plants, irrigation, flood control, erosion control, and inland navigation.

One semester, one and one-half credits.

CE 16 WATER SUPPLY AND PURIFICATION. Prerequisite, Satisfactory Senior Standing.

A study of the problems involved in the procurement, treatment, and distribution of municipal and industrial water supply.

One semester, one and one-half credits.

CE 18 HYDRAULIC AND SANITARY DESIGN. Prerequisites, CE 15, 16.

Design problems dealing with the development of a surface water supply and with the provision of sewerage for a community.

One semester, one and one-half credits.

CE 19 SEWERAGE AND SEWAGE TREATMENT. Prerequisites, CE 15, 16.

A study of the principles of design, construction, and maintenance of sanitary sewers and storm-water drains and of works for the treatment of sewage and industrial wastes.

One semester, one and one-half credits.

CE 24 TRANSPORTATION ENGINEERING. Prerequisite, Satisfactory Senior Standing.

A study of the principles of transportation engineering including the location, design, and construction of urban and rural streets and highways, and appurtenant structures. Attention is devoted to planning, finance, organization, economics, administration, and traffic control. In addition, highway design problems are worked out in the drafting room.

One semester, five credits.

CE 32 MATERIALS OF CONSTRUCTION.

A study of the more important engineering materials used in construction and manufacturing with particular emphasis on the physical and chemical properties that would govern the selection of the proper material in design work.

One semester, one credit.

CE 41 HYDRAULICS.

A textbook and problem course treating with hydrostatics and hydrokinetics. Constant emphasis is placed on the degree of precision obtainable, in practice, by the use of available experimentally determined constants to modify idealized computations to meet actual conditions.

One semester, two credits.

CE 53 Local Planning Administration.

Local planning problems will be approached from the point of view of those who are charged with the responsibility for developing and administering planning programs. Both principles and procedures will be illustrated by examples selected from the best practices developed by leading city planners.

One semester, one and one-half credits.

CE 54 Municipal Public Works Administration. Prerequisite, CE 53.

Municipal problems will be approached from the point of view of such top-level administrators as city managers, department heads, and their principal aides. The emphasis will be on the actual workings of municipal administration with an analysis of the duties and the responsibilities of the administrator.

One semester, one and one-half credits.

CE 56 Construction Planning & Plant. Prerequisite, CE 81.

A study of the problems involved in planning the economical design and construction of engineering works covering preliminary planning, the selection of the construction method, the arrangement of the construction plant, and the management of the construction program.

One semester, two credits.

CE 60 Surveying.

Theory, field work, drafting, and computations dealing with cadastral, topographic, hydrographic, and route surveys and with the basic theory of engineering astronomy.

One semester, three and one-half credits.

CE 61 Engineering Surveys. Prerequisite, CE 60.

Instruction in astronomical observations and geodetic surveys coupled with extensive field experience in conducting engineering surveys, with emphasis on production, management, and the development of responsibility and leadership on the part of the student.

One semester, four credits.

CE 73 Construction Estimates and Schedules. Prerequisite, CE 56.

A study of the procedures incident to the submission of bids on public and private construction and of the methods used in estimating the cost of such construction. Cost estimates are prepared by the student for small projects involving various types of construction.

One semester, three credits.

CE 75 STRUCTURAL THEORY. Prerequisite, Phys 20.*

A course in statically determinate structural theory involving some graphic statics and thorough drill and computations for finding moments and shears in beams and stresses in structural members and trusses. The use of influence lines and the positioning of moving loads for maximum effectiveness are studied.

One semester, one and one-half credits.

CE 76 STRUCTURAL THEORY. Prerequisite, CE 75.

A course in statically indeterminate structural theory involving drill and computations in the use of elastic energy and slope-deflection equations and moment distribution for the solution of a variety of problems.

One semester, two credits.

CE 78 STRUCTURAL DESIGN. Prerequisite, Satisfactory Senior Standing.

Bridge and building structures form the medium for designs using riveted and welded construction and reinforced concrete and modern timber framing. Orderly computational procedures and familiarity with design codes are required. Only enough of the designs are detailed to familiarize the student with basic requirements.

One semester, three and one-half credits.

CE 79 ADVANCED STRUCTURAL DESIGN. Prerequisite, CE 78.

The design of a simple span railroad plate girder bridge and of a multiple span beam highway bridge, with full detailing of both structures, will comprise the basic requirements. Discussion and some work will be given to the design of the members of a highway truss bridge and of some of the member connections.

One semester, three credits.

CE 80 REINFORCED CONCRETE. Prerequisite, Satisfactory Senior Standing.

The fundamentals of reinforced concrete as applied to the design of buildings and other civil engineering structures. Emphasis is given to continuity of members and the relationship of the members to the structure as a whole. Limited attention will be given to prestressed concrete.

One semester, three credits.

CE 81 STRENGTH OF MATERIALS. Prerequisite, Phys 20.*

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

* Not offered after 1960-61.

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 properties of steel, wood, and concrete. The results of each test are summarized in an engineering report.

One semester, three credits.

CE 82 STRENGTH OF MATERIALS. Prerequisite, CE 81.

A continuation of the stress-strain relationships begun in CE 81.

One semester, two credits.

CE 83 SOIL MECHANICS AND FOUNDATIONS. Prerequisite, Satisfactory Senior Standing.

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; slope stability, lateral pressures; frost heaving; soil stabilization; and problems relating to the proper design of soil-supported foundations for engineering structures. The theoretical study is supplemented by experimental work in the soil mechanics laboratory.

One semester, two and one-half credits.

DEPARTMENT OF ELECTRICAL ENGINEERING

FREDERICK A. RUSSELL, *Chairman*
ROBERT E. ANDERSON, *Executive Associate*
Professors: ANDERSON, FISHMAN, JORDAN, RUSSELL; *Associate Professors:* BOGNER, DICKEY, PADALINO, RIPS, WINSTON; *Assistant Professors:* CARLUCCIO, MEOLA, MOHSEN, REDMON, ROSE; *Instructors:* AYOUB, CHOW, SCRUPSKI, TSCHANG; *Assistant Instructors:* CLEMENTS, HOLLINGSWORTH, MATULA, RICCI, STRANO; *Special Instructing Staff:* CURTIS, TULCHIN.

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 two years of the four year curriculum. During the third and fourth 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. Examples from the field of electronics or power are used to illustrate the principles and their application. Thorough demonstration, verification and application of these principles in the well equipped laboratories: Electric Circuits, Electric Machinery, Electrical Measurements, and Electronics; are made by the student himself. This laboratory work is performed under the guidance of the same instructor with whom the theory is studied.

The aim is to educate an electrical engineer who can think analytically and creatively, and work efficiently. Also he can 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 the field of research or development. Or, the curriculum can serve as a terminal engineering program leading to industrial work or activity as a professional engineer dealing with the functional fields of engineering: production, operation, or service. Also, he is prepared to undertake his own technical business if such be his wish.

Contacts with local industry and familiarity with contemporary problems in engineering practice are promoted through extra-curricular organizations of students. Branches of the American Institute of Electrical Engineers, the Institute of Radio Engineers and Eta Kappa Nu are active and stimulate interest in the practical and professional aspects of electrical engineering.

FOURTH YEAR

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
EE	15	Electric Transmission Circuits	3	0	3	—	—	—
EE	17	Advanced Circuit Measurements	2	3	2½	—	—	—
EE	24	Electromagnetic Fields	—	—	—	3	0	3
EE	38	Electron Tube Circuits II	—	—	—	2	3	4
EE	55	Electric Machines II	2	3	4	—	—	—
EE	57	Electric Machines III	—	—	—	3	3	4½
EE	93	Electron Tube Circuits I	4	0	½	—	—	—
EE	94	General Applications	—	—	—	0	3	1½
Ind E	22	Industrial Management	—	—	—	3	0	6
Ind E	31	Economics	3	0	6	—	—	—
Ind E	44	Engineering Cost Analysis	—	—	—	3	0	3
Ind E	51	Business Law	1	0	2	—	—	—
ME	57	Mechanical Engineering	3	0	3	—	—	—
ME	61	Mechanical Engineering Laboratory	0	3	1½	—	—	—
PR	14	Staff Control	3	0	1½	3	0	1½
Phys	71	Engineering Physics	—	—	—	3	0	4½

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

FIRST AND SECOND YEARS

The subjects offered in the first and second years will be found on pages 53-54.

Students taking the Air Force ROTC program will find Air Science Options for substitutions listed on pages 54-57.

THIRD YEAR
(1961-62 only)

Subject			Hours Per Week 1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
EE	5	Circuit Measurement and Analysis	2	3	4	—	—	—
EE	12	Electric Circuits (Networks)	4	0	2	—	—	—
EE	14	Electric Circuits (Transients)	—	—	—	4	0	2
EE	40	Theory of Electron Devices	3	0	3	—	—	—
EE	42	Electronic Circuits	—	—	—	3	3	4½
EE	51	Magnetic Circuits	3	0	3	—	—	—
EE	53	Electric Machines I	—	—	—	3	3	4½
Eng	70	History of Industrial Civilization	1	0	½	1	0	½
*Math	36	Theory of Measurements	—	—	—	1	0	2
Math	103	Mathematics for Electrical Engineers I	3	0	3	—	—	—
Math	104	Mathematics for Electrical Engineers II	—	—	—	3	0	3
Phys	24	Kinematics and Kinetics	—	—	—	4	0	5
Phys	37	Strength of Materials (Recitation)	4	0	5	—	—	—
Phys	38	Strength of Materials (Laboratory)	0	3	1½	—	—	—
Phys	60	Thermodynamics	—	—	—	3	0	3
PR	13	Staff Control	2	0	2½	2	0	2½

*Math 36 is optional, but recommended for students who contemplate graduate work.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF ELECTRICAL ENGINEERING

EE 5 Circuit Measurement and Analysis. Prerequisite, Phys 51.*

An introduction to the techniques of electrical laboratory work is an objective of this course. Experiments are performed which demonstrate the principles studied in Phys 50 and 51. Various methods of measuring circuit parameters, voltage, current and power are discussed in class and carried out in the laboratory.

One semester, three credits.

EE 7 Alternating Current Circuits (Applied Electricity). Prerequisites, Math 21,* Phys 50.*

For Chemical Engineering students, this initial study of alternating currents opens with the quantitative description of sinusoids and their mathematical manipulation. The concepts of impedance and admittance are then introduced, with the processes for combining them in the usual ways and converting from one to the other. Complex quantities are used extensively. The computation of power in single-phase and multi-phase circuits is included.

One semester, two credits.

EE 10 Electric Circuits and Measurements. Prerequisites, Phys 2, Math 20.

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 will stress the correct use of a laboratory notebook.

One semester, three credits.

EE 12 Electric Circuits (Networks). Prerequisites, Math 21,* Phys 51.*

A course designed to give the student facility in analyzing electrical networks for subsequent courses in transients and transmission lines. Among the topics are: Mathematics of complex quantities; Kirchoff's Laws; "T" to "Pi" transformations; Thevenin's theorem; resonant circuits; tuned coupled circuits; Maximum Power Transfer and Superposition theorems.

One semester, two credits.

* Not offered after 1960-61.

EE 14 Electric Circuits (Transients). Prerequisites, EE 12, Math 103.

Transient variations of current, voltage, and energy in lumped-constant electric circuits are studied in this course. Elementary operational methods are employed and switching transients are stressed. Two hours of problem computation are included.

One semester, two credits.

EE 15 Electric Transmission Circuits. Prerequisite, EE 12.

This course extends the work of course EE 12 into the field of propagation at variable frequency in the general linear four-terminal network. The lumped-circuit applications include attenuators and filter circuits, and the distributed-constant systems treated include power transmission, audio-frequency communication, radio-frequency and ultra-high frequency lines.

One semester, two credits.

EE 17 Advanced Circuit Measurements. Prerequisites, EE 5, 14, 37.

Advanced techniques in circuit measurements with multiple-frequency signals are studied including a-c bridge measurements, filters, harmonic analysis, resonance measurements and square-wave testing, transients in circuits, very-high and ultra-high frequency measurements, and field plotting.

One semester, two and one-half credits.

EE 24 Electromagnetic Fields. Prerequisite, Math 104.

This is a foundation course, designed to lay a basis for advanced work in television, radar, and ultra-high frequency techniques. The basic principles of electromagnetic field theory, including Maxwell's field equations, are developed. The modern engineering point of view is maintained throughout, and advanced methods of analysis are introduced as needed.

One semester, two credits.

EE 38 Electron Tube Circuits II. Prerequisites, EE 17, 93.

As a complement to the previous electronics courses, this course deals with the performance of the previously studied circuits and more advanced circuits, including wave-shaping circuits.

One semester, three credits.

EE 40 THEORY OF ELECTRON DEVICES. Prerequisites, Phys 16,* Phys 51.*

Atomic structure, wave equation, semiconductors, junction effects, photoelectric phenomena, gaseous conduction. Transistors, vacuum and gas electron tubes, photoelectric devices.
One semester, two credits.

EE 42 ELECTRONIC CIRCUITS. Prerequisites, EE 5, 12, 40.

Two-terminal nonlinear circuit elements, with continuous and discontinuous signals: vacuum, gas, and semiconductor diode circuits. Basic theorems of transconductance circuits: transistor and vacuum triode and pentode equivalent circuits. Active linear circuits: transistor and vacuum-tube small-signal amplifiers. Active quasi-linear circuits: audio power single-ended and push-pull amplifiers.
One semester, three and one-half credits.

EE 51 MAGNETIC CIRCUITS. Prerequisite, Phys 51.*

Study of non-linear analysis with emphasis on magnetic circuits. Topics include electromagnetic circuits, permanent magnets, energy in magnetic fields, magnetic pull, magnetic losses, induced voltages, mutual inductance, principles of transformers and magnetic amplifiers.
One semester, two credits.

EE 53 ELECTRIC MACHINES I. Prerequisites, EE 5, 51.

A classroom and laboratory course in basic fundamentals of electromagnetic devices. These fundamentals are applied in a comprehensive study of the construction, operation and performance of transformers and direct-current machines.
One semester, three and one-half credits.

EE 55 ELECTRIC MACHINES II. Prerequisite, EE 53.

Basic rotating machine principles are applied in a study of polyphase induction machines and synchronous machines. Emphasis is on analysis, operation and application.
One semester, three credits.

EE 57 ELECTRIC MACHINES III. Prerequisite, EE 55.

A continuation of EE 55, with discussion extended to include single-phase motors, special types of machines, and control.
One semester, three and one-half credits.

EE 84 APPLIED ELECTRICITY. Prerequisites, EE 7, Math 21.*

This is essentially a laboratory course involving electrical measurements of special interest to the chemical engineer. A brief study is made of direct-current and alternating-current circuits and machines, electron tube characteristics and elementary electron tube circuits.
One semester, two and one-half credits.

* Not offered after 1960-61.

EE 88 Applied Electricity I. Prerequisites, Phys 51,* Math 21.*

For Mechanical Engineering students. A study of the application of the fundamental principles of electricity to direct-current and alternating-current circuits and machines. The subject is presented through coordinated classroom instruction and laboratory practice.

One semester, three credits.

EE 89 Applied Electricity II. Prerequisite, EE 88.

A continuation of EE 88, involving study and operation of various alternating-current motors commonly used in industry as well as typical industrial applications of electron tubes and circuits.

One semester, three credits.

EE 93 Electron Tube Circuits I. Prerequisites, EE 14, 42.

A continuation of EE 42 involving more advanced electronic circuit theory. Included are such topics as tuned amplifiers, oscillators, rectifiers, modulators and demodulators.

One semester, one and one-half credits.

EE 94 General Applications. Prerequisites, Full Senior Standing, Attendance at Student E.E. Professional Society Meetings During Preceding Semester.

A synthesis and focusing of all the student's previous experience, in college and out, upon a series of electrical engineering problems. Design, construction and testing are usually involved. Class members are in touch with all the projects through seminar discussions. Projects are available in optional fields of power and communications. Attendance at student E.E. Professional Society meetings will be required.

One semester, one and one-half credits.

* Not offered after 1960-61.

DEPARTMENT OF INDUSTRIAL AND MANAGEMENT ENGINEERING

OLIVER J. SIZELOVE, *Chairman*
IRVING R. GOLDSTEIN, *Acting Executive Associate*
Professors: JAFFE, SIZELOVE; *Associate Professors:* GOLDSTEIN, RICH, RIGASSIO; *Assistant Professors:* LA VERDA, MIHALSKY; *Instructor:* SCHIRGER.

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.

Currently, two curriculums, and a series of service courses in Economics, Law, Engineering Cost Analysis, and Industrial Management for the other four professional engineering departments, are in operation. The Engineering Management Option in the Mechanical Engineering curriculum, jointly administered by the Department of Mechanical Engineering and the Department of Industrial and Management Engineering, will terminate with the class of 1963 and will be replaced by the Bachelor of Science in Industrial Engineering curriculum, whose first graduates will be members of the class of 1964. Thus, both curriculums for the appropriate years appear in this catalog: the Engineering Management Option on pages 88 to 90, and the new Industrial Engineering courses on pages 53-54.

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 Computer Center will replace current use of off-campus electronic computers in applicable courses.

For early indoctrination in professional development, students in the department become affiliated with the NCE Student Chapters of the American Institute of Industrial Engineers (AIIE) and the Society for Advancement of Management (SAM). In addition to their local college meetings and plant visitations, the student members attend the meetings and conferences of the parent sponsoring chapters; the North Jersey Chapter of AIIE and the Northern New Jersey Chapter of SAM.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF INDUSTRIAL AND MANAGEMENT ENGINEERING

The courses prefixed by IE represent the courses given in the new curriculum.

The courses prefixed by EM are subjects presented in the Engineering Management Option. These courses will have been discontinued by June, 1963.

The courses prefixed by IndE are service courses now being given by the Department to students in other professional departments. They also will have been discontinued by June, 1963.

IE 23 Economics

This course is designed to combine the classical and contemporary approaches to economics and serves as a springboard for future study. It presents basic principles which form the groundwork for analysis and discussions of contemporary problems. The American economic system vs. communism, fascism, and socialism is also discussed.

One semester, two and one-half credits.

IE 24 Production Process Design

Introduction to the design of manufacturing processes and producibility. Includes metals, non-ferrous, glass, plastic, rubber, ceramics, electronics, woodworking, and chemical processes, control and methods of measurement and application. Selection of the best and most economical process to meet design specifications is stressed. This course treats such subjects as: (1) Milling, shaping, grinding, honing, lapping, turning, drilling, hot-working and cold-working metals processing; (2) Glass and ceramic forming, etching and sealing; (3) Electronic cutting, drilling, welding; (4) Plastics moulding, extruding and vacuum forming; (5) Welding — spot, seam resistance, and butt; (6) Brazing and soldering; (7) Fasteners — rivets, staples, nuts and bolts, pins, sealing; (8) Casting — sand, die, investment, centrifugal; (9) Measurement and gauging; (10) Interchangeable manufacture. In addition to lecture and discussion of these processes, the student will observe them in the laboratory, by means of films, or by plant visitation.

One semester, three credits.

IE 25 Logic and the Scientific Method

This course is designed as an introduction to the logical systems and methods currently used in decision making, experimentation, and symbolic reasoning in modern management principles and procedures. The basic concepts to be discussed are inductive and deductive logic, syllogistic reasoning, symbolism, logical operations, probability, measurement, statistical methods, experimentation, etc.

One semester, two credits.

IE 26 INTRODUCTION TO INDUSTRIAL ENGINEERING

A course which surveys the elements of Industrial Engineering in the industrial enterprise. The integration of the various techniques for organizing, operating and controlling an industrial enterprise is stressed. Topics treated include the background of scientific management, organization, plant location and layout, materials handling, production planning and control, standardization, quality control and methods of wage payment.

One semester, three credits.

EM 55 SELECTION, SUPERVISION, AND CONTROL OF STAFF I. Prerequisite, PR 12.*

The elements of selection, supervision, and control are first considered individually and then collectively. Under selection, the techniques of interviewing, job description, job evaluation, methods of selection, and the follow-up of placements are considered. Under supervision, the modern techniques as they apply to the engineer-supervisor are stressed. The control aspect is stressed particularly in EM 56.

Two semesters, four credits.

EM 56 SELECTION, SUPERVISION, AND CONTROL OF STAFF II. Prerequisite, EM 55.

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.

Two semesters, three credits.

EM 57 INDUSTRIAL RELATIONS LEGISLATION, Prerequisite, EM 69.

The course deals with the history of labor in this country supplemented by a detailed description and analysis of existing labor lesiglation. It treats the history of management in this country as well as a complete analysis of both the restrictive and non-restrictive legislation affecting management. The problem of maintaining high productivity through capitalistic initiative with government restrictions and controls is discussed.

One semester, two credits.

EM 58 INDUSTRIAL RELATIONS LEGISLATION SEMINAR. Prerequisite, EM 57.

In this course the theory and background material of Industrial Relations Legislation is applied to existing, specific managament-labor-government problems. The facts of typi-

* Not offered after 1960-61.

cal management-labor and management-government problems are placed before the student by men from business and industry who have encountered them. With his training as a background, the student will attempt solution. Discrepancies, if they exist, between the student's solution and the one found in industry will be thoroughly discussed.

Two semesters, four credits.

EM 62 Engineering Management and Operation.

A survey course which considers the problems of the management of research, design and development, the management of production, and the management of distribution. The profit motive is used as the key to the integration of phases.

One semester, one credit.

EM 64 Motion and Time Study. Prerequisites, EM 62, 67, and EM 75 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.

Two semesters, four credits.

EM 65 Plant Visitations and Reports. Prerequisites, EM 62, 67, First Semester of EM 68.

The purpose of the course is two-fold: one, to give the student a general picture of the industries represented; and two, to give the student specific information. The latter is obtained through discussion with a delegated plant executive.

One semester, one and one-half credits.

EM 67 Economics.

Essentially this is a course in both pure and applied economics. Although it develops the theoretical principles of economics along classical lines, it also considers some more recent developments of economic theory. In addition, it pays considerable attention to contemporary economic problems of basic industries such as steel, chemical, textile, metal fabricating, etc.

Two semesters, four credits.

EM 68 Management of Production and Distribution. Prerequisites, EM 62, 67.

The objective of this course is to present the modern techniques of progressive management in the fields of produc-

tion 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.

Two semesters, four credits.

EM 69 LAW.

This course is planned to acquaint the management engineering student with the basic principles of common and statutory law to be encountered during normal business relations and places special emphasis on legal cases and judicial decisions.

One semester, two credits.

EM 71 ACCOUNTING AND COST ACCOUNTING.

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.

Two semesters, four credits.

EM 74 ENGINEERING ECONOMY. Prerequisite, EM 67.

"Hunch" decisions vs. decisions based upon costs, the time element in economy, capital recovery, prospective rate of returns, increment and sunk costs, replacement costs, depreciation, break-even and minimum-cost points, and cost estimating are the subjects covered.

One semester, two and one-half credits.

EM 75 INDUSTRIAL STATISTICAL METHODS. Prerequisite, Math 21.*

This course presents statistical methods together with their applications. The subjects treated include: selection, analysis, and interpretation of engineering and other data, charts, frequency distribution, central tendency, dispersion, skewness, curve fitting, Poisson distribution, significant differences, variance, correlation, and trend analysis.

Special emphasis is placed on the application to industrial fields.

One semester, three credits.

* Not offered after 1960-61.

IndE 21 INDUSTRIAL MANAGEMENT. Prerequisite, IndE 31.

This course for Mechanical Engineering students presents some of the important techniques underlying modern management methods. It includes a study of plant layout and equipment, organization, production control, standardization, statistics and quality control. The second semester is devoted mainly to the techniques of motion and time study.

Two semesters, four credits.

IndE 22 INDUSTRIAL MANAGEMENT. Prerequisite, IndE 31.

This course is for Electrical Engineering students. Its content is similar to that of Ind E 21 except that motion and time study are covered in considerably less detail.

One semester, three credits.

IndE 31 ECONOMICS.

This course is designed to combine the classical and contemporary approaches to economics and serves as a springboard for future study. It presents basic principles which form the groundwork for analysis and discussions of contemporary problems of economic life. The challenge to American capitalism is also discussed.

One semester, three credits.

IndE 43 FINANCING OF ENGINEERING PROJECTS.

This course is designed for Civil Engineering students and includes a study of financial principles and of the methods of financing the construction and maintenance of public and private engineering works as well as basic accounting fundamentals.

One semester, two credits.

IndE 44 ENGINEERING COST ANALYSIS.

This course is designed for Electrical and Mechanical engineering students and combines engineering economics with accounting and cost principles.

One semester, two credits.

IndE 51 BUSINESS LAW FOR ENGINEERS.

This course acquaints the engineering student with the basic philosophy and principles of common and statutory law as applied to the engineer in his business relations. It treats contracts, agency, sales, bailments, negotiable instruments, patents, copyrights and trademarks, master and servant, damages, evidence, and business criminal offenses.

One semester, one credit.

DEPARTMENT OF MECHANICAL ENGINEERING

GEORGE B. THOM, *Chairman*
JEROME L. POLANER, *Executive Associate*
EDWARD MILLER, *Assistant Executive Associate*
Professors: MILLER, POLANER, THOM; *Associate Professors:* BANNON, HSIEH, JACOBS, LEVY, MICHELS, PREDALE, SCHNEIDER, SMITHBERG, STAMPER; *Instructors:* JAFFE, PEARCE, WILSON; *Assistant Instructors:* DROUGHTON, FLICKER, PREUSSE, SHEPHERD; *Special Instructing Staff:* MILLER.

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 machines to accomplish these ends.

For the first two years the curriculum centers on the basic sciences of mathematics, physics, chemistry and mechanics. Supplementing this core of science courses are service courses in English, engineering graphics, electricity, materials of engineering, an introduction to the humanities and a program of orientation toward engineering and the problems of engineers.

The program for the first two years, common to all departments, is shown on page 53. The second year program for students majoring in mechanical engineering is shown on page 54.

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 a study of manufacturing processes and through application courses in the areas of machine design and applied thermodynamics. The courses are supplemented by laboratory courses, where appropriate, to develop an understanding of and a respect for testing procedures. 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.

For some years an option in Engineering Management has been offered within the framework of the curriculum in Mechanical Engineering. This option will terminate with the class of 1963 and will be replaced by the Bachelor of Science in Industrial Engineering curriculum, whose first graduates will be members of the class of 1964. Thus both curriculums for the

appropriate years appear in this catalog: the Engineering Management Option on pages 88 to 90, and the new Industrial Engineering courses on pages 53-54.

The undergraduate curriculum with its option 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.

LABORATORIES

The Department operates the following laboratories: The Mechanical Engineering Laboratory is devoted to the study and calibration of test instruments, fuel calorimetry, gas analysis, fluid flow and heat transfer measurements and the testing of power plant equipment.

The Metallurgy and Metallography Laboratory has facilities for the preparation of metals for microscopic examination for heat treatment and for the recording of metallic structure by means of photomicrography.

The Stress and Vibration Laboratory is equipped to make stress studies by means of strain gauges, stress coat and photoelastic techniques and to conduct vibration studies by a variety of methods.

The Manufacturing Processes Laboratory is equipped with modern machinery and instrumentation for the study of manufacturing processes and machine capability.

The Corrosion Laboratory is devoted to the study of corrosion and its prevention.

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

FIRST AND SECOND YEARS

The subjects offered in the first and second years will be found on pages 53-54.

Students taking the Air Force ROTC program will find Air Science Options for substitution listed on pages 54-57.

THIRD YEAR
(1961-62 only)

Subject			Hours Per Week 1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
ME	1	Mechanisms	4	0	5	—	—	—
ME	8	Machine Tool Laboratory	—	—	—	0	3	1½
ME	29	Thermodynamics	3	0	4½	—	—	—
ME	32	Heat Power	—	—	—	3	0	3
ME	49	Heat Power Laboratory	—	—	—	0	3	3
ME	70	Fluid Mechanics	—	—	—	3	0	3
EE	88	Applied Electricity I	2	3	4	—	—	—
EE	89	Applied Electricity II	—	—	—	2	3	4
Eng	71	History of Industrial Civilization	—	—	—	2	0	1
Ind E	31	Economics	3	0	6	—	—	—
Math	31	Differential Equations	3	0	4½	—	—	—
*Math	32	Vector Analysis	—	—	—	3	0	4½
Phys	22	Kinematics and Kinetics	2	0	2½	2	0	2½
Phys	37	Strength of Materials (Recitation)	4	0	5	—	—	—
Phys	38	Strength of Materials (Laboratory)	—	—	—	0	3	1½
PR	13	Staff Control	2	0	2½	2	0	2½

ENGINEERING MANAGEMENT OPTION

Subject			Hours Per Week 1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
ME	7	Machine Tools and Laboratory	1	3	2	—	—	—
ME	29	Thermodynamics	3	0	4½	—	—	—
ME	49	Heat Power Laboratory	—	—	—	0	3	3
ME	57	Mechanical Engineering	—	—	—	3	0	3
EM	55	Selection, Supervision and Control of Staff I	3	0	1½	3	0	4½
EM	57	Industrial Relations Legislation	—	—	—	3	0	3

*Math 32 is optional, but recommended for students who contemplate graduate work.

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
EM	62	Engineering Management and Operation	—	—	—	2	0	1
EM	67	Economics	2	0	4	2	0	4
EM	69	Law	3	0	3	—	—	—
EE	88	Applied Electricity I	2	3	4	—	—	—
EE	89	Applied Electricity II	—	—	—	2	3	4
Eng	70	History of Industrial Civilization	1	0	½	1	0	½
Phys	37	Strength of Materials (Recitation)	4	0	5	—	—	—
Phys	38	Strength of Materials (Laboratory)	—	—	—	0	3	1½
		Electives	2	0	2½	2	0	2½

FOURTH YEAR

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
ME	13	Vibration Analysis	4	0	5	—	—	—
ME	16	Machine Design I	5	0	4	—	—	—
ME	17	Machine Design II	—	—	—	5	0	4
ME	19	Stress Analysis	—	—	—	4	0	2
ME	20	Metallurgy	3	0	3	—	—	—
ME	22	Metallography	—	—	—	0	3	1½
ME	35	Applied Heat Power	4	0	6½	—	—	—
ME	38	Applied Heat Power	—	—	—	4	0	5
ME	51	Mechanical Laboratory I	0	3	4½	—	—	—
ME	52	Mechanical Laboratory II	—	—	—	0	3	4½
Ind E	21	Industrial Management	3	0	4½	2	0	2½
Ind E	44	Engineering Cost Analysis	—	—	—	3	0	3
Ind E	51	Business Law	—	—	—	1	0	2
*Math	36	Theory of Measurements	1	0	2	—	—	—
PR	14	Staff Control	3	0	1½	3	0	1½

ENGINEERING MANAGEMENT OPTION

Subject			Hours Per Week					
			1st Semester			2nd Semester		
			Class	*Lab.*	*Prep.*	*Class*	*Lab.*	*Prep.*
ME	11	Elements of Machine Design I	4	0	3½	—	—	—
ME	12	Elements of Machine Design II	—	—	—	4	0	3½

*Math 36 is optional, but recommended for students who contemplate graduate work.

ME	20	Metallurgy	3	0	3	—	—	—
EM	56	Selection, Supervision and Control of Staff II	3	0	1½	3	0	1½
EM	58	Industrial Relations Legislation Seminar	3	0	1½	3	0	4½
EM	64	Motion and Time Study	1	2	3	1	2	3
EM	65	Plant Visitations and Reports	—	—	—	0	3	1½
EM	68	Management of Production and Distribution	3	0	3	3	0	3
EM	71	Accounting and Cost Accounting	2	1	3	2	1	3
EM	74	Engineering Economy	—	—	—	3	0	4½
EM	75	Industrial Statistical Methods	3	0	6	—	—	—
		Electives	2	0	2½	2	0	2½

ELECTIVES
(1961-62 only)

First Semester		Second Semester	
Eng 72	Contemporary English & American Literature	Eng 73	Modern Drama
Eng 74	Modern United States History	Eng 75	International Relations
Eng 76	Public Speaking	Eng 77	Debating
Eng 78	Music Appreciation	Eng 79	The Fine Arts
Eng 82	Engineering Report Writing		
PR 15	Psychology	PR 16	Sociology
PR 17	Principles of Philosophy	PR 18	Representative Philosophers

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF MECHANICAL ENGINEERING

ME 1 MECHANISMS. Prerequisites, Math 21,* Phys 16,* 20.*

This course includes an extended treatment of velocity and acceleration; analysis of linkages; a kinematic study of gear teeth and gear trains; a detailed analysis of the motion of cams; and investigations of miscellaneous mechanisms. The recitations are supplemented by problem work.

One semester, three credits.

ME 7 MACHINE TOOLS AND LABORATORY.

A lecture and laboratory course, supplemented with visits to nearby industrial plants, designed to furnish a general background in metal shaping and finishing, the theory of power-driven machine tools, and the principles underlying machine shop measuring instruments, feeds, speeds, tolerances and classes of fits.

One semester, two credits.

ME 8 MACHINE TOOL LABORATORY.

A combined lecture and laboratory course covering such topics as small tools, cutting angles and forces, casting processes, welding, forging, stamping, gages, and jigs and fixtures. Theory is supplemented with practice and visits to nearby industrial plants.

One semester, one and one-half credits.

ME 11 ELEMENTS OF MACHINE DESIGN I. Prerequisites, ED 2,* Math 21,* Phys 38.

A class and laboratory course designed to apply the elements of mechanisms and the properties of common engineering materials to the analysis and design of simple machine members, such as cams, gears, screw fastenings and riveted joints.

One semester, two and one-half credits.

ME 12 ELEMENTS OF MACHINE DESIGN II. Prerequisite, ME 11. Continuation of ME 11 with emphasis on the design of belts, shafts, couplings, bearings and springs. Introduction to vibration and its isolation.

One semester, two and one-half credits.

ME 13 VIBRATION ANALYSIS. Prerequisites, Math 31, Phys 22.

The basic theory of systems with single and multiple degrees of freedom is developed and applied to the solution of pertinent problems. Damped vibrations and vibration iso-

* Not offered after 1960-61.

lation are investigated through the solution of appropriate problems.

One semester, three credits.

ME 16 MACHINE DESIGN I. Prerequisites, ED 2,* ME 1, Phys 38.

Principles of mechanics, strength of materials and mechanisms in class and drawing room projects are applied to the design of machine elements, such as riveted joints, keys, shafting, belts and wire rope drives. Fatigue and stress concentration are considered in some detail.

One semester, three credits.

ME 17 MACHINE DESIGN II. Prerequisite, ME 16.

A continuation of ME 16 devoted to consideration of strength and wear of gear teeth, lubrication, bearings, springs, clutches, brakes and flywheels. Theory is correlated with practice through the use of design projects in the drawing room.

One semester, three credits.

ME 19 STRESS ANALYSIS. Prerequisite, Phys 38.

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.

One semester, two credits.

ME 20 METALLURGY. Prerequisite, Chem 11.*

A course designed to acquaint the student with the nature of a metal and the characteristics of the various types of alloys. Emphasis is given to the three principal means by which the properties of metals are varied; plastic deformation; phase-change interruption; and precipitation-hardening. These are illustrated by frequent reference to such common commercial metals as brass, steel and aluminum alloys.

One semester, two credits.

ME 22 METALLOGRAPHY. Prerequisite, ME 20.

A laboratory course wherein the principles discussed in ME 20 are illustrated. Both ferrous and non-ferrous alloys are subjected to various physical and thermal treatments and the results studied by means of the microscope and other laboratory procedures.

One semester, one and one-half credits.

* Not offered after 1960-61.

ME 29 THERMODYNAMICS. Prerequisites, Math 21,* Phys 16.*

The thermodynamic theory of gases and vapors is studied. The subject matter includes a study of energy and its availability; the properties of gases and vapors; energy changes during expansions and compressions; the various ideal cycles for converting heat into work; and the general theory of the flow of fluids.

One semester, two and one-half credits.

ME 32 HEAT POWER. Prerequisite, ME 29.

The principles of thermodynamics are applied to heat power problems. The subject matter includes combustion, heat transfer, steam engine principles, steam cycles, steam flow, vapor refrigeration, air and vapor mixtures. The course emphasizes the practical applications of the basic thermodynamic theory.

One semester, two credits.

ME 35 APPLIED HEAT POWER. Prerequisites, ME 32, 70.

A course for Senior M.E. 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.

One semester, three and one-half credits.

ME 38 APPLIED HEAT POWER. Prerequisites, ME 32, 70.

A course for Senior M.E. students that applies the principles of thermodynamics, fluid mechanics and heat transfer to the design and analysis of components of fluid handling and thermal equipment.

One semester, three credits.

ME 49 HEAT POWER LABORATORY. Prerequisite, ME 29.

A course for Mechanical Engineering students in their Junior Year. The course is intended to provide fundamental instruction in mechanical testing. It will emphasize instrument study and calibration, fuel and gas calorimetry, gas analysis, fluid flow measurements and engine studies.

One semester, two credits.

* Not offered after 1960-61.

ME 51 MECHANICAL LABORATORY I. Prerequisites, ME 32, 49.

A laboratory course for senior mechanical engineering students, applying the principles of thermodynamics and fluid mechanics to the testing of power plant equipment. Tests are conducted on boilers, pumps, steam engines, condensers and steam and hydraulic turbines. Heat transfer and fluid flow phenomena are investigated.

One semester, two and one-half credits.

ME 52 MECHANICAL LABORATORY II. Prerequisites, ME 32, 49.

A laboratory course for senior mechanical engineering students applying the principles of thermodynamics and fluid mechanics to the testing of fuels and lubricants, gasoline and diesel engines and refrigeration and air conditioning equipment. Compressible fluid flow is studied by means of fans, blowers and a model wind tunnel.

One semester, two and one-half credits.

ME 57 MECHANICAL ENGINEERING. Prerequisite, Phys 60.

Lectures, discussion, and problems in applied thermodynamics and heat engines for students not majoring in mechanical engineering. The course covers the study of fuels, combustion, boilers, feedwater, heat transfer, steam engines and turbines, pumps, internal combustion engines, air compressors, and refrigeration.

One semester, two credits.

ME 58 MECHANICAL AND HYDRAULIC LABORATORY. Prerequisite, Phys 60.

A laboratory course covering tests on steam engines and turbines, gasoline and diesel engines, pumps and other hydraulic machinery and equipment; and experimental work in fuel calorimetry, exhaust gas analysis, and the flow characteristics of conduits and hydraulic measuring devices carrying liquids of varying degrees of viscosity.

One semester, one and one-half credits.

ME 59 FUEL AND INSTRUMENT LABORATORY. Prerequisite, Junior Standing in Ch.E. Department.

For Chemical Engineering students. Experimental studies of fuels and oils; physical testing of liquid and solid fuels; Combustion and lubricating studies. Study and calibration of instruments and their proper uses in experimental analysis.

One semester, one and one-half credits.

ME 61 MECHANICAL ENGINEERING LABORATORY. Prerequisite, Phys 60.

This course in heat power engineering laboratory is for students in electrical engineering. The experimental work in the laboratory includes tests on steam engines and turbines; gasoline and diesel engines; pumps and hydraulic equipment; fuel calorimetry and exhaust gas analysis.

One semester, one and one-half credits.

ME 70 FLUID MECHANICS. Prerequisite, ME 29.

A course in the fundamentals of fluid mechanics, treating the principles of fluid statics, one dimensional compressible and incompressible flow, dimensional analysis, dynamic similarity, laminar and turbulent flow.

One semester, two credits.

DEPARTMENT OF AIR SCIENCE

COLONEL GRAVES H. SNYDER, *Chairman*
MAJOR CARROL HAMENT, *Executive Associate*
Professor: SNYDER; *Assistant Professors:* FOSTER, GIRARD, HAMENT, LUCAS, STOLLE, WOJCIEHOSKI, WOOD; *Instructors:* FRYER, PERRY, RAMSEY, SCHULZ, WILLIAMS.

The Department of Air Science offers qualified students a four year course leading to a commission as a Second Lieutenant, United States Air Force Reserve. The course includes sufficient practical and theoretical instruction so that the student can be quickly integrated into the Air Force organization with a minimum of additional training in the event of active military service. Emphasis is placed upon leadership training and in preparing the student to serve as an officer in the United States Air Force.

The first two years are devoted to the basic course and the last two years are devoted to the advanced course.

Classes in Air Science are not offered, other than six Introduction to AFROTC lectures, in the first term of the first year. In lieu thereof the satisfactory completion during the first term of an appropriate course, of two or more semester credits, in the areas of mathematics, physical or natural sciences, the humanities or social sciences, will be accepted as satisfying the first term academic requirements of AFROTC. At registration, students will be advised as to specific courses which may be designated for this purpose.

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 of Air Science. Entrance into the advanced 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 Advanced Course Selection Board Members' estimate of the cadet's potential officer qualities and leadership ability. In addition, an applicant for enrollment in the advanced 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 advanced course. The categories to choose from are as follows:

CATEGORY IP In this category are those cadets who express a 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 In this category are those cadets who express a 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 In this category are those cadets who are pursuing Electrical, Mechanical, Civil, and Chemical Engineering or who are majoring in Mathematics, Electronic Data Processing, Metallurgy, Nuclear Physics, Nuclear Chemistry, Nuclear Engineering or Physics, and who meet the mental and physical standards for an Air Force commission. The active duty obligation is four years.

CATEGORY II (Meteorology) In this category are those cadets who are pursuing courses leading to a degree in Meteorology or who will complete the following: Any degree, providing the cadet will agree, in writing, to take college Math, thru Integral Calculus, with at least a "C" average and a mandatory minimum grade of "C" in the Differential and Integral Calculus courses, 6 semester hours or quarter hours equivalent of College Physics with at least a "C" average and a mandatory minimum grade of "C" in the last Physics course completed. The active duty obligation is four years.

CATEGORY III (Any Degree) In this category are those cadets who are pursuing courses leading to degrees in Liberal Arts and Sciences or Chaplain candidates, and who meet the mental and physical standards for an Air Force commission. The active duty obligation is four years.

CATEGORY IV In this category are veterans with two or more years of service in any of the armed forces and who can meet the mental and physical standards for an Air Force commission. They have no mandatory active duty obligation.

CATEGORY V Is reserved for cadets enrolled in Category IP and IN who, after enrollment in the advanced course, become physically disqualified for flying or, in the case of Category IP cadets, are eliminated from the Flight Instruction Program for aptitudinal reasons, provided the cadet is physically qualified for commission and elects to continue in the Air Force ROTC. Category V cadets will be called to active duty for 6 months or 4 years, depending upon the needs of the service at the time.

The inclusion of Air Science 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 90 cents a day or approximately $27

per month. Each student enrolled in the freshman and sophomore year will be required to pay a $15.00 uniform deposit.

Advanced students will normally attend summer training between the Junior and Senior years. While attending summer training, students receive approximately $75.00 per month, transportation to and from training, medical attention, subsistence, quarters and uniforms.

Credit for Air Science 1 is granted only upon the successful completion of Air Science 2, unless approved by the Professor of Air Science and proper college officials. No partial credit for any work completed in Air Science 1 or 2 will be given without the consent of the Professor of Air Science and the Dean of the College.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF AIR SCIENCE

Introduction to AFROTC

An introduction to the Air Force RTOC program. Purposes, policies, curriculum content and related activities of the program are presented. Required of all freshmen registered for AFROTC.

One lecture per week for the first six weeks of the freshman year, no credits.

AS 1 First Year Basic Course

Designed to provide the student with an understanding of the elements and potentials of aerospace power to include: fundamentals of air power, military air power of the world, military research and development, air vehicle industries, airlines and airways, general aviation, principles of flight, control and navigation, propulsion systems, space vehicles, the military instrument of national security and professional opportunities in the United States Air Force.

One period of laboratory per week each semester, two lectures per week during the spring semester, 2 credits per year.

AS 2 Second Year Basic Course. Prerequisites, AS 1 or 6 months' active military service.

A more advanced consideration of aerospace power, as exemplified by the combat capabilities of the United States Air Force. The general subjects included are: evolution of aerial warfare, weapons system development, employment of air forces, and operations in space.

Two lectures and one period of laboratory per week each semester, 3 credits per year.

AS 3 First Year Advanced Course. Prerequisites, AS 2 or one year's active military service.

Major socio-psychological principles of leadership relevant to Air Force problems, a consideration of the leader-follower relationship in an Air Force environment, and communication theory relevant to leadership are studied. Emphasis is placed on important behavior skills basic to leadership performance, with provision for practice and development of these skills in realistic situations.

Four lectures and one period of laboratory per week each semester, 5 credits per year.

AS 4 Second Year Advanced Course. Prerequisite, AS 3.

A study of global relationships which are of special concern to the Air Force Officer. The course is subdivided into the

following blocks of study: weather, navigation, international relations, military aspects of world political geography and the Air Force Officer.

Four lectures and one period of laboratory per week each semester, 5 credits per year.

HUMANISTIC-SOCIAL GROUP

The foundation courses of our curriculum are supplied by the Technological and the Humanistic-Social Groups. The former provides a basic knowledge of science and technology; the latter introduces the student to the problems of human nature and human affairs.

The Humanistic-Social Group consists of the Department of Professional Development and Industrial Relations. and the Department of English. Certain courses offered by the Department of Industrial and Management Engineering (pages 81 to 85) also apply. Prescribed courses, required of all students, are supplemented by a number of electives.* At present these electives may be taken only by the following groups:

1. *Juniors and Seniors in Civil Engineering* (See pages 65-67.)

   Eng 72—Contemporary English and American Literature;
   Eng 73—Modern Drama
   Eng 74—Modern United States History; Eng 75—International Relations
   Eng 76—Public Speaking; Eng 77—Debating
   Eng 78—Music Appreciation; Eng 79—The Fine Arts
   PR 15—Psychology; PR 16—Sociology
   PR 17—Principles of Philosophy; PR 18—Representative Philosophies
   CE 8—Physical Geography; CE 9—Economic Geography
   CE 53—Local Planning Administration; CE 54—Municipal Public Works
   Chem 50-51—Biology (2 semesters)

2. *Juniors in Chemical Engineering* (See page 59.)

   All of the above except CE 8-9, and CE 53-54.

3. *Juniors and Seniors in Engineering Management* (See pages 88-90.)

   All of the above plus English 82, except CE 8-9, CE 53-54, and Chem 50-51.

ROTC students, whatever their professional department, may not elect any of these courses.

*The Faculty may, on special request, authorize changes in or addition to courses listed.

DEPARTMENT OF ENGLISH

LLOYD M. FELMLY, *Acting Chairman*
HERMAN A. ESTRIN, *Executive Associate*
Professors: ESTRIN, FELMLY; *Associate Professors:* CRATER, FERNSLER, KEABLES, NAPIER, SHAWCROSS; *Assistant Professors:* JOHNSON, STEINBERG, WACKER, WISE; *Instructors:* DRUKS, WINTERS, ZIRNITE.

An engineering college makes very special demands upon its English Department. The technical work of the engineer requires him to write notes, letters, and reports in a clear, concise manner. He must be able to read both technical and non-technical writing quickly and accurately. His advancement will depend upon the impression which he makes upon his superiors. Consequently, the spoken English which he uses in conversation and in meetings will affect his professional progress.

As the engineer advances in his profession, his contacts are more and more with men who have little technical background. With these men he cannot use scientific language—the terminology and formulas of chemistry or mathematics. If he is to make himself clear, he must be able to use the English language in a way which will make his hearers understand his facts and ideas. If he is to persuade his hearers that what he advocates is the proper thing to do, he must speak or write so that they feel he is a competent, trustworthy man. All these qualities and abilities the English Department must try to develop.

But a truly liberal education must provide, in addition to specific professional training, a sympathetic understanding of the varied activities and interests of all men. The reading of good literature will help the student to understand how people act and feel under various conditions, but much other work must be done in the general field of humanistic studies. Since the common requisite of all such studies is cultured, sensitive use of one's own language, the English Department includes in its scope all courses in the humanities not naturally claimed by other departments. History, foreign languages, the fine arts—all these gain added significance when spun upon the core of a firm knowledge of our native tongue.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF ENGLISH

Eng 11 ENGLISH (Freshman).

Freshman English, a course in the skills of reading, writing, speaking, and listening, includes literature, composition, and public speaking.

One semester, three credits.

Eng 12 ENGLISH (Freshman). Prerequisite, Eng 11.

This course is a continuation of Eng 11.

One semester, three credits.

Eng 21 ENGLISH LITERATURE. Prerequisites, Eng. 12.

A study of significant seventeenth, eighteenth, and nineteenth century literary figures of England which introduces these writers as individuals and as participants in historical and intellectual movements. The students will prepare oral and written assignments related to the reading.

One semester, two credits.

Eng 22 AMERICAN LITERATURE. Prerequisite, Eng 21.

A study of significant seventeenth, eighteenth, and nineteenth century literary figures of America which introduces these writers as individuals and as participants in historical and intellectual movements. The students will prepare oral and written assignments related to the reading.

One semester, two credits.

Eng 23 ENGLISH LITERATURE (1961-62 only).

For ROTC students, similar to Eng 21, with the addition of public speaking.

One semester, two and one-half credits.

Eng 24 AMERICAN LITERATURE (1961-62 only) Prerequisite, Eng 23.

For ROTC students, similar to Eng 22.

One semester, two and one-half credits.

Eng 70 HISTORY OF INDUSTRIAL CIVILIZATION. (1961-62 only).

A course designed to provide students with a broad picture of both the social and political aspects of our cultural history and to lay particular stress upon the role played by science and technology. It meets one hour a week during the Junior year.

Two semesters, one credit.

Eng 71 HISTORY OF INDUSTRIAL CIVILIZATION.

This course is similar in content to History of Industrial Civilization Eng 70, but is offered to Mechanical Engineering students in one semester only.

One semester, one credit.

Eng 72 Contemporary English and American Literature.

Selections of important literature since 1920 are read and discussed, with emphasis on writers who most characteristically express our civilization.

One semester, one and one-half credits.

Eng 73 Modern Drama.

Important plays are read and discussed, with the purpose of gaining some understanding of how dramatists, in both subject matter and technique, reflect the spirit of our times.

One semester, one and one-half credits.

Eng 74 Modern United States History.

The principal events of modern United States history are studied, with particular emphasis upon the development of our present governmental, social, and industrial system.

One semester, one and one-half credits.

Eng 75 International Relations.

This course includes a study of the political, social, economic, technological, and geographical factors in international relations, and correlates them with current affairs and the evolution of the United Nations.

One semester, one and one-half credits.

Eng 76 Public Speaking.

This advanced course in the art of presenting facts and ideas to an audience trains the student to adapt his material and manner to the great variety of situations arising in professional life.

One semester, one and one-half credits.

Eng 77 Debating.

This course makes practical application of the fundamental principles of argumentation and persuasive speech, of public-speaking methods, and of audience psychology.

One semester, one and one-half credits.

Eng 78 Music Appreciation.

This course is designed to train the ear and the mind to enjoy great music. The principles of musical structure and technique are presented in lectures, illustrated by recordings of representative artists and composers.

One semester, one and one-half credits.

Eng 79 THE FINE ARTS.

This course is designed to impart appreciation of sculpture, painting, and architecture. By illustrated lectures, by visits to local museums and galleries, and by actual practice in class, the student becomes familiar with the nature of art.

One semester, one and one-half credits.

Eng 81-82 ENGINEERING REPORT WRITING.

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. Eng 81 is required for Civil Engineering students. Eng 82 is an elective for Management students.

One semester, one and one-half credits.

HU 25 DEVELOPMENT OF THE MODERN WORLD.

A study of the growth of political, economic, and cultural institutions and ideas from the late Middle Ages to the present day, with special attention paid to the significant features and events of each period.

One semester, two and one-half credits.

HU 26 DEVELOPMENT OF THE MODERN WORLD. Prerequisite, HU 25.

A continuation of HU 25.

One semester, two and one-half credits.

DEPARTMENT OF PROFESSIONAL DEVELOPMENT AND INDUSTRIAL RELATIONS

ROBERT E. KIEHL, *Chairman*
PAUL L. CAMBRELENG, *Executive Associate*
Professors: CAMBRELENG, KIEHL, STEPHANS; *Associate Professor:* LUBIN; *Assistant Professors:* LORD, METZLER, STOCHAJ, ZIMMER; *Instructor:* GILROY; *Special Instructing Staff:* BEDROSIAN, MALONE, NOYES.

The guiding philosophy of the Department of Professional Development and Industrial Relations is based on a recognition that the student must mature as an 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 in which we live. With this knowledge, the scientific and mathematical proficiency of the engineer will be complemented by insights important to leadership and success. The broad areas of concern in the implementation of this philosophy include:

Personal adjustment and orientation to college life.

An understanding of the college and the opportunities it offers in its curricula and extra-curricular activities.

The nature of the engineering profession.

The promotion of a strong sense of ethics and moral principles.

The development and organization of American industry with the recognition of the role of the engineer.

The motives and incentives that influence industrial life.

The formal and informal means for the successful dealing with individuals as well as groups of personnel.

The development of skill in oral communication.

The development and characteristics of American labor organizations and their role in the economy.

The effect of social and labor legislation on industry, labor, and the general public.

The responsibility of our educated citizenry to be aware of the problems that face society and to participate in their solution.

The Department of Professional Development and Industrial Relations is associated with the Placement Office and the

Counseling Center in seeking to stimulate consideration of a choice of career based on the student's analysis of his qualifications and of the requirements for professional employment in various branches and functions of engineering. Part of the course work is designed to give the student a thorough understanding of the techniques of placement in the engineering profession. Students at Newark College of Engineering are assisted in finding their own professional employment in positions for which they are best suited.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF PROFESSIONAL DEVELOPMENT AND INDUSTRIAL RELATIONS

IR 21 PSYCHOLOGY OF PERSONAL ADJUSTMENT.

Success in engineering depends on the early recognition that preparation for a profession involves many disciplines. This course, therefore, deals with personal adjustment as a basic concept in professional development. Areas of exploration include effective study habits, principles of learning, personality development, mental health, and the development of personal values as a basis for a life philosophy. Emphasis is given to those other disciplines inherent to a mature concept of the study of engineering as an educational process. Stress is given to the philosophy of the College, engineering methodology, as well as technical, professional, and social conduct.

One semester, one-half credit.

IR 22 PREFACE TO THE ENGINEERING PROFESSION.

The fundamental disciplines intrinsic to the engineering profession are expanded to include the responsibilities of professional life. The role of engineering in society, both past and present, is considered and emphasis is placed on the development of professional consciousness, social and economic responsibilities, and the philosophy of the profession. Within this societal framework the branches and functions of engineering are explored for the purpose of assisting students in the choice of a professional department.

One semester, one-half credit.

IR 23 ELEMENTS OF INDUSTRIAL GROWTH.

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.

One semester, one credit.

IR 24 ELEMENTS OF INDUSTRIAL GROWTH. Prerequisite, IR 23.

A continuation of IR 23.

One semester, one credit.

IR 31 INTRODUCTION TO COLLEGE AND TO THE ENGINEERING PROFESSION.

This course combines the material of IR 21 and IR 22 for students enrolled in AFROTC.

One semester, one credit.

PR 13 STAFF CONTROL AND PERSONNEL PROBLEMS. Prerequisite, PR 12.*

This is a series of conferences and lectures designed to explore those phases of personnel management which are likely to be part of the engineer's responsibility. The leadership of the conference is assumed by the students under faculty guidance. The broad area of manpower management is investigated and particular attention is given to the areas of personnel recruitment, selection, placement, and related techniques, personnel services, training, rating, financial and non-financial incentives, and working conditions. The study of these areas is directed toward the problem of employee morale.

Two semesters, three credits.

PR 14 STAFF CONTROL AND EXECUTIVE PROBLEMS. Prerequisite, PR 13.

The conference method and lectures are continued during the Senior year. Labor-management relations will be explored and specific attention will be 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. Executive problems in the development and control of staff will be reflected in this work. Further emphasis on these group relationships will be considered in the study of the effects of technology on society and the engineer's responsibilities in the community.

Two semesters, three credits.

PR 15 PSYCHOLOGY.

This course is designed to assist the engineer as a professional man to acquire insight with regard to human behavior. Through lectures and discussions an analysis is made of the dynamics of adjustment. In view of the leadership and responsibilities of the engineer today, consideration is given

* Not offered after 1960-61.

to basic human needs, adjustment to complex situations, evaluation of personality, and mental health.

One semester, one and one-half credits.

PR 16 SOCIOLOGY.

The impact of technological change on society has been such as to warrant the attention of the engineer. In order to be meaningful, a study of the forces within society in general, and the relationships of industrial groups in particular, is undertaken. A study of the forces operating in society is the primary objective of the course.

One semester, one and one-half credits.

PR 17 PRINCIPLES OF PHILOSOPHY.

An examination of problems of a social, ethical, political, aesthetic, and scientific nature and a study of the related principles and methods of philosophy, with emphasis on logic. Particular attention is given to the practical application of these principles in everyday living.

One semester, one and one-half credits.

PR 18 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.

One semester, one and one-half credits.

PR 19 STAFF CONTROL (PERSONNEL AND LABOR RELATIONS PROBLEMS).

Prepared especially for the ROTC student, this course includes topics on personnel relations such as interviewing, testing, wage administration, and personnel operating problems. This is followed by 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.

Two semesters, three credits.

TECHNOLOGICAL GROUP

The Technological Group consists of the Departments of Chemistry, Mathematics, Physics and Mechanics, and Engineering Graphics.

The function of the Technological Group is to motivate and guide the student in acquiring:

a mastery of fundamental scientific principles;

a thorough understanding of the engineering method;

the ability to express himself clearly and concisely by oral, written and graphic means;

an appreciation of the relation of each course in the Technological Division to his general training.

Since the ultimate aim of the student's general training is to prepare him to take his place in the community as an engineer, as a citizen, and as a man, the student is helped to acquire an appreciation of the relation of each course in the Technological Division to his general training.

This requires that the student:

recognize the fundamental ideas, principles, and methods that permeate the various topics in any course and give unity to the course;

perceive that the subject of any course in the Technological Group is part of an integrated pattern within that group;

see clearly how the Technological courses bear on the professional and on the humanistic-social courses.

DEPARTMENT OF CHEMISTRY

M. LELYN BRANIN, *Chairman*
JOSEPH M. FITZGERALD, *Executive Associate*
FREDERICK W. BAUDER, *Assistant Executive Associate*
Professors: BAUDER, BISHOP, BRANIN; *Associate Professors:* FITZGERALD, RAM; *Assistant Professors:* CAGNATI, MOROSON, POETZ, PRICE; *Instructors:* FUNKE, PANDYA; *Assistant Instructors:* BARBAZ, FRIEDMAN, MYTELKA, PERSURANCE; *Special Instructing Staff:* KORNBLUM.

The Department of Chemistry offers courses in general college chemistry, quantitative analysis and the principles of engineering materials. Instruction also is given in biology and in sanitary chemistry and bacteriology as technical options for students majoring in Chemical Engineering or in Civil Engineering.

In all courses, an effort is made to correlate the subject with the various fields of engineering. Laboratory classes are divided into small sections in order to insure that each student will receive personal consideration and close supervision.

The chemistry laboratories are located on the top floor of Colton Hall.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF CHEMISTRY

Chem 15 CHEMISTRY.

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.

One semester, four and one-half credits.

Chem 16 CHEMISTRY. Prerequisite, Chem 15.

A continuation of Chem 15.

One semester, four and one-half credits.

Chem 25 PRINCIPLES OF ENGINEERING MATERIALS. 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.

One semester, two and one-half credits.

Chem 28 INTRODUCTION TO QUANTITATIVE ANALYSIS. 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.

One semester, two credits.

Chem 48 SANITARY CHEMISTRY AND BACTERIOLOGY. Prerequisite, Chem 21.*

A lecture and laboratory course covering the chemistry and bacteriology of water and sewage. Types and distribution of bacteria in water, sewage and certain foodstuffs such as milk and shellfish are examined and studied in relation to problems of sanitation and public health. Chemical treatment and purification methods are included.

One semester, five credits

Chem 50 and 51 BIOLOGY.

This course is broad in its coverage and an effort is made to bring the student in contact with the newer concepts of biology. The first semester is devoted largely to establishing a foundation knowledge. During the second semester the emphasis is on man and the biological problems which confront him.

Two semesters, three credits.

* Not offered after 1960-61.

DEPARTMENT OF ENGINEERING GRAPHICS

FRANCIS J. BURNS, *Chairman*
ROBERT G. SALAMON, *Executive Associate*
Professor: BURNS; *Associate Professor:* SALAMON; *Assistant Professors:* DUJETS, HANUS, RIGHTS; *Instructors:* GOLDEN, GRAVES; *Assistant Instructor:* SHEPHERD; *Special Instructing Staff:* O'HARA.

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 abilities to read carefully and to follow instructions meticulously since the professional engineer cannot leave himself open to misinterpretation. We try to teach Graphics, then, as a professional addition to the students' verbal and mathematical languages and from the present point of view of the profession that engineers are less and less likely to be engaged in the actual production of detail drawings in the future. A wide understanding of the geometries of construction, plus extensive drill in freehand sketching, is stressed so as to lay a sound foundation for the professional design work to follow.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF ENGINEERING GRAPHICS

EG 1 ENGINEERING GRAPHICS.

This, a one-term course, consists chiefly of work in descriptive geometry plus freehand sketching and lettering exercises. Studies cover basic orthographic theory, coordinate systems, planes, lines, orientations, auxiliaries, normals, axials, obliques, directed views, solids, rotations, spheres, convolutes, cylinders, cylindroids, helices, etc. Homework is minimal, requiring about two and one-half hours per week. It consists of a simple freehand sketch, a brief lettering exercise, and the reading of several assigned pages of text for each class. A one-hour lecture is given each week.

One semester, two and one-half credits.

EG 2 ENGINEERING GRAPHICS. Prerequisite, EG 1.

This, a one-term course, consists of combined drawing and problem solving. Standards of annotation and dimensioning, special scales, sections and conventions, limits, threads, etc., are briefly introduced; the balance of the term deals with engineering curves and graphs, steel truss details, concrete detailing, perspective, axonometrics, vectors and centros, areas (Simpson's rule or planimeter), templates, ASA standards, piping, circuits, topography, and others. Homework continues and, as in the first term, consists of a freehand sketch, a brief lettering exercise, and for each class

the reading of certain assigned pages of text, except that in this term the complexities of the sketches are considerably increased. Lectures are given in the classes by the individual instructors as each different phase of the program is arrived at. In addition, a one-hour lecture is given each week.

One semester, two and one-half credits.

DEPARTMENT OF MATHEMATICS

HENRY ZATZKIS, *Chairman*
POMPEY MAINARDI, *Executive Associate*
Professors: BARKAN, FITHIAN, P. MAINARDI, VIRENE, ZATZKIS; *Adjunct Professor:* MOLINA; *Associate Professors:* FOSTER, KONOVE, KOREN, WASSON; *Assistant Professor:* LIONE; *Instructor:* BROWER; *Assistant Instructors:* FISCHER, MARX, VAN-MEERBEKE; *Special Lecturer:* WYNNE.

The principal aim of the various courses offered by this department is to impart a basic knowledge of mathematics, a knowledge which can be of use to engineering students in their studies of the sciences while in training and which can also be of use to them later, in actual engineering practice. But, in keeping with the trend for greater emphasis on the humanities in engineering curricula, it is also attempted to single out, whenever the opportunity arises, and hold up for consideration such other aspects of mathematics as may be of epistemological, philosophic or cultural interest or value.

In the earlier years of instruction the courses are conducted especially for the purpose of acquainting the student with the concepts, theories and techniques of mathematics. But as his knowledge of engineering principles and physical laws increases, the student is given more and more training in the analysis of real engineering problems of various types, their reduction to mathematical symbolism and language, and their subsequent solution by mathematical methods. The student is encouraged throughout to rely on rational processes rather than memorization and the use of formulas, and to have confidence in his reasoning, the adequacy of his methods and the accuracy of his results.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF MATHEMATICS

Math 10 MATHEMATICS (Introductory).

This is primarily a course in analytic geometry. It includes certain topics in college algebra and a unit on the algebra of mathematical systems.

One semester, four credits.

Math 15 MATHEMATICS (Calculus I). Prerequisite, Math 10.

The theories and techniques of the differential calculus are developed in this course. Applications to both physical and geometrical problems are considered throughout.

One semester, four credits.

Math 20 MATHEMATICS (Calculus II). Prerequisite, Math 15.

This is a course in integral calculus. Considerable emphasis is placed on physical applications of the theories and techniques in order to more fully develop the analytical power of the student.

One semester, four credits.

Math 25 MATHEMATICS (Calculus III). Prerequisite, Math 20.

This course consists of additional topics in calculus (multiple integrals, infinite series) and an introduction to differential equations through linear equations of first order. Fourier Series and hyperbolic functions are also introduced.

One semester, four credits.

Math 31 DIFFERENTIAL EQUATIONS. Prerequisite, Math 21.*

This is a practical course in ordinary differential equations. It studies the usual equations of first and second order, linear equations with constant coefficients of any order, systems of equations and solutions in series and applies the methods developed to the solution of various engineering problems. A brief introduction to Fourier Series is included.

One semester, two and one-half credits.

Math 32 VECTOR ANALYSIS. Prerequisite, Math 31.

This course includes the algebra and calculus of vectors; line, surface, and volume integrals with various applications to geometry, mechanics and electro-magnetic theory and the derivation of several partial differential equations of physics.

One semester, two and one-half credits.

Math 36 THEORY OF MEASUREMENTS. Prerequisite, Math 21.*

A study of the reliability of results obtained from physical measurements, based on least squares and probability theory; curve fitting; empirical equations; interpolation by finite differences, and applications to specific problems from various technical fields.

One semester, one credit.

Math 103 MATHEMATICS FOR ELECTRICAL ENGINEERS I. Prerequisite, Math 21.*

Ordinary differential equations, especially linear equations with constant coefficients, and their applications to practical problems. The course also includes hyperbolic functions, determinants, with application to the linear

* Not offered after 1960-61.

dependence of systems of algebraic equations, and material from related mathematical subjects such as Fourier Series, complex variables and Laplace Transforms.

One semester, two credits.

Math 104 MATHEMATICS FOR ELECTRICAL ENGINEERS II. Prerequisite, Math 103.

Three dimensional vector analysis and certain topics in advanced calculus such as line, surface and volume integrals, with an introduction to Potential Theory. Physical applications, especially to electrical and heat flow problems, and an introduction to the solution of partial differential equations.

One semester, two credits.

DEPARTMENT OF PHYSICS AND MECHANICS

PAUL O. HOFFMANN, *Chairman*
ACHILLE CAPECELATRO, PAUL E. NIELSEN, *Executive Associates*
CHARLES H. DUURSEMA, GEORGE L. WILLIAMS, *Assistant Executive Associates*
Professors: BERTSCH, CAPECELATRO, HOFFMANN, M. MAINARDI, NIELSEN, ORENS, RAMBERG; *Associate Professors:* DUURSEMA, GREENBAUM, REFF, SMITH, WELLER, WILLIAMS; *Assistant Professors:* GRANIK, KINGERY, LOVERIDGE, MONACK, TOWFIK; *Instructors:* EBERHART, CIESLA, KUHARETZ, LANDSMAN, REIZISS, SHUKUR, TAYLOR, WITTES; *Assistant Instructors:* GIORDANO, MCGURN, SAVIN; *Special Instructing Staff:* REITER, SCHWEIZER.

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 Strength of Materials. The Department of Physics and Mechanics is supplied with two General Physics laboratories completely equipped to enable the student to perform experiments in mechanics, electricity, heat, sound and light. The Strength of Materials laboratory has equipment approximating industrial laboratories, and the performance of experiments is carried out in such manner as to verify the theory studied in the classroom.

SUBJECTS OF INSTRUCTION IN THE DEPARTMENT OF PHYSICS AND MECHANICS

Phys 1 PHYSICS.

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.

One semester, three and one-half credits.

Phys 2 PHYSICS.

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.

One semester, three and one-half credits.

Phys 3 PHYSICS.

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 relationships 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.

One semester, three and one-half credits.

Phys 4 PHYSICS.

The ideas of Modern Physics are taken up in this course. 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.

One semester, three and one-half credits.

Phys 22 KINEMATICS AND KINETICS. Prerequisites, Phys 20,* Math 21.*

Kinematics: linear and angular displacement, velocity, and accelerations; rectilinear and curvilinear motion: relative motion; motion of rigid bodies; instantaneous center. Kinetics: Newton's laws; motion of mass-center; translation, rotations and plane motion of a rigid body; work, power, energy; impulse and momentum with applications to special types of motion of rigid bodies.

Two semesters, three credits.

Phys 24 KINEMATICS AND KINETICS. Prerequisites, Math 21,* Phys 20.* (For Electrical Engineering Students.)

Kinematics: linear and angular displacement, velocity, and accelerations; rectilinear and curvilinear motion; relative motion; motion of rigid bodies; instantaneous center. Kinetics: Newton's laws; motion of mass-center; translation, rotations and plane motion of a rigid body; work, power,

* Not offered after 1960-61.

energy; impulse and momentum with applications to special types of motion of rigid bodies.

The content of this course is similar to that of Phys 22, except that vector analysis methods are also used.

One semester, three credits.

Phys 35 STRENGTH OF MATERIALS (Recitation). For Chemical Engineering Students. Prerequisites, Math 21,* Phys 20.*

An elementary course in strength of materials and structural design as it pertains to the structures most frequently encountered in the chemical industries. The objective is to give the student sufficient knowledge of structural design so that he can design minor projects and cooperate with the structural engineer on major projects.

One semester, two and one-half credits.

Phys 37 STRENGTH OF MATERIALS (Recitation). Prerequisites, Math 21,* Phys 20.*

A study of the stress and strain analysis of some of the elements of which machines and structures are composed, such as shafts, beams and tension and compression members. Sufficient study of properties of materials and of design problems is included to enable the student to apply the theoretical study to practical problems.

One semester, three credits.

Phys 38 STRENGTH OF MATERIALS (Laboratory). Prerequisite, Phys 35 or 37 (or Phys 35 or 37 concurrently).

A series of experiments and problems designed to investigate the properties of materials and to verify the theory of stress and strain analysis.

One semester, one and one-half credits.

Phys 60 THERMODYNAMICS. Prerequisites, Math 21,* Phys 16.*

A Junior Course for electrical and civil engineering students. The thermodynamical theory of gases and vapors is studied. The subject matter includes the theory and application of the first and second laws of thermodynamics, properties of gases and vapors, energy changes during expansions and compressions, the conversion of heat into work, and the general theory of fluid flow.

One semester, two credits.

Phys 71 ENGINEERING PHYSICS. Prerequisites, Phys 37, Math 104.

The first half of the course takes up the concept of a field as applied to elastic media, fluid media and heat flow. The

* Not offered after 1960-61.

general principles of fluid dynamics will be examined together with the solution of La Place's equation.

The second half of the course begins with an introduction to neutron physics and its applications to nuclear reactor design. This is followed by a discussion of the water boiler reactor, reactor startup, and radiation hazards and shielding.

One semester, two and one-half credits.

Mech 1 MECHANICS 1.

Mech 1 is devoted entirely to Statics. Topics included in this course are vector composition, two and three dimensional resolution of force systems, moment of a force, couples, force and a couple, resultant of force systems, equilibrium, friction, moments of inertia of areas and of masses, engineering application of statics, and flexible cables.

The emphasis in this course is on engineering mechanics in which a maximum use is made of the free body diagram approach. Emphasis is placed on an understanding of the principles employed in the solution of problems.

One semester, two credits.

Mech 2 MECHANICS 2.

Mech 2 covers Kinematics and Kinetics. The topics of instruction are rectilinear and angular motion, curvilinear motion, motion of rigid bodies including relative motion, Newton's laws of motion for particles, plane motion of rigid bodies subjected to unbalanced forces, principles of work and energy, and principles of impulse and momentum. The student is made aware of the fact that rest (statics) is only a special case of motion. The free body diagram approach is used in Kinetics, and elementary vector analysis methods are introduced and employed occasionally.

One semester, two credits.

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